Scientific Information on Gulf of Mannar - A Bibliography

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Project on

Conservation and Sustainable Use of
Gulf of Mannar Biosphere Reserve's Coastal Biodiversity

August 2006

Gulf of Mannar Marine Biosphere Reserve Trust
Ramanathapuram - 623 501, Tamilnadu
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Contents

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FOREWORD

Gulf on Mannar, located in the southeast coast of India, is a unique marine environment, and is rich in biodiversity. It extends from Kanyakumari in the south to Rameswaram in the north. The importance of the Gulf of Mannar lies in the fact that it has a chain of 21 islands along a stretch of 140 km in between Rameswaram and Tuticorin. Although, all the islands are small and uninhabited, they are surrounded by a rich diversity of corals and associated ornamental and food fishes. The Gulf of Mannar Biosphere Reserve (GOMBR), because of its possession of a variety of resources including corals, seagrasses, seaweeds, pearl oysters, sacred chanks, turtles, crabs, lobsters, shrimps, fishes, seahorses and the endangered seacows is a rich bio-diversity area.

Gulf of Mannar in recent years has been encountering a variety of threats, both natural and anthropogenic, which might tell upon the sustainability of the marine resources in the region. Although the creation of a Marine National Park and protection of the Gulf of Mannar as a Marine Biosphere Reserve are on the agenda of the managers, the threats posed by a variety of sources need to be addressed in order to take suitable measures so that the marine resources of the Gulf of Mannar can be enjoyed on a sustainable yield basis. In order to achieve this we need to know the existing scientific information on the Gulf of Mannar and identified gap areas where more information is to be collected. Towards this, the Gulf of Mannar Biosphere Reserve Trust's (GOMBRT) initiative to get the present bibliography compiled by a team lead by Prof. A.K. Kumaraguru of Madurai Kamaraj University is a right step forward. Almost all scientific literature published so far, comprising nearly 3,000 publications, has been brought under one umbrella in this bibliography which will be useful not only to a number of researchers but also to administrators and managers working in the Gulf of Mannar region.

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MESSAGE

The Gulf of Mannar along the coastline in Tamil Nadu is a priority area for marine bio-diversity conservation in our country. Its uniqueness and richness of bio-diversity is well acclaimed, yet it is a fragile system which cannot withstand the onslaught of ever increasing pressures and disturbances from many quarters in the coastal belt. These pressures will have to be curbed through proper understanding and acknowledging the future consequences by all the stakeholders. Scientific research is a key input in understanding our beautiful world, our natural heritage, its scope, limitations and developing options towards achieving proper, judicious and sustainable use of the fruits of natural resources for the welfare and prosperity of humankind and its progenies.

Gulf of Mannar has attracted a number of scientists, researchers, agencies and institutions who have undertaken a variety of studies and surveys in the area in the past. The present publication is an attempt by the GOMBRT to facilitate compilation of the research works done in the area so far and their key findings. I place on record my deep appreciation for Dr.A.K. Kumaraguru, Professor & Director and his team from Centre for Marine and Coastal Studies, Madurai Kamaraj University for their sincere work. This will be of great help to scientists, researchers, managers and other agencies involved in the Gulf of Mannar area and will reduce undue duplication and studies of works already undertaken on various themes and issues in the area.

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MESSAGE

Coastal zone of India is important and known for its high productivity and human dependence on the resources. Coastal and marine ecosystems are extremely diverse and complex. Coral reefs, seagrass beds, mangrove enclosed seas and systems, estuaries, marshes, mud flats etc., are fragile and highly sensitive to abiotic factors. The Gulf of Mannar region along the Indian coast is a jewel in the crown of marine and coastal areas in the country and is rightly referred to as biologists' paradise. Off late, this unique paradise is facing lot of disturbances and threats due to growing populations and their need and also because of fast growing economies.

In the past, a lot of research inputs from various scientists, researchers and others have gone in the area and compilation of the outcomes of these inputs was a felt need.

I am glad that the Gulf of Mannar Biosphere Reserve Trust (GOMBRT) has brought out a detailed bibliography on scientific information on the Gulf of Mannar through active involvement of the Centre for Marine and Coastal Studies, Madurai Kamaraj University. I wish to congratulate the Trust and the scientists led by Prof. A.K. Kumaraguru from Madurai Kamaraj University, who have scanned various sources to make this publication informative and intensive. I hope it would meet the needs of the researchers working in field and also to many other stakeholders involved in various works in the Gulf of Mannar area.

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GULF OF MANNAR BIOSPHERE RESERVE TRUST

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MESSAGE

The bounty of natural wealth is depleting and degrading both in terms of quality and quantity in a faster and unprecedented rate. The needs and greeds of people and societies around the natural resources have been growing in an unparallel pace. This is a global reality of today and is much more alarming in developing countries. The marine and coastal wealth of nature is no exception. In the longer run, the societies cannot afford this irreplaceable loss and degradation as it will put their own survival and future at a point of no return.

Gulf of Mannar along the coastline of Tamilnadu is one of the marine biodiversity rich areas with multiple users. A plethora of problems and threats have engulfed the Gulf of Mannar. Conflicting interests, lack of understanding of problems and its links with future security and availability of resources, and failure to appreciate and acknowledge the value and need of conserving this biological richness, is constantly making it harder and harsher to find sensible, sustainable and mutually acceptable ways and means to curb and reverse the situation.

GOMBR comprising of GOMMNP with 21 coral rich islands and the vast extent of marine treasure from Pamban in Ramanthapuram district to Kanyakumari has received concern and some effort for its improved protection, conservation and sustainable use. GOMBRT is a unique and pioneering initiative of the Government of Tamilnadu to bring desired focus on coordinated approach among all concerned to link biodiversity conservation and sustainable utilization of marine resources with the livelihood security of coastal people of this area. The GEF-UNDP project on “Conservation and Sustainable Use of Gulf of Mannar Marine Biosphere Reserve’s Coastal Biodiversity” is being implemented by the Trust with the above focus in mind.

The Gulf of Mannar has attracted many marine biologists, scientists and researchers to undertake various research projects, studies and surveys to understand various facets of marine wealth and glory of its status and future challenges. Understanding biodiversity conservation, amidst so many adverse factors and realities affecting its sustainable survival in an ever growing society of ours, calls for coordinated and enhanced research inputs and processing the available information in order to finalize priority areas and themes which will be useful to the managers for biodiversity conservation.

The interpretation, management, conservation, preservation and its judicious utilization have to be understood very clearly and explicitly and therefore, to bring all available data, information on various parameters from all sources is the first earnest action towards ultimate biodiversity conservation protocols and initiatives. The present attempt by the Trust has been a similar and sincere effort to compile all scientific information which has and will have rationale with ongoing initiatives towards biodiversity conservation in the Gulf of Mannar area. The compilation will be useful as a database for many scientists and other stakeholders equally and will open up vistas for future areas of priorities for research and monitoring for secured health of the unique yet fragile resource base of the Gulf of Mannar.

I wish to place on record the appreciation of the Trust for Dr. A.K. Kumaraguru and his team for undertaking the task and doing full justice with it.

(V.K. MELKANI)

GULF OF MANNAR BIOSPHERE RESERVE TRUST

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MESSAGE

Gulf of Mannar Biosphere Reserve is known throughout the world for its rich marine biodiversity. It is the first marine biosphere reserve in the country, as well as in South and Southeast Asia. Many Research Institutions are working along the coast of Gulf of Mannar (GOM). They have carried out studies on various marine organisms and marine ecosystem related issues. The Major Institutions which contributed most in this area are CMFRI, CSMCRI, FC&RI, CAS in MB, MK University, SDMRI and more recently Alagappa University and MS University. Eventhough, lot of works were carried out, there was no attempt made to compile the researches carried and to identify the information Gap areas so as to learn more about GOM. This was creating problem to scientists as well as Research Organizations to arrive at sure conclusions about each issue in the area. Most of the Research works have been undertaken based on the fund availability from various sources. Since the coral conservation based funding organizations are many, the works in coral field is reasonably good. Marine Mammals have not been studied very well.

When Gulf of Mannar Biosphere Reserve Trust (GOMBRT) decided to take up serious Research on Biodiversity and management related issues, no solid compilation with scientific categorization was available. Hence it was decided to make a thorough compilation of whatever has happened so far in GOM in terms of research. The task was assigned to Dr. A.K. Kumaraguru of Madurai Kamaraj University. He has taken pain and passion in compiling all works related to GOM. He has also categorized the organisms and the ecosystems and has arrived at conclusions clearly guiding GOMBRT in finalizing priority Gap areas for serious research. This attempt has brought a compilation of Research works which has nearly 3000 articles. The effort is appreciable and will surely provide a platform for the Research efforts of GOMBRT. It also provides the base for prioritization of research works for this region.

I wish that this bibliographic compilation will provide direction to all scientific institutions in the region and to the funding agencies in facilitating them to study the unexplored fields in GOM. I congratulate Dr. Kumaraguru and his team for the final output.

(V. NAGANATHAN)

MADURAI KAMARAJ UNIVERSITY

(UGC's, University with Potential for Excellence)

CENTRE FOR MARINE AND COASTAL STUDIES

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27th August, 2006

Preface

Gulf of Mannar, situated along the Southeast coast of India, is one of the richest marine ecosystems with nearly 3600 species of living flora and fauna. It has been recognized as a marine biosphere reserve mainly because of its possession of a rich variety of Flora and Fauna. It also has one of the important Marine National Parks of India. The chain of 21 islands within the biosphere and their surroundings with a rich diversity of corals and associated fishes of ornamental and food value gives the Park its importance.

In recent years, the Gulf of Mannar biosphere reserve with its marine national park is under threat due to a variety of human activities. The anthropogenic interference on the resources of the Gulf of Mannar include coastal marine pollution, over-exploitation of living resources, use of inappropriate crafts and gears, and destructive fishing methods. Apart from these, the resources of the Gulf of Mannar are also faced with threats due to natural causes such as cyclonic storms and unusual increase in water temperature causing damage to corals which includes the coral bleaching phenomenon. Therefore, the concept of creating the Gulf of Mannar Biosphere Reserve with a marine National Park was conceived in the early 1980s and brought into existence in the late 1980s in order to protect and conserve the marine resources so as to utilize them in a judicious manner on a sustainable yield basis for the socio-economic benefit of the local people. In order to achieve this goal and to bring it to practice, the Gulf of Mannar Biosphere Reserve Trust was formed by the joint efforts of the Union Government of India and the State Government of Tamilnadu with the help of Global Environment Facility through the UNDP.

As a first step in its efforts to achieve the target, the Gulf of Mannar Biosphere Reserve Trust decided to compile all the available scientific information so that the gap areas in research can be identified and pursued. Towards this, Madurai Kamaraj University was entrusted with the work of compiling all the available scientific information in the form of a bibliography. The team sieved the various scientific repositories and gathered nearly 3,000 publications and compiled them in this bibliography. The Bibliography has been prepared in a user friendly manner. All the publications have been serially numbered and arranged alphabetically based on the first author of the publication. This Bibliography contains an introduction part that gives information on the Gulf of Mannar and the various islands within its marine national park. At the end of the bibliography, there is a subject index elaborately prepared and arranged alphabetically based on keywords derived out of the abstracts and/or titles of the publications, with which any reader can easily access information. An index of the authors of the publications is also included at the end. Almost all the publications have the addresses of the authors for any one to contact them.

It is expected that the bibliography will be of use to a number of researchers and managers of the present and future. The Madurai Kamaraj University team has put in all its sincere efforts to bring all the available information within one ambit. The compilation team will appreciate readers pointing out any errors and omissions which might have crept in, in spite of the earnest efforts taken, so that they can be rectified in the future edition of this bibliography. The team is grateful to the Gulf of Mannar Biosphere Reserve Trust for sanctioning necessary funds to get this compilation done successfully.

(A.K. Kumaragru)

Executive summary

Gulf of Mannar Marine Biosphere Reserve :

Gulf of Mannar in the southeast coast of India extends from Rameswaram Island in the north to Kanyakumari in the south. It has a chain of 21 islands stretching from Mandapam to Tuticorin to a distance of 140 km along the coast. Each one of the islands is located anywhere between 2 and 10 km from the mainland. The Gulf of Mannar Biosphere Reserve was set up on 18th February 1989 jointly by the Government of India and the state of Tamilnadu. The government of Tamilnadu in G.O. M.S. No 962 dated 10th September 1986 notified under section 35(1) of the Wildlife (Protection) Act 1972 the intention to declare the 21 islands as Marine National Park for the purpose of protecting marine wildlife and its environment including depths of 3.5 fathoms on the bay side to 5 fathoms on the seaward side.

The compilation of all available scientific literature in the form of an annotated bibliography of the Gulf of Mannar biosphere reserve has brought to light the existence of nearly 3,000 publications up to date. This covers the literature published from as early as 1864 to the current year. A large number of publications in the first half of the 20th century have brought out information on the variety of fauna and flora found in the Gulf of Mannar, their biology and ecology. A lot of emphasis on the fish and fisheries research has been given only in the second half of the 20th century. Emphasis is being given on biochemical aspects of flora and fauna in the later part of the 20th century and at present.

Ecosystems and Biodiversity :

Gulf of Mannar is endowed with a rich variety of marine organisms because its biosphere includes ecosystems of coral reefs, rocky shores, sandy beaches, mud flats, estuaries, mangrove forests, seaweed stretches and seagrass beds. These ecosystems support a wide variety of fauna and flora including rare cowries, cones, volutes, murices, whelks, strombids, chanks, tonnids, prawns, lobsters, pearl oysters, seahorses, seacucumbers etc. The biosphere reserve and particularly the Marine National Park of the Gulf of Mannar also gains more importance because of the alarmingly declining population of the endangered Dugongs.

The Gulf of Mannar biosphere reserve has an area of about 10,500 km^2 running along the mainland coast for about 170 nautical miles including the 21 islands in the gulf. The total area of the islands is about 623 hectares. The Exclusive Economic Zone (EEZ) of Gulf of Mannar is about 15,000 km^2 in which, commercial fishing is carried out in about 5,500 km^2 up to a depth of 50m. Gulf of Mannar is considered as "Biologists' paradise" for, it has 3600 species of flora and fauna. The diverse nature of ecosystems in the Gulf of Mannar supports a wide variety of significant species including 117 species of corals, 641 species of crustaceans, 731 species of molluscs, 441 species of finfishes and 147 species of seaweeds apart from the seasonally migrating marine mammals like whales, dolphins, porpoises and turtles. The mangrove habitats in the Gulf of Mannar have 9 different species of vegetation supporting a variety of marine fauna including seabirds and sea snakes.

Major Scientific Research :

The major scientific areas of research in the Gulf of Mannar include 1) Finfish fishery 2) Shellfish fishery 3) Aquaculture and 4) Seaweed research. The finfish fishery includes perches, carangids, barracudas, mackerels, milkfish, mullets, tunas, sardines, scombroids, silverbellies, pomfrets, lethrinids, groupers, sharks and rays. The shellfish fishery includes oysters, mussels, clams, prawns, lobsters and crabs. Aquaculture research has been concentrated on pearl oysters, edible oysters, crabs, prawns, milkfish, etc.

Extensive research has been carried out on the biology, ecology, biochemistry and production of seaweeds of the Gulf of Mannar. Dedicated researches on these aspects of seaweeds have been going on in the Central Salt and Marine Chemicals Research Institute (CSMCRI) and the algal study unit of the Central Marine Fisheries Research Institute (CMFRI). In recent years a number of academic institutions have also evinced interest in seaweeds mainly to do research on bioactive compounds especially on those with antibacterial qualities. Researches on culture of organisms of export value such as seacucumbers, seahorses and ornamental fishes have been carried out by institutions including the State and Central fisheries departments and academic institutions.

Corals and coral reefs of Gulf of Mannar form an important ecosystem, which support a variety of ornamental fishes and provide feeding and breeding grounds for a number of edible species of finfishes and shellfishes. The available publications on corals include taxonomy, identification and available locations.

The existing literature indicates that chank fishery (Sacred Chank) and Pearl oyster fishery have dwindled in the last few decades and the reasons attributed to this decline are overexploitation and the introduction of mechanized fishing including trawl fishing in the Gulf.

Relatively few studies exist on the endangered marine mammal dugong of the Gulf of Mannar. These studies done in the 1970s are based on a few captive animals kept in the CMFRI facility. Available research publications on Dolphins include only data on either stranding or of those caught in fishing nets. Many of the reports are based on dead animals washed ashore. This is the case with Whales, which are stranded periodically, and porpoises that are washed ashore occasionally.

Although the sea turtles were exploited for meat, until they were protected by law, not many research publications have come out. The available reports indicate that some of the islands in the Gulf of Mannar have nesting grounds of these turtles. Extensive research on sea cucumbers, which includes captive breeding, rearing and culture, has been carried out by the CMFRI. Research publications on seahorses of Gulf of Mannar are only limited and they are about their fishery and trade. However, available information indicates that breeding and rearing in captivity have been carried out successfully.

Studies on Mangrove ecosystem are limited concurrent with the limited extent of their distribution. Some of the studies related to mangrove plants are on using mangrove leaves for extracting Bioactive compounds. Literature on seagrass ecosystem is also limited.

Studies on socioeconomic aspects of fishermen communities in the Gulf of Mannar region include utilization of coastal resources such as seaweeds, shell collection and trade, and selling fish in local markets by fisherwomen. Some of the studies indicate the financial problems encountered by fishermen especially due to middlemen exploiting their catch.

Although separate publications on destructive fishing practices are limited, a number of papers give information about such practices, mainly about trawl net fishing near coral reef areas, trap laying for ornamental fish collection on coral reefs, overexploitation of chanks, seacucumbers and pearl oysters by skin diving and seaweed collection in coral reef areas which are blamed for the destruction of fishery resources.

A number of publications of the fisheries institutions include information on crafts and gears used in fishing. The gears include trawl nets, purse seines, cast nets, long lines, shore seines, crab nets and ornamental fish traps. The crafts used are mechanized and non-mechanized types. The non-mechanized ones

are small canoes used by smalltime fishermen in the lagoon area. The mechanized vessels are either canoes fitted with in-board engines or motor boats (launches) used for trawl nets.

Remote Sensing and GIS :

There are only a limited number of publications on application of remote sensing in either assessing the resources of the Gulf of Mannar or in monitoring coastal water pollution status. The Department of Ocean Development through its Integrated Coastal and Marine Area Management Project (DOD-ICMAM) has brought out a Resource Information System for Gulf of Mannar using GIS that gives baseline data on the distribution of marine living resources such as mangroves, coral reefs, seaweeds, seagrasses, finfish, shell-fish and other marine organisms. Pollution studies in the Gulf of Mannar area are only limited and the areas studied include only large towns such as Tuticorin and the pilgrim town Rameswaram.

Gap Areas :

Information on the existence of various species of corals are available. However, the extent of their distribution needs to be assessed as it is being done in the case of forests. Research on coral reef ecology particularly the interaction of other animal species with corals needs to be carried out, in order to understand their contribution to fishery. The impact of SethuSamudram Ship Canal Project (SSCP) on the coral reef ecosystem needs to be studied especially in the context of the southwest and northeast monsoons influencing the underwater current patterns. The concern raised by a few publications on bio-invasion due to the SSCP and the operation of foreign vessels in future in the region needs to be addressed.

The endangered dugong has drawn the attention of a number of scientists. However, not much valuable research has been carried out to study *in-situ* the biology, behavior, ecology, reproduction and population structure of this rare and endangered species and hence needs immediate attention. Although some information is available on the morphometry of the Dolphins based on their carcasses, more efforts may be spared to study their biology, ecology and behavior in nature. Research on sea turtles, especially about their nesting grounds and breeding populations, needs to be carried out.

The technology of seacucumber culture has been demonstrated. It needs to be extended to the field, so that the fisherman can take it up as an alternate livelihood option since it has great export potential. The technology of pearl culture is available but has not penetrated the field very well and hence needs attention. Seagrass ecosystem which is important for the endangered dugongs needs to be studied properly. It is also necessary that the availability and extent of distribution of sea grass in the Gulf should be assessed. Although the extent of distribution of mangroves in the Gulf of Mannar is limited, their ecology in terms of their support to fisheries, land protection and significance as feeding and breeding grounds for sea birds, sea snakes and other organisms needs to be studied.

A GIS based Resource Information System is available with the DOD to give baseline information. It needs to be adopted to conduct current underwater surveys to locate pearl oyster beds, chank beds, seaweed grounds, seagrass beds and coral reef distribution. A resource map should be prepared based on such underwater surveys. The vast majority of scientific information available with us is based on studies carried out in the northern part of the Gulf of Mannar encompassing the chain of 21 islands. Information on the southern part of the Gulf is only limited and hence attempts must be made to cover the southern parts also and identify any new grounds of living resources.

Pollution is known to be a cause for concern in the Gulf of Mannar. However, a thorough understanding of the situation is lacking. Hence it is necessary to conduct research to find out the impact of pollution and the polluting sources, including domestic, municipal and industrial discharges, on the marine living resources of the Gulf. A thorough coastal survey between Dhanushkodi and Kanyakumari should be conducted to identify and map the pollution sources using GIS. Although training programmes are conducted and extension activities carried out periodically by scientific institutions in order to disseminate information and spread aquaculture technology such as pearl culture, seaweed culture, seacucumber culture etc., to local people including fishermen, not many success stories are reported mainly because of lack of follow up and encouragement both technically and financially. Therefore efforts should be made to develop entrepreneurship training facility. Remote sensing should be used, including aerial surveys and photography, to assess the current status of the topography, geomorphology, and land and forest cover of the islands in the Gulf of Mannar. The same technique may be used for surveying the coastal area also.

Introduction

The Gulf of Mannar lies between India and Sri Lanka. It encompasses the territorial waters of the southeast coast of India, from Dhanushkodi in the north to Kanyakumari in the south (Figure 1). It has a chain of 21 islands, with each island having an area of 0.5 ha minimum and 129 ha maximum. They are located 2 to 10 km from the mainland along the 140 km stretch between Tuticorin and Rameswaram (Lat 8°55'-9°15'N and Long 78°0'-79°16'E). They have fringing coral reefs and patch reefs rising from shallow areas of sea-shore. Fringing reefs are located mostly at a distance of 50 - 100 m from the islands and are narrow. Patch reefs arise from depths of 3 to 5 fathoms and are 1-2 km in length with widths of as much as 50 meters. These coral reefs have a rich variety of food fishes and ornamental fishes of various dimensions, colours and designs. The Gulf of Mannar Marine Biosphere Reserve (GOMMBR) has a Marine National Park. The Biosphere includes several ecosystems such as coral reefs, rocky shores, sandy beaches, mud flats, seaweeds, seagrasses and mangroves, each having its own zonation pattern supporting its own characteristic communities.

The Gulf of Mannar Marine Biosphere Reserve came in to existence on 18th February 1989 by a joint declaration of Government of India and Government of Tamil Nadu. The same has been recognized by the Man and Biosphere Programme of the UNESCO. Within the Gulf of Mannar Marine Biosphere Reserve is the Gulf of Mannar Marine National Park that surrounds the chain of 21 islands which was set up by a G.O. Ms.No.964 of the Forest and Fisheries department dated 10th September 1986. The purpose of this declaration was to protect wildlife within the Marine National Park. The Protection is to safeguard the breeding and feeding grounds of the endangered and vulnerable fauna and flora. This is expected to gradually eliminate disruptive and destructive activities affecting the Park Ecosystem. This ecosystem will then conserve the gene pool resources for marine and aquatic species. This will help to restore and protect natural vegetation and stabilize the islands. The purpose of the marine park is to create awareness on conservation and management of the marine resources in a scientific manner so that there will be proper socioeconomic development in the region. The aim of the park is to promote judicious and optimal utilization of the resources for research, education and recreational purposes following appropriate ecological principles.

The Gulf of Mannar Biosphere Reserve is one of the last preserves of the dugong, the most endangered mammal on earth. The Gulf of Mannar Biosphere Reserve has an area of 10,500 km^2. The area of the Gulf of Mannar under the Indian EEZ is about 15,000 km^2 where commercial fishing takes place only in about 5,500 km^2 and that too only up to a depth of 50 m. The depth of the Gulf of Mannar beyond the island chain ranges from 3.5 to 15 m with a sudden fall after that giving oceanic condition. This marine ecosystem supports a wide variety of flora and fauna of taxonomic and economic importance. They are comprised of 117 species of corals, 641 species of crustaceans, 731 species of molluscs, 441 species of fin- fishes, 147 species of seaweeds and 52 species of seagrasses. Apart from these, there are seasonally migrating marine mammals like whales, dolphins and porpoises. The curious visitors include turtles. The endangered dugongs are residents of the Gulf of Mannar. There are large patches of mangrove vegetation holding 9 different species with which they support a variety of fauna including sea birds and sea snakes.

A large number of taxonomic, biological and ecological studies on coral reefs, mangroves, seaweeds, seagrasses, sponges, corals, gorgonids, polychaetes, crustaceans, bivalves, gastropods, echinoderms and fishes of the Gulf of Mannar have been made by a number of organizations including the Central Marine Fisheries Research Institute, Central Salt and Marine Chemicals Research Institute, and other institutions. The total marine fish landings (including crustaceans and molluscs) in the Gulf of Mannar during 1997 -

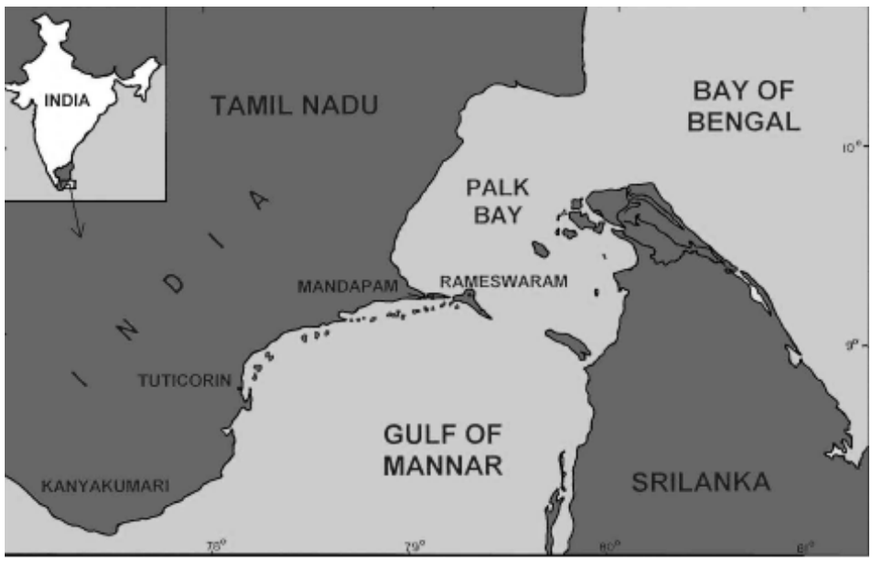

Fig. 1. *Map Showing Gulf of Mannar and Palk Bay*

2001 fluctuated from 49,813 tons to 79,089 tons (CMFRI, 2001). In the total catch, the pelagics contributed 54.4 %, demersals 34.9%, crustaceans 5.7% and the rest molluscs.

The coastline of Gulf of Mannar from Rameswaram in the north to Kanyakumari in the south is about 170 nautical miles. The Gulf of Mannar takes its name from Thalaimannar of Sri Lanka. It stretches from the longitude 78º 08’ East to 79º 30’ East and along the latitude from 8º 35’ North to 9º 25’ North. The islands in the Gulf of Mannar along the Indian coast have a total area of 623 hectares. Nearly one third of the 1000 km coastal length of the State of Tamil Nadu is occupied by the Gulf of Mannar coast in a stretch of 300 km. The area of the islands and distance from the mainland coast are given in Table-1. All the islands can be grouped in to four categories viz., Tuticorin group, Vembar group, Keelakarai group and Mandapam group.

Gulf of Mannar Environment

The Environmental conditions of Gulf of Mannar are unique, mainly because of the coral reefs, seagrass beds and mangroves, which act as spawning and feeding grounds and shelters for many species of economically important finfish and shellfish. The islands in the Gulf of Mannar are formed of calcareous substratum with dense coral growth around them. The depth of waters nearer to the islands range from 3.5 to 15 meters. The islands near Valinokkam and off Pamban have deeper waters than the islands near Tuticorin. The Gulf of Mannar is influenced by both southwest and northeast monsoons and hence the physical, chemical and biological characteristics are different from other areas.

Palk strait is the northern boundary of Gulf of Mannar and southern boundary is the Indian Ocean at Kanyakumari. It has been reported that there are strong currents from the north during November to March flowing southward. The direction of the current reverses during April to October flowing from the south towards north bringing in the Indian Ocean waters into the Gulf. The Gulf is also known to be influenced by a trough of west wind drift through the Agulhas and Mossambic currents and drift. It is also known that a tributary of Australian current, that is influenced by a trough of west Australian cold current, joins Agulhas. Therefore the influence of Oceanic water mass appears to be conspicuous in the Gulf.

Light penetration in the Gulf of Mannar varies from season to season. Secchi disc value of 7.5 meters is common in the inshore region. During summer, calm weather conditions exist and the euphotic zone is known to go even beyond 100 meters depth. However, during the monsoon period the water becomes turbid, during July-September, and hence the Secchi disc values can become 2 meters or less. This is because of the agitation of water column and re-suspension of bottom sediments.

In most parts of Gulf of Mannar, the water temperature is influenced by atmospheric temperature. Thus, the temperature steadily increases from January to April with the highest value reaching 32° C in the peak summer of May. In the following months, the temperature gradually declines till August. The second peak of surface temperature may occur between September and October and then it falls down between December and January. This type of oscillation in water temperature is unique in the Gulf of Mannar. In the shallow regions of the Gulf of Mannar, closer to the land, the water temperature may exceed even the atmospheric temperature during summer.

Salinity values of the Gulf of Mannar vary from 31.7 to 35.2 ppt. Peak salinity values coincide with peak temperature values in the Gulf. In the coastal areas, the rate of evaporation may exceed the rate of freshwater input and hence the salinity has been reported to exceed even 40 ppt. Freshwater input from rivers in the Gulf of Mannar region is only limited. The only perennial river is Thamiraparani and that too has its own limitations because of dams constructed across its path. There are other minor rivers, which bring in freshwater only during the northeast monsoon season and that too only in small quantities. Therefore, the influence of freshwater drainage on the salinity of Gulf of Mannar waters is only limited. This is considered to be one of the reasons for the limited distribution of mangrove vegetation in the Gulf of Mannar.

The Dissolved oxygen in the Gulf of Mannar waters is dependent on factors like temperature, salinity, oxygen solubility, consumption and production. The highest value of 6.2 ml per liter has been found to occur during April to May, which is associated with maximum organic production. The dissolved oxygen content of water during most part of the year is below its solubility, which is due to the sustained regeneration of nutrients, from organic matter of untreated sewage discharged from coastal towns. Such a condition is known to reduce oxygen availability in nearshore water. Hydrogen sulphide production due to sulphate reduction may scavenge the available oxygen. Thus, the fishing harbor area of Tuticorin which is under the influence of municipal sewage has been found to contain only 0.5 ppm of dissolved oxygen.

Studies on nutrients such as nitrate, phosphate and silicate in the Gulf of Mannar are only limited. As high as 3,081 µg.at NH_3-N/l has been reported. Nitrite nitrogen occurs in small concentrations of < 0.5 µg.at NO_2-N/l. Nitrate nitrogen is not in high concentrations i.e., < 5 µg.at NO_3-N/l. Such levels occur in shallow waters with high organic matter and low dissolved oxygen. Phosphate occurs from trace levels to 3 µg.at PO_4-P/l. Tuticorin sewage waters supply large quantities of water soluble organic phosphorous (65% total soluble phosphorous). The exchangeable phosphorous in the sediments of Tuticorin coastal waters has been found to be very high with 81% and the sedimentary organic phosphorous is 12%. The biologically usable iron and aluminum phosphorous is 1.5%. Such high concentrations can cause phytoplankton bloom. However, the monsoon current systems flushes away such nutrients and hence the nutrient load is diluted. The silicate nutrient in the Gulf of Mannar is known to vary from 85 to 16,725 µg.at Si/l. This has negative correlation with salinity. Dissolved silica has not yet been reported to be important for phytoplankton production in the Gulf of Mannar.

The COD & BOD values of seashore waters of Gulf of Mannar are 13.6 to 44 ppm and 1.5 to 16

ppm respectively. The Gross Primary Production in the Gulf of Mannar has been reported to be 500 mg C/ day. The mean productivity has been estimated to be 400 tons C/km^2/year. Heavy metals such as iron, lead, zinc, copper and calcium are found in trace quantities of 21.5µg, 5.15µg, 4.84µg, 3.29µg and 0.13 µg/l respectively. Investigations indicate that mercury in sediments, seaweeds and finfishes may be due to sewage disposal in the Gulf of Mannar. Seaweed Enteromorpha was found to have 0.124 ppm mercury. The fish Sardinella sp., had 0.182 ppm. The mercury content of algae, fishes and Dolphins have been found to be lower than the maximum allowable limit of mercury in human and animal food. The heavy metals copper, zinc, iron, and aluminum in the fly-ash polluted water off Tuticorin coast are 5.93, 17.28, 27.85, and 29.8 zinc µg/l respectively. In the sediments, heavy metals such as copper, aluminum and iron are in high concentrations due to siltation of fly-ash. The physical effects of fly-ash have been found to be pronounced in the benthic environment than that of the heavy metals of fly-ash.

Islands of the Gulf of Mannar

There are 21 islands in the Gulf of Mannar (Figure 2). They can be classified into 4 major groups. They are Tuticorin group, Vembar group, Keelakarai group and Mandapam group. Tuticorin group has Van island, Kasuwar island, Karaichalli island and Vilanguchalli island. Vembar group has Upputhanni island, Puluvunnichalli island and Nallathanni island. Keelakarai group has Anaipar island, Vallimunai island, Poovarasanpatti island, Appa island, Thalaiyari island, Valai island and Mulli island. Mandapam group has Muyal (Hare) island, Manoli island, Manoliputti island, Poomarichan island, Pullivasal island, Krusadai island and Shingle island (Table 1).

1. Van Island

The local fishermen call this island by the name Vaan Theevu (Theevu in Tamil language means Island). This island is located 6 km away from Tuticorin. It has a circumference of 2,015 meters. The square area of the island is 16 hectares. The island soil is sandy with sparse vegetation of low bushes, mostly of grasses and xerophytic plants.

2. Kasuwar Island

The name of this island is called as “Koswari” in local language. This island is situated 7 km from Tuticorin. The circumference of the island is 2,160 meters. It has an area of 19.50 hectares. The island soil is mainly sandy, with small sand dunes here and there. Lot of shingles can be found strewn. A few bushes can be seen here and there and no large trees. The whole island is covered with xerophytic plants only. In the southwestern side of the island living coral reefs can be seen 500 meters away from the shore.

3. Karaichalli Island

This island is also called by the name “Karia Shuli”. This island is seen 15 km away from Tuticorin. It has a circumference of 1,610 meters. The square area of the island is 16.46 ha. Live coral reefs are found all around the island at a distance of 0.5 to l km.

4. Vilanguchalli Island

The name of this island is also called as “Vilangu Shuli”. It is a very small island and has a circumference of 614 meters only. The square area is therefore 0.95 ha only. This island has only coral rubble strewn all around with some bushes and grasses in the middle of the island. Isolated patches of thin reef of corals can be found along the southeastern side of the island.

5. Upputhanni Island

The name of the island means salt water (in Tamil language uppu means salt and thanni means

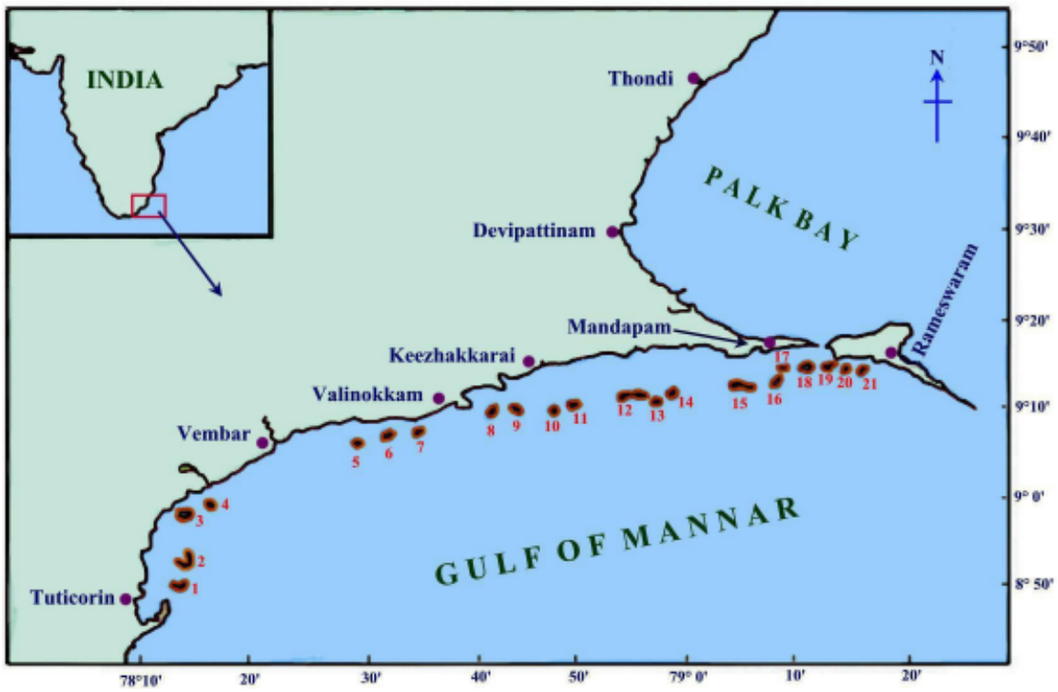

Fig. 2. *Map showing Gulf of Mannar Islands*

Table 1. *Islands in the Gulf of Mannar*

No.	Island Group	Name of the Island	Square area in hectares	Distance from previous island in km	Location	
					North Latitude	East Longitude
1.	Tuticorin Group	1. Van	16.00	0	8º50’	78º13’
		2. Kasuwar	19.50	3	8º52’	78º13’
		3. Karaichalli	16.46		8º57’	78º14’
		4. Vilanguchalli	0.95		8º56’	78º15’
2.	Vembar Group	5. Upputhanni	29.94		9º05’	78º30’
		6. Puluvunni challi	6.12	3	9º06’	78º35’
		7. Nallathanni	110.00	3	9º06’	78º35’
3.	Keelakarai Group	8. Anaipur	11.00	14	9º09’	78º42’
		9. Vallimunai	6.72	17	9º09’	78º44’
		10. Poovarasanpatti	0.25		9º09’	78º49’
		11. Appa	28.63	9	9º09’	78º49’
		12. Thalaiyari	75.15	9	9º11’	78º54’
		13. Valai	10.15	5	9º11’	78º56’
		14. Mulli	10.20	1.5	9º11’	78º57’
4.	Mandapam Group	15. Muyal	129.04	9.5	9º12’	79º05’
		16. Manoli	25.90	6.5	9º13’	79º07’
		17. Manoliputti	2.34		9º13’	79º07’
		18. Poomarichan	16.58		9º14’	79º11’
		19. Pullivasal	9.95		9º14'	79º11’
		20. Krusadai	65.80		9º15’	79º12’
		21. Shingle	12.69	1.5	9º15’	79º14’

water). This island is about 29.94 ha in square area. The circumference of the island is 2,292 meters. It is located opposite to Mookaiyur village. The island is about 8 km away from Vembar. The island has a few trees here and there, with a number of tall bushes. Grasses cover the entire island. Coastal fishermen of Narippaiyur used to camp here to mine the coral boulders buried in the centre of the island until the forest department controlled it in recent years. They also used to camp here frequently for collection of commercially important seaweeds *Gelidiella* sp. and *Gracilaria* sp.

6. Puluvunnichalli Island

The circumference of this island is 1,372 meters and the total area is 6.12 ha. This island has good sandy beach. A large portion of the island has thick vegetation. A few *Thespesia* trees are found on the eastern side of the island. This island is surrounded by live coral reefs except for a small stretch on the eastern side.

7. Nallathanni Island

The name of the island means good water (in Tamil language nalla means good and thanni means water) indicating availability of sweet water in the island. This island is 2 km away from Mundhal village. The circumference of the island is about 4,700 meters and the square area is 110 hectares. This is one of the bigest islands having a large number of coconut, palmyrah and other woody trees. Coral reefs and coral boulders are distributed all around the island at a distance of 0.5 km on the southern side and near to the northern shore.

8. Anaipar Island

This island is 9 km away from Keelakarai with a circumference of 1,605 meters. The square area of the island is 11 ha. This island is fully covered with tall shrubs and trees. A large amount of dead coral blocks can be seen on the southern shores up to a distance of 200 meters where lush growth of seaweeds are found. Live corals can be found near the western shores of the island up to a maximum distance of 200 meters.

9. Vallimunai Island

This island is also called by the name Palliyarmunai. This island is about 9 km from the mainland. The circumference of the island is 1,170 meters and the square area is 6.72 ha. This is a small island with an elongated shape lying parallel to the mainland coast. It is close to Thalaiyari island separated by a channel which is submerged during high tide.

10. Poovarasanpatti Island

This is a narrow sand flat (100m x 25m) and is exposed only during low tide. It is fully covered by seawater during high tide. The square area is only 0.25 ha. It is a misnomer to call it an island. It actually lies midway between Appa and Valliamunai islands. Live coral reefs are found around the area up to a distance of 100 meters, except on the northern side. Apart from a few boulder type corals occurring on the eastern side there are branching type corals which lie at depths of 1-2 meters. Collection of seaweed *(Gelidiella* sp.) by fishermen is the major activity here.

11. Appa Island

This island is located 8 km away from Keelakarai. It has a circumference of 4,840 meters and a square area of 28.63 ha. This island is traversed on the southern side by an intervening coral stone studded sand flat that is flooded during high tide preventing easy accessibility from one end to the other. The southern portion of the island is highly elevated (6 meters), standing on fossilised coral stones of large

dimensions. The northern portion has an elevation of only 2.5 meters, like other islands, at the spring tide level.

12. Thalaiyari Island

This island is located 10 km away from Keelakarai. This is an extensively elongated island with a circumference of 8,338 meters. The square area of the island is about 75.15 hectares. The widest portion of the island is on the western tip. The island is thickly covered with trees and cattle grazing meadows are seen. There is a narrow strip of foreshore on the northern side. A restricted foreshore on the southern side can be seen. Live corals can be seen very close to the shore all along the length of the island on the northern shore except for an area near the northwestern edge. Continuous fringing reefs are found for a distance of 0.75 km along the southern side.

13. Valai Island

It is a small island lying parallel to the mainland coast. Interconnecting this with Thalaiyari island is a channel submerged during high tide. This island has a circumference of 1,889 m and an area of 10.15 hectares. The western side of northern shore has a good cover of boulder reefs as well as branching corals. The southern reef is far out beyond and lies at 3 meters depth.

14. Mulli Island

It is about 1,712 meters in circumference with a square area of 10.20 ha. It is located 9 km away from Keelakarai. It is a sandy island completely covered with tall shrubs and bushes with a swamp inside. The northern approach of the island is studded with boulder corals. On the eastern side low fringing reefs continue outward up to 3 meters depth. The southern reef is far away at a distance of 1.25 km from the shore and extends towards west.

15. Muyal Island

The name of the island means Hare (in Tamil language Muyal or Musal in local dialect means Hare). This island is situated 7 km away from Mandapam and has a circumference of 11,520 meters. This is the largest of all the islands with fringing reefs. It is nearly 4 kilometers long with a width ranging from 250 to 1,800 meters. The total square area is about 129.04 ha. Human occupation in the past has introduced vegetation and animal population different from that of the other islands. Cattle, goats and monkeys can be seen in addition to other animal populations of the islands of this area. Dense coconut groves are found and the shore has sandy beaches.

16. Manoli Island

The name of this island has been spelt differently by various authors which includes “Manauli”, “Manalli”, “Manali” etc. Manoli island is 6 km from Mandapam. It is about 2 km long and 350 meters wide covering an area of 25.9 hectares. It has a circumference of 2,958 meters. It has a complex topography. The northern and southern beach ridges are separated by an area of *Thespesia* woodland. Pools and open mud flats are seen. Shrubs and trees are found in large numbers in this island. Extensive coral reefs are present. Fishery, especially the “Kalankatti” fishery used to be regular. Seaweeds are collected by fishermen from this island area. The creeks and pools of this island are rich in milkfish and mullet seeds. Large number of sea birds visit this island during March to September period.

17. Manoliputti Island

It is a very small island adjacent to Manoli island. It is located about 8 km away from Mandapam. It has a square area of about 2.34 hectares only. Extensive mud flats with a large population of bushes are

present. Patchy corals can be found around this island. From this island, fishing is carried out during particular seasons.

18. Poomarichan Island

The name of this island has also been spelt as “Pumorichan” by some authors. This island is about 4 km from Mandapam. It covers an area of about 16.58 hectares. The soil around the island is muddy and slushy. Thickly wooded trees are found spread in the island. The water area has a continuous reef.

19. Pullivasal Island

The name of this island is also called as Pallivasal which means mosque in the local language. This island is about 7 kilometers from Mandapam. This island is actually the continuation of Krusadai island, cut off only by a shallow stretch of water. The square area of the island is about 9.95 hectares. The northern part of this island is muddy and slushy. The eastern and southern shores, on the other hand, are sandy. A continuous stretch of coral reef can be seen projected into the sea from the southern shore. This forms an ideal shelter for an array of life forms making this island a biologically interesting one. Thick cover of woody plants add an attraction to this island. Sweet water is available in this island.

20. Krusadai Island

The name of this island is also spelt as “Kurusadai” by some authors as it is called by the local people. This island is popularly known as the biologists’ paradise, because of the richness of the variety of fauna and flora. This island is 4 km away from Pamban. The area of this island is about 65.8 hectares. Large number of students and zoologists visit this island. The seaward beach ridges have diverse vegetation of grasses and sedges. Mangrove woodland is extensive on the northern coast. Many ornamental species of plants have been introduced in this island. Generally, no fishing activity is allowed around this island. Field rats, birds, moths, beetles and garden lizards are the main inhabitants of this island. The Marine Biological Station of the Tamil Nadu State Fisheries Department, which is at present functioning at Mandapam, was originally established in this island and was carrying out valuable research activities in fisheries. Hydrobiology of the sea around the island was studied regularly. Experiments on milkfish culture, oyster culture and seaweed culture were also attempted. The western end of the island is full of mangrove trees and other vegetation. The coral beds of these islands are well suited for several groups of animals. West of this coral bed sponges can be seen. The rare hemichordate *Balanoglossus* sp., is found in this island.

21. Shingle island

This island is 4 km away from Pamban. It has an area of 12.69 hectares. The northwest shore is sandy and slopes rapidly down into moderately deep waters. It has higher steep beaches compared to the other islands. The northeastern shore of this island is also sandy. Here one can see a large variety of live corals of various shapes and colors. The southwestern shore is full of dead corals offering shelter to a rich variety of fauna. It appears that in the past, Singhalese fishermen used to land here during their fishing operations and hence it was called “Singala theevu”, which has later taken the name ‘Shingle theevu’ (Theevu in Tamil language means Island). This island is covered with bushes and trees. Several years ago coral removal for commercial purpose was going on in this island. No fishing activities are found in this island at present.

Bio-resources of Gulf of Mannar

The Gulf of Mannar has more than 225 fishing villages, 118 fish landing centers, 3961 mechanized vessels, 12681 country crafts, 8586 catamarans and the annual fish production is 87,113 tonnes, out of the total 350,790 tonnes of Tamilnadu.

Gulf of Mannar islands have mangrove vegetation which includes the species of Rhizopora, Avicennia, Bruguiera, Ceriops and Lumnitzera. All the islands in the Gulf of Mannar, especially the Manauli island has luxuriant growth of mangrove vegetation. There are about 40 species of algae found in the Gulf of Mannar. The production of seaweeds in the Gulf of Mannar has been estimated to occur in 17,125 hectares. Luxuriant growth of seaweeds is found in Mandapam and Keelakkarai areas and only minimum algal production is found in between Tuticorin and Kanyakumari. The average density of algae in the Gulf of Mannar is 0.11 kg/m^2 in wet weight. Some of the important algae found in the Gulf of Mannar are *Ulva reticulata*, *Halimeda opuntia* and *Caulerpa recimosa*. *Sargassum* sp., *Turbinaria* sp., *Gelidiella acerosa, Padina* sp., and *Gracilaria* sp., are used in the production of agar, cellulose and algin. The annual harvest of seaweeds in the Gulf of Mannar is nearly 5,000 to 7,000 tones by dry weight, which involves more than 1,000 men and 450 women in the business. The seagrass beds of Gulf of Mannar are unique since they provide food source for the endangered marine mammal Dugong. Some of the important species of sea grasses in the Gulf of Mannar are Enhalus sp., Thalassia sp., Halophila sp., and Cymadocea sp., of the total 13 species recorded in the Gulf.

The coral reef resources of the Gulf of Mannar are unique. They grow surrounding all the 21 islands. They offer shelter to a variety of organisms and protect the mainland from storms, currents and shore erosion. Coral reef ecosystem is a complex one. The shallow water corals fix the energy from the sunlight using the dissolved nutrients brought by the water currents. A number of reef animals come to feed on plants and plankton. Finfishes like Acanthurids, Nemipterids, Balistids, Labrids and Chaetodontids spawn in coral reefs. Since the fishing communities are dependent on the coral reef ecosystem, it is necessary to conserve and protect this ecosystem. Towards this, the Government of Tamil Nadu by its order Number 116 dated 20.5.1982 prohibited the removal of corals, dead or alive, from the water. The interlocked and enmeshed calcareous skeletons of dead corals form the islands. There are around 137 species of corals belonging to 37 genera. The species of Acropora, Montipora and Porites are commonly available in the Gulf. The algal species of Rhodophyta, Chlorophyta and Bryophyta are responsible for the high production of calcium carbonate in the corals through symbiotic zooxanthellae.

Shrimps are abundant in the Gulf of Mannar. *Penaeus semisulcatus*, *P. indicus* and *P. monodon* are commonly available. There are 18 species of shrimps of which 10 are heavily exploited. The lobsters *Panulirus homarus*, *P.ornatus*, *P. logipes* and *P. versicolor* are abundant, of the 7 species of spiny and sand lobsters. The crabs *Scylla serrata*, *Portunus pelagicus*, and *P. sanguinolentus* are the three commercially important species. The sacred chunk, *Xancus pyrum,* forms an important fishery in the Gulf of Mannar. About 1,000 km^2 area of inshore waters of Gulf of Mannar have been identified as chunk grounds.

The pearl oyster fishery is an important one in the Gulf of Mannar. Pearl Oyster beads are common in Tuticorin region. Although 6 species of pearl oysters have been reported in Indian waters, natural pearls are obtained from *Pinctada fucata* in the Gulf of Mannar. Gulf of Mannar has about 80 pearl banks and the fishing season is November to May. The fishing seasons for chunks are from September to March. A large number of pearl banks in Tuticorin region are available at a depth of 10-20 meters. The cephalopod fisheries of Gulf of Mannar includes squids and cuttlefishes. Among the squids *Loligo duvancelli* and among the cuttlefishes *Sepia pharaonis, S. aculata* and *Sepia inermis* form the major fishery of cephalopods. Seacucumbers which belong to holothurians are available in the Gulf of Mannar. They are collected by skin diving, at depths ranging from 2-10 meters. The seacucumbers *Holothuria scabra* and *Holothuria spinifera* have been over-exploited. *H. scabra* is a valuable species for the preparation of seacucumber *Beech-de-Mer*.

A large number of finfish species are available in the Gulf of Mannar. This includes nearly 125 species of reef fishes. The common finfishes of Gulf of Mannar belong to Leiognathids, Sardines, Lethrinids, Perches, Carangids, Anchovies, Seer fishes, Red mullets, Half beaks, Needle fishes and Elasmobranchs such as sharks and rays. There are 15 species of silver bellies in this region of which four species of Leiognathus are common. They are *L.equulus*, *L.bindus, L.dussumieri* and *L. splendens*. As many as 20 species of lethrinids have been reported. The commonly available species of Lethrinus are *L. ornatus*, *L. varigatus, L. hark*, *L. lentjan, L. nebulosus* and *L. microdon*. The other major contributors to the fishery are Perches, Nemipterids Haemulids, Serranids, Lutjanids and Epinephelids.

There are 5 species of turtles which frequent the Gulf of Mannar. They are *Chelonia mydas* (green turtle), *Caretta caretta* (Logger head), *Lepidochelys olivacea* (Olive rideley), *Eretomochelys imbricata* (Hawk's bill), and *Dermochelys coriacea* (leatherback turtle). The marine mammals of Gulf of Mannar include 11 species of whales, 14 species of Dolphins, 1 species of Dugong and 1 species of porpoise. *Dugong dugon*, which is also known as the sea-cow, is an endangered marine mammal living in the Gulf of Mannar.

Corals and Coral Reefs

Corals are invertebrate animals and live in colonies in association with certain algae called zooxanthellae. In India, corals are found in the Gulf of Kutch, around Lakshadweep islands, off Ratnagiri, Malvan and Mangalore, in the Gulf of Mannar, Palk strait, and around Andaman and Nicobar islands.

Corals essentially make massive deposits of calcium carbonate with minor additions of calcareous algae and other organisms which secrete calcium carbonate. As they are sedentary, they can't run away if attacked. As a result, to evade predators, they produce fouling agents or poisonous chemicals to keep their predators at bay. To avoid overcrowding on the reef, corals produce chemicals that inhibit even reproduction of their competing neighbours. However, against man they are helpless. Why man should lay hands on them while the oceans possess an abundant source of fish, prawns, crabs, and a variety of algae? Man's insatiable search for materials, found the corals to be an abundant source of lime which could be used for construction of not only shelters but also roads, and bunds for canals, and in recent decades as a raw material in cement manufacture.

Coral reefs are made of coral colonies which thrive in shallow and warm tropical marine waters. Corals are known for their colour, and sheer beauty of form and design. They are highly productive. In fact, among the biological organisms, man's ability to alter the surface of the earth is rivalled only be colonies of tiny coral polyps. They also have the potential of yielding a variety of bioactive substances including drugs for curing diseases.

Importance of Corals

1. Educational and Scientific value:

Coral reef ecosystems are some of the complex marine ecosystems because they harbour diverse fauna and flora, thus supporting a tremendous variety of life forms. There is a complex food web and trophic organization in coral reef ecosystems. Therefore they are of great educational and scientific value especially for the students of our schools, colleges and universities.

2. Recreational benefits

Coral reef ecosystems are places of recreation for people who like swimming, snorkeling, and diving for hobby. Since the waters where in the corals live are normally clear and clean, swimmers and divers can enjoy seeing a variety of corals and associated fauna and flora. This to a certain extent is also of

educational value and gives the impetus to the hobbyists to spread the message of the need to conserve the coral reef resources. However, in India this type of recreation has not become popular mainly because of the high cost involved in procuring and maintaining the snorkeling and diving equipment.

3. Aesthetic qualities

Coral reefs also play an important role in maintaining aesthetic qualities of certain places. This is particularly true for tourist resort islands, which are common in countries like the Republic of Maldives, Seychelles, and the Mauritius. Unfortunately the aesthetic outlook is also not ingrained well among our people in India although a lot of tourists from within India and abroad visit places like the Andamans and Laccadives. Practically there is no such value attached places in the Gulf of Mannar area. It is essential that an awareness and appreciation for aesthetic qualities must be developed in our people. Enjoying the sheer beauty, colour and forms of corals and associated fishes and other flora and fauna will greatly help psychologically in relieving the tension in the lives of a lot of our people.

4. Food resources

Coral reefs act as breeding grounds for a variety of commercially important food fish and shellfish. This helps in the collection of fish and shellfish seeds for mariculture purpose. The fish yield from coral reefs is comparable to other productive marine ecosystems. For instance, in the mid 1980s the annual world fish yield from coral reef areas was as much as 9 million tonnes, i.e., 12% of the total catch of 75 million tonnes. Coral reefs also give sustenance, in terms of food, to a large number of economically poor fishermen around the world including those in the Gulf of Mannar area.

5. Genetic resources

Coral reef ecosystems support a wide variety of species of plants and animals. Corals themselves exhibit a great diversity in species composition. Therefore coral reef ecosystems can be considered as potential reservoirs of genetic resources. Besides, they can be maintained in large aquaria and called as aquarium biological gardens. This is particularly relevant when ecologists throughout the world are concerned about protecting the genetic resources of various ecosystems.

6. Industrial chemicals

Corals and a number of their associated organisms like sponges, starfishes, seacucumbers, and gorgonians have been found to produce chemicals which have pharmaceutical and medicinal value. Many of them produce antifouling and antimicrobial compounds which have great economic potential. Judicious use of harvesting techniques could help obtain natural products to meet our demands for chemical and pharmaceutical materials.

7. Raw materials

In many countries, corals are used to make jewelry especially in the African nations and in the Far Eastern countries. The colour pigments of the corals can be used in making special dyes also. If used judiciously this can create jobs for economically weaker sections of fishermen communities.

8. Protection against natural calamities

Corals protect land borders against waves and storm surges. They act as baffles and bear the brunt of nature’s fury. This is practically seen in many of the island nations such as the Republic of Maldives, Mauritius, Seychelles, and parts of India i.e., in the Andaman-Nicobar islands and Lakshadweep islands. This was also true in the case of the Gulf of Mannar until a few decades ago. Due to removal and destruction

of corals in the Gulf of Mannar, cyclonic storms which happen to cross this area once in a while cause havoc on the coastal dwellings of fishermen communities.

9. Use in construction

Corals have been used and are being used in many countries still, as materials for construction of places, for human inhabitation. Blocks of corals are used as such or broken pieces are mixed with substances like cement to make concrete. During the last several decades, thousands of tonnes of coral materials have been removed from the Gulf of Mannar for construction of buildings. Before independence, several miles long roads have been constructed using coral materials.

10. Representation of our heritage

Corals have been there for eons around our land and islands and thus they also exist as a part of our heritage. Therefore it is imperative that we protect and conserve our coral reef resources for the benefit of not only our generation but also for the generations to come.

Disturbance to coral reef ecosystems

Disturbance to corals and coral reefs are due to multifarious activities of human populations settled along the coastline.

1. Pollution

Pollution of coastal waters of the Gulf of Mannar in the recent decades has been on the increase. One of the causes is human population settlement along the coastline, the size of which ranges from small hamlets with a few hundred individuals to large cities with populations of more than 100,000. The contamination level also varies from unsanitary conditions created along small stretches of the beaches to dumping of enormous quantities of untreated sewage. In fact, none of the towns or cities along the coastline of the Gulf of Mannar has sewage treatment facilities. As a result, dumping of sewage directly into the sea causes not only unsanitary conditions of the beach but also contamination of the various components of the coastal marine ecosystem. The resultant effects are not only foul smell, emanating from the beaches but also contamination of seafood.

There are a number of chemical industries, such as fertilizers and alkali chemicals, established on the Gulf of Mannar coastline, which let out either untreated or partially treated effluents into the coastal waters. Almost all these industries are concentrated near Tuticorin. Effluents from these industries may cause not only mortality among the plant and animal populations which get exposed to the chemicals but also accumulation of chemical residues such as heavy metals in seafood. This should be a cause for concern because of the ill-effects that may ensue in human population.

There is a thermal power plant also close to the coast near Tuticorin which dumps thermal effluents along the coast. Besides, a lot of fly-ash washing also has found its place into the coastal waters. This has caused not only an elevation of temperature but also inorganic nutrients of the waters nearby. This in turn has resulted in enchanced primary productivity particularly that of algal growth. Such local productivity, inspite of its appearance as a good prospect, has resulted not only in siltation but also clogging of the coastal waters adjacent to the power plant and killed what was once a rich shellfish ground. If things are allowed to go like this it may not take too long before this effect is felt in the islands of the Tuticorin group.

There are a few small ports like Valinokkam and Mandapam and a large commercial port at Tuticorin all of which are located in the Gulf of Mannar. These ports, especially that at Tuticorin, have a large number

of cargo vessels visiting. Besides, all along the coast of the Gulf of Mannar there are several small coastal towns from where motorized fishing vessels are operated. Such operation of motorized marine vessels both for cargo handling and for fishing is causing spillage of waste diesel oil and petroleum hydrocarbons. This results in contamination of not only the coastal waters but also the waters around the islands where the sensitive coral reef ecosystems exist.

2. Coastal Development

Rapid coastal development in the Gulf of Mannar causes land runoff. A number of small hamlets and villages have sprung up along the coast of the Gulf of Mannar during the last few decades. This has resulted in sedimentation which has caused destruction of coral reefs.

3. Mining

One of the islands in the Tuticorin group is “Vaan theevu” (8°50' N. Lat. and 78° 13' E. Long.) located a few kilometers off the coast of the city of Tuticorin. It is a small island with an approximate area of 16 hectares. It has a peculiar conch shape which has changed in the past two decades because of human activity particularly coral mining. Some fishermen of Tuticorin have been actively engaging themselves in coral mining even before the 1980s. They worked in groups of 5 or 6 and used crowbars and small pickaxes to mine the corals from the wave washed shoreline. This was done mainly to lift blocks of coral stones. There were several boys with baskets collecting small broken coral pieces washed ashore. As a result of continuous coral mining in the past several decades, the coastline of the island has got eroded and the “Beacon” which was located on the southern tip of the island during the 1940s now stands in seawater at a distance of about 200 meters from the shore. Continuous coral mining has also resulted in the shifting of sand and silt which have got deposited on the north-western tip as a long strip of sand bar changing the shape of the island itself. It is learnt that, a long time ago waters surrounding this island had plenty of coral growth; but now, nothing in the vicinity up to a depth of 2 meters.

The irony of the situation is that while we continue to disturb even the limited stretches of available corals, other countries, like Australia for instance where they have the Great Barrier Reef extending to a distance of about 2000 km, researchers are trying to exploit the corals without destroying them. They are extacting valuable bioactive medicinal substances such as prostaglandins and antibiotics and even substances with antitumor activity and life saving drugs.

Of course, without knowing the ecological implications, our people are removing the corals, both live and dead. They are doing this even now only for their livelihood. However there is an urgent need for the conservation of marine flora and fauna in and around the islands of the Gulf of Mannar.

4. Increased Tourism

In recent years, there is a tremendous increase in tourism in the Gulf of Mannar area. This is not due to tourists visiting the Gulf of Mannar for enjoying the beauty of the islands and the corals around the island but due to pilgrims visiting holy places like Rameswaram. Tourist inflow in great numbers occurs particularly during the period between October and January. The increased tourist inflow into a small town like Rameswaram was made possible mainly because of the opening of the road bridge across the Pamban pass connecting the mainland Mandapam with the Rameswaram island. Because of increased tourist inflow into Rameswaram town there is great pressure on the limited sanitary facilities available. Thousands of pilgrims take holy bath in the sea during important religious festivals. There are a number of tourist lodges and boarding houses which have sprung up in recent years to cater to the needs of the hundreds of thousands of tourists who visit this coastal town. As a result, large quantities of sewage water and refuse are dumped

into the sea around the town. This has not only contaminated the coastal waters around Rameswaram but also has the possibility of dissipating the same to nearby islands. In fact, such sewage contamination has killed all the rich coral beds which used to be there around Rameswaram in the 1970s. The coral kill was not only due to contamination by sewage waters but also due to the resultant algal growth which settled on coral reefs.

5. Blasting

A number of years ago some fishermen used to catch fish by exploding dynamite in the waters around some of the islands in the Gulf of Mannar. This caused a lot of damage to corals by not only uprooting them but also by generating large quantities of silt which upon sedimentation killed the corals. However, this practice of dynamite blasting has been totally banned now. The enforcement authorities viz., the Forest Department through the Wildlife Warden and the Coast Guard Authority have effectively put an end to this practice.

6. Poisoning

Use of chemicals like rotenone to poison the fish in coral reef areas in order to catch them was practiced in many countries. It is believed that several years ago it was one of the methods used for catching fish by fishermen in some areas of the Gulf Mannar. However, it is not practiced now.

7. Mementos or Souvenirs

The habit of collecting mementos and souvenirs among people is so ingrained in them that in all the countries where corals and coral reefs exist a variety of colourful corals and associated animals are removed in large numbers and quantities. Large number of molluscan shells, puffer fishes, and porcupine fishes are collected for this purpose. This has caused a lot of damage to many coral reef areas of the world. Gulf of Mannar was not alone. A large number of shops in Rameswaram used to cater to the needs of memento and souvenir lovers. Although the number of these shops and the quantity of materials sold by them have come down substantially in recent years, enough damage has already been done during the last few decades when tens of hundreds of tonnes of these materials have been removed. One of the typical examples is the case of Umbonium shells or small ear stud shells. They used to be found in plenty at the souvenir shops in the late 1960s. They were so plenty that they were kept in big heaps at the shops and sold at cheap rates. Nobody walking on the beach could miss seeing one of these shells. Unfortunately they have become extremely limited and rare now because of over-exploitation.

8. Acquisition of specimens for shell collection

In addition to making mementos and souvenirs, a lot of shells of bivalve and gastrapod molluscan species were harvested for shell collection. This was done not only by private individuals but also by students of colleges and schools for their institutions. This activity for the last several decades has caused depletion of populations of several species of molluscs. A good example is the case of the sacred chank which was being collected for the value of the milk white shell. The demand for this shell is also due to its religious value among the Hindus, particularly in the northern part of India.

9. Tropical fish hobby

An abundant source of ornamental fishes is available in the Gulf of Mannar, especially in the coral reef ecosystem. These fishes include butterfly fishes, clown fishes, squirrel fishes, parrot fishes, and the Sergeant major. As these fishes are in great demand among fish hobbyists, there is a potential danger of over-fishing them from the Gulf of Mannar. Therefore suitable measures must be taken to harvest such fishes with judicial management approach. One such approach used in many Far Eastern countries is the use of Fish Aggregating Devices or FADs.

Fish Aggregating Devices (FADs), also known as “Payaws” or “Payaos” in the Far Eastern countries, are buoys or rafts anchored in deep water. These are used to attract pelagic fishes for enhancing commercial and recreational fishing. A relative structure is called “artificial reef” although practically it is also a FAD. Literature on FADs is rather recent. Nearly 86% of publications on FADs have been written after 1969. The use of FADs in India is quite recent and there is not much published literature as it is still in experimental stage.

FADs can be either floating on or near the surface or suspended in mid-water. If they are kept at the bottom then they will be called as artificial reefs although the size of the reefs can be enormous. If the same reef is small and can be dislocated then it can be called a Benthic FAD.

FADs are being widely used, in recent years, in the Far Eastern and Pacific countries. In Australia and the USA they are used for recreational fishing. Invariably FADs attract a variety of fishes from their vicinity. Therefore they can be useful also in enhancing the production of ornamental fishes of export value without disturbing their natural populations.

10. Dredging and Siltation.

Dredging is done periodically in shallow areas of marine ports. This is especially true in the old harbour of Tuticorin. At present the dredging of Sethusamudram Ship Canal is going on. Invariably dredging operation kicks up a lot of sand and mud which forms the silt that can settle down on the corals and coral reefs around the islands. This can lead to the death of corals and coral colonies. Studies are being conducted by various institutions to know how much of siltation problem will there be to cause damage to corals around the islands in the Gulf of Mannar.

11. Exploitation of Biological Products

Exploitation of corals for biological products has been going on for the last few decades. Soft corals including several species of gorgonians are being collected periodically to export them to various countries where their properties are investigated for bioactive compounds. Coral associated organisms such as the seacucumbers are also removed in large numbers for export not only because of their demand for human consumption in the far eastern countries but also for their biological value as animals yielding bioactive compounds.

12. Coral Breakage

Coral breakage is caused in the Gulf of Mannar mainly by anchors and anchor harness of small fishing vessels and canoes which are taken around the islands to get fish. Although storm loosened artificial reefs or tires is a problem in many countries, fortunately it is not the case in the Gulf of Mannar mainly because no such artificial reefs have been constructed near the islands. Similarly coral breakage due to swim flippers or fins of divers and snorkelers are common in other countries while it is not the case in the Gulf of Mannar because snorkeling and diving are not popular hobbies yet in this part of the world.

13. Destruction

Destruction of corals and coral reefs is also possible due to oil and gas development in this area. Already the Oil and Natural Gas Commission of India has dug out exploratory drills along a few sites around the Gulf of Mannar area where potential yield of oil and natural gas has been found. When development activities get initiated towards exploitation of these natural resources then one may expect destruction of the corals and coral reefs because of the polluting effects of these products.

So far vessel grounding has not been a problem in the Gulf of Mannar. However, this might become

a reality if the Sethusamudram channel is dredged and opened for passenger and cargo vessel traffic. Destruction of corals and coral reefs due to over-fishing in the Gulf of Mannar have started showing signs of strain. With increase in number of fishermen settlements and the resultant population along the Gulf of Mannar coast this can become a problem in a decade or two. Seastar (crown of thorns) population explosion was a problem in Australia a few years ago. This is not a problem in the Gulf of Mannar area mainly because of the hectic fishing activity which removes many of the commercially unimportant invertebrates.

Use of in appropriate fishing gear impact is a definite problem in the Gulf of Mannar. Observations made around several islands in the Gulf of Mannar in the last several years indicate that many of the coral grounds have been destroyed because of unscrupulous fishing practice. For instance, use of trawl nets in shallow depths of 2 to 3 fathoms and use of shore seine fishing nets around the islands have caused breakage and hauling out of large coral blocks. Operation of such fishing gears has also caused disturbance to the bottom sediments resulting in siltation and killing of corals around many islands.

14. Nature's Fury

Apart from all the human activities and interference, at times, nature's fury also causes damage to the coral reef ecosystem in the Gulf of Mannar. This includes unusually intense storms and rains which lash the area. Strong storms can uproot corals and surging waters can wash away the freshly settled larvae of coral organisms. Similarly, heavy rains can dilute the salinity of the seawater locally which can kill coral organisms.

The Bleaching of corals all over the world and also in the Gulf of Manner during April-May 1998 was suspected to have been caused by EI-Nino phenomenon and the consequent world wide increase in seawater temperature. It is feared that this has killed 70% to 80% of the corals in the Gulf of Mannar region. Added to this, the tsunami of 26th December 2004 also caused damage to many of the islands in the Gulf of Mannar although not to a great extent.

Conclusion

In view of the sensitive nature of the Gulf of Mannar Marine Biosphere Ecosystem and the dangers faced by it due to multifarious anthropogenic activities in recent years, the Government and other national and international organizations have evinced great interest to protect and conserve this ecosystem. Towards this, the Global Environment Facility (GEF) through United Nations Development Programme (UNDP) has facilitated the project on "Conservation and Sustainable Use of Gulf of Mannar Biosphere Reserve's Coastal biodiversity" which is being carried out by the Gulf of Mannar Marine Biosphere Reserve Trust (GOMMBRT). As a first step towards achieving the target, it was decided to compile the existing scientific literature on Gulf of Mannar in the form of a Bibliography and identify the Gap areas in research so that steps could be initiated to conduct important research studies on urgent basis. The present work on the compilation of "Scientific Information on Gulf of Mannar - A Bibliography" is the first step made towards achieving the goals set.

(Source : Reference Nos. - 1273, 1355, 1598, 1739, 2003)

A Report of research done in the Gulf of Mannar

Gulf of Mannar Marine Biosphere Reserve

Gulf of Mannar in the southeast coast of India extends from Rameswaram Island in the north to Kanyakumari in the south. It has a chain of 21 islands stretching from Mandapam to Tuticorin to a distance of 140 km along the coast. Each one of the islands is located anywhere between 2 and 10 km from the mainland. The Gulf of Mannar Biosphere Reserve was set up on 18th February 1989 jointly by the Government of India and the state of Tamilnadu. The government of Tamilnadu in G.O. M.S. No 962 dated 10th September 1986 notified under section 35(1) of the Wildlife (Protection) Act 1972 the intention to declare the 21 islands as Marine National Park for the purpose of protecting marine wildlife and its environment including depths of 3.5 fathoms on the bay side to 5 fathoms on the seaward side.

The compilation of all available scientific literature in the form of an annotated bibliography of the Gulf of Mannar biosphere reserve has brought to light the existence of nearly 3,000 publications up to date. This covers the literature published from as early as 1864 to the current year. A large number of publications in the first half of the 20th century have brought out information on the variety of fauna and flora found in the Gulf of Mannar, their biology and ecology. A lot of emphasis on the fish and fisheries research has been given only in the second half of the 20th century. Emphasis is being given on biochemical aspects of flora and fauna in the later part of the 20th century and at present.

Ecosystems and Biodiversity :

Gulf of Mannar is endowed with a rich variety of marine organisms because its biosphere includes ecosystems of coral reefs, rocky shores, sandy beaches, mud flats, estuaries, mangrove forests, seaweed stretches and seagrass beds. These ecosystems support a wide variety of fauna and flora including rare cowries, cones, volutes, murices, whelks, strombids, chanks, tonnids, prawns, lobsters, pearl oysters, seahorses, seacucumbers, etc. The biosphere reserve and particularly the Marine National Park of the Gulf of Mannar also gains more importance because of the alarmingly declining population of the endangered Dugongs.

The Gulf of Mannar biosphere reserve has an area of about 10,500 km^2 running along the mainland coast for about 170 nautical miles including the 21 islands in the gulf. The total area of the islands is about 623 hectares. The Exclusive Economic Zone (EEZ) of Gulf of Mannar is about 15,000 km^2 in which, commercial fishing is carried out in about 5,500 km^2 up to a depth of 50m. Gulf of Mannar is considered as “Biologists’ paradise” for, it has 3600 species of flora and fauna. The diverse nature of ecosystems in the Gulf of Mannar supports a wide variety of significant species including 117 species of corals, 641 species of crustaceans, 731 species of molluscs, 441 species of finfishes and 147 species of seaweeds apart from the seasonally migrating marine mammals like whales, dolphins, porpoises and turtles. The mangrove habitats in the Gulf of Mannar have 9 different species of vegetation supporting a variety of marine fauna including seabirds and sea snakes.

Major Scientific Research :

The major scientific areas of research in the Gulf of Mannar include 1) Finfish fishery 2) Shellfish fishery 3) Aquaculture and 4) Seaweed research. The finfish fishery includes perches, carangids, barracudas, mackerels, milkfish, mullets, tunas, sardines, scombroids, silverbellies, pomfrets, lethrinids, groupers, sharks and rays. The shellfish fishery includes oysters, mussles, clams, prawns, lobsters and crabs. Aquaculture research has been concentrated on pearl oysters, edible oysters, crabs, prawns, milkfish, etc. Extensive research has been carried out on the biology, ecology, biochemistry and production of seaweeds

of the Gulf of Mannar. Dedicated researches on these aspects of seaweeds have been going on in the Central Salt and Marine Chemicals Research Institute (CSMCRI) and the algal study unit of the Central Marine Fisheries Research Institute (CMFRI). In recent years a number of academic institutions have also evinced interest in seaweeds mainly to do research on bioactive compounds especially on those with antibacterial qualities. Researches on culture of organisms of export value such as seacucumbers, seahorses and ornamental fishes have been carried out by institutions including the State and Central fisheries departments and academic institutions.

Aquaculture

Aquaculture prospects and problems have been discussed in a number of publications. The growth hormone involved in aquaculture for high yield of marine animals have been discussed. Marketing aspects of aquaculture products including price, market value, etc., have been reported. Polyculture of marine animals has been done experimentally successfully in coconut-cum-fish culture. Culturable fish species identified are *Chanos chanos, Channa striatus, Ompok bimaculatus, Lates calcarifer, Mugil cephalus, etc*.

Aquaculture problems like fouling by barnacles, bird menace, poaching, bad weather, etc., have been studied. Culture techniques like pen culture, cage culture, raft culture have been described. Aquaculture feed selection and live feeds used have been reported. Antibiotics and probiotics used for aquaculture have been discussed. Aquaculture Training and modernisation techniques have been reported.

Chank fishery

Chank fishery prospects are expected to increase with the introduction of SCUBA diving in the Gulf of Mannar as reported in a paper. Underwater surveys of chank beds to assess the fishery potential and diversity have been given in detail in a few articles. Annual chank landings, yield variations from area to area, account of the chank fishery in important centers, details of the diving method and the extent of the chank grounds are discussed in some papers. Commercial shells such as spider conch exploitation by skin diving has been explained.

Coral reefs

Many of the publications on corals are on taxonomy using morphological characters. Check lists of Coral fauna have been presented in many papers. A bibliographic compilation on coral reefs has been published. Several new records of corals have been encountered and redescribed by various workers.

Transplantation studies have been carried out in *Acropora formosa* and their growth and survival were analysed. The rejuvenation of corals has been studied. Coral bleaching due to *El niño* effect has been studied. The biodiversity of reef associated animals has been reported. Anthropogenic impacts on coral reef ecosystem, which includes Coral mining and poaching, have been reported. The post-tsunami status of coral reef diversity has been studied. Some reports related to sedimentation impacts on coral reef ecosystem are available. Bio-physical status assessment of corals using Line Intercept Transect method has been reported. ARMDES database software has been used for the coral reef composition study. Coral reef conservation and management aspects were dealt in some publications.

Coral reef associated fishes are Groupers, *Epinephelus summana, Epinephelus undulosus* and *Epinephelus tauvina* ornamental fishes and molluscs. Some national and international organisations involved in coral reef monitoring are GCRMN, ICRMN, ICLARM and CORDIO. Coral reef distribution around the Gulf of Mannar islands has been assessed and reported. Reef fish diversity, sex ratio, fecundity,

reproductive biology, food and feeding habits for some species in selected islands of Gulf of Mannar have been studied. Coral reef bacterial flora have been studied. Antimicrobial activity of some corals has been described.

Artificial reefs

The assemblage and diversity of reef fishes have been studied in Tuticorin coast. Fish restoration analysis was done in an artificial reef ecosystem. Different kinds of structures to create artificial reef environment using concrete blocks, used tyres, floating bamboo bundles etc., have been described. Cirripedes observed as biofouler in the artificial reef ecosystem has been reported. The other foulers identified in the ecosystem were sponges, ascidians, hydroids, molluscs, oyster spat etc. Epibenthic communities were surveyed in this ecosystem. The commercial catches of lobster in this ecosystem have been analysed.

Crafts and Gear

Trawl nets operated by mechanized boats to capture swimming crabs, dogfish sharks, etc., at great depths have been reported. A record catch of 820 kg of deep-sea dogfish shark has been landed by a single boat by using trawl net. An estimated 158.15 tonnes and 226.9 tonnes of threadfin bream fish have been landed by trawl nets with a catch rate of 6.31 and 10.13 kg/unit in 1987 and 1988 respectively giving an average of 3.6% of the total catch by trawl net.

During the period 1980/81 new trawling techniques were introduced in Tamilnadu. The data discussed bumper catch of balistids from trawl fishery. Prawn fishery and ray fish landings by commercial shrimp trawlers have been discussed in detail. In lobster fishery, Trawlers landed about 33 tonnes and the same has been discussed.

Gill net, purse seine, trawl net and ring seine were the major gears employed for the exploitation of mackerel fishery. Mechanized boats operating otter trawl have been found to land about 90% of the catch.

The usage of marine fishing crafts and gears have been discussed in detail. Gillnets, trawl nets, and hooks and lines were the major gears contributing to 50%, 35% and 9% respectively and purse seines and indigenous gears are also used. In general drift nets, gillnets, hooks and lines, and purse seines were found to be the major gears employed.

EEZ (Exclusive Economic Zone)

It has been reported that the total area of the Indian EEZ is approximately 2.02 million square kilometers and that of the Gulf of Mannar is 15,000 km^2. This is widely dispersed along the coastline and around the islands. Many of the features of our EEZ are still unknown and what lies ahead cannot be evaluated with any substantial degree of accuracy and precision.

Squid and cuttlefish resources in the neritic waters appear to be substantial. Cephalopod production is about 1,000 tonnes in 1973 and 30,000 tonnes in 1985. They consist of demersal fishes, shoaling pelagic fishes, large pelagic fishes, crustaceans, cephalopods, sedentary molluscs, seaweeds, etc. It is estimated that the Economic Zone may support about 4.5 million tonnes.

Annual average tuna production (1998-2003) by Indian fleet from our EEZ is about 47,000 tons of coastal and 10,000 tons of oceanic tunas. Presently only 23% of the annual potential yield of coastal tunas and a mere 6% of oceanic tunas are harvested. The tuna resources in the EEZ's of India, Maldives and Sri Lanka are likely to be of shared stocks.

Finfish fishery

A number of articles have been published on finfish fishery, finfish resource, deep sea fishery, pelagic fishery, coastal fishery, EEZ fishery, environmental problems, taxonomy, etc. Biology, age and growth, length and weight relationship, taxonomy, distribution, commercial importance, landing data, seasonal abundance, fishing gears and crafts, reproductive biology, mouth brooding habit, migration behavior, etc., of catfish have been reported in many publications. Similarly the croaker sciaenid fish biology, landing data, spawning, fecundity, sex-ratio, morphometry, gonadal abnormality, hermaphroditism, etc., have been presented in some articles. There are a number of publications on demersal fishery aspects. These papers have dealt with annual catch, landing data, fishery biomass, trawl catch, etc. There are only a limited number of papers which deal with dog fish fishery.

Fish otolith studies have been reported in some papers. Mackerel fish genetics, morphometry, landing data, taxonomy, seasonal abundance, etc., have been given in detail. Herring fishery, abundance, landing data, etc., have been reported in some papers. Seer fish fishery, feeding, spawning, taxonomy, migration, landing data, etc., have been dealt with in some publications. Milkfish fishery, culture, seasonal variation, fish fry conservation, fish fry culture, fishing regulation, etc., have been dealt with in many publications.

Scombroid fish fishery, fishery potential, spawning and landing data have been studied. Mullet fish fishery, food and feeding habits, culture, breeding biology, etc., have been discussed in some papers. Carangid fish, its fishery resources, landing data, seasonal abundance, osteology, breeding biology, maturity stages, length weight relationship, fecundity, etc., have been studied. Ulua fish, fishery resource, length weight relationship, etc. have been given. Dorab fish, its fishery resource and landing data have been reported.

File fish fishery, distribution, habitat, morphology etc., have been described. Teira bat fish and its dislocation due to tsunami impact has been reported. A new record of gobi fish, its morphometry, taxonomy etc., have been reported. Barracuda fishery, its yield, growth, stock assessment, and landing data etc., have been given. Sand whiting fish, its eggs and larvae, food and feeding habits etc., have been described. Big-jawed jumper fish and its fishery and landings have been reported.

Threadfin bream fish, its fishery, growth and mortality, and fishery problems have been elucidated. Pig face bream fish, its fishery, biology and maturation have been described. Pipe fish, its fishery, development and embryology have been given. Hemirhamphid fish, its food and feeding habits, biology, fishery resources, seasonal variations, and gut contents have been described. A new record of skate fish has been given. Lizard fish, its post larval stages and laboratory rearing have been reported. Zebra sole fish has been reared in the laboratory. Scad fish, its fishery, biochemistry, protein content, fat content, and food and feeding habits have been described.

Microbial quality of fish, post harvest technology, delayed icing problem etc., have been discussed in some publications. Dry fish preparation, marketing, sun drying, and related bacteriology have been discussed.

Lobster fishery

Growth, regeneration, size, sex composition, and respiratory metabolism of panulirid lobster have been reported. Breeding and reproduction biology, larval development have been discussed in some papers. Lobster fishery resources and development of management strategies have been given.

Lobster fishing gears, mode of operation, collection methods, and by-catch have been given in

detail. Tagging experiments on spiny lobsters have been reported. Commercial value, market trend, and ornamental shell industry of spiny lobster have been given in detail in some articles.

Culture techniques and potential resource for lobster culture have been discussed. Phyllosoma larval studies of lobsters have been reported in some papers. Packing of live lobster for export has been given in detail. Creation of artificial habitats for lobsters has been discussed. New records of lobsters have been given. *Vibrio cholarae* in processed lobster has been reported in one paper.

Dolphins

Morphometric measurements of stranded dolphins have been reported. Sometimes dead animals have been washed ashore whose measurements have been taken. Sometimes the dolphins get entangled in trawl fishing nets. In some cases stranded dolphins have been rescued. The stranded and washed ashore dolphins belonged to *Stenella longirostris, Tursiops aduncus* and *Sousa chinensis.*

Dugongs

The rare endangered dugongs have been studied in captivity. The morphometric characters of stranded dugongs have been illustrated in a number of articles. Osteological data on stranded animals have been described in some articles. The annual catch in terms of stranding has been calculated. The catch data on dugongs entangled in fishing and trawling nets have been given. In the early 1970s breeding of dugong in captivity was recorded by the Central Marine Fisheries Research Institute at Mandapam Camp.

Porpoises

Only a few articles have described the morphometric characters of stranded finless black porpoise, *Neophocaena phocaenoides*.

Whales

Most of the records on whales in the Gulf of Mannar region are on stranding data. Pilot whale stranding has been observed at Kanyakumari and Manapad coasts. Periodic stranding of Sei whale has been observed at Kundhukal, Vellapatti, Tuticorin, Kayalpattinam, and Tuticorin Wharf. Live Sei whale has been sighted from FORV Sagar Kanya expedition.

Baleen whale has been caught and landed at Tuticorin fishing harbour. Baleen whale skull has been found washed ashore near Dhanuskodi. Rorqual whale has been found stranded near Ovari. False killer whale has been landed accidentally at Veerapandianpatnam coast near Tiruchendur. Two false killer whales have been stranded at Pozhikara near Kanyakumari coast.

Sperm whale has been found stranded at Krusadai island. The osteological characteristics of Sperm whale have been studied. Humpback whale song has been heard and recorded onboard in the Gulf of Mannar area.

Mangroves

Mangrove ecosystem studies give information on diversity, resources, abundance, associated fauna etc., in some detail. Mangrove mapping using remote sensing has been reported. Mangrove destruction, deforestation, firewood collection, and threats to mangroves have been discussed. Mangrove associated plants are given in some papers. Mangrove species diversity and genetic diversity studies have been reported. Coliphage occurrence in Mangrove ecosystem in the islands of the Gulf has been given.

Pearl culture

Pearl formation and artificial pearl production have been discussed in many articles. Pearl sac theory has been discussed in a few articles. The surgical equipments involved in pearl culture and Pearl nucleus implantation as applied for artificial pearl production have been discussed. Abalone culture for pearl production has been described. Quality pearl production techniques have been reported in many papers. Various types of culture techniques such as rack and raft techniques have been described. Pearl oyster hatchery production has been elaborated. Tissue culture methods as applied in pearl production have been reported.

The pearl fishery of the Gulf of Mannar coast has been discussed in many articles. The hydrography status of pearl culture lagoons has been monitored. Pearl oyster resources in all pearl banks have been monitored using SCUBA Diving. Scientific methods involved in pearl culture have been described. The prospects and problems involved in large scale pearl culture have been discussed in some articles. *Isochrysis galbana* and *Chaetoceros calcitrans* have been used as pearl oyster feed. Larval rearing and induced breeding of pearl oyster spat have been described. The relation between lunar period and pearl production has been discussed.

Pearl Banks

The history, biology and diversity of Pearl banks have been discussed in many papers. Occurrence of natural pearl banks of Tuticorin, Vepolodai and Ramanathapuram coast has been reported. The meteorological and physico-chemical parameters in the pearl bank ecosystem have been studied. Surveys of natural conditions of Pearl bank areas have been carried out.

Pollution

There is rapid coastal development and human settlement and consequently increased tourism. Increased heavy metal concentration due to industrial development has been reported. Microbial pollution in seawater and sediments have been noticed. Microbial pollution in seawater due to heavy inflow of tourist has been pointed out. Heavy metal concentrations in nearshore waters of Thermal power plant have been reported. Studies on Mercury accumulation in bivalve molluscs are available. Heavy metal concentrations in edible oyster have been discussed. Data on fish mortality due to inflow of industrial effluent in Kayalpatnam coast have been given. Determination of lethal concentration of heavy metals in bivalve molluscs due to industrial contaminants has be given.

Accumulation of Chlorinated pesticide in rayfish has been reported. Tributyl tin accumulation in sediments and seawater of Tuticorin harbour has been given. Impacts of thermal effluent in Tuticorin waters have been given. Sedimentation rate, historical trend of sedimentation rate and Sediment core sampling at polluted sites have been discussed. Organic matter and nutrients in the sediments of coral reef environment and seagrass beds have been discussed.

Fly ash

Heavy metal pollution in Tuticorin coastal waters due to fly ash of thermal power plant has been reported. Impact of fly ash on embryonic development of the big-fin squid has been studied. Physico-chemical and mineralogical characteristics of fly ash of thermal power plant has been given. Sedimentation of fly ash in salt pans of Tuticorin has been studied.

Sewage recycling

Fish culture has been done as a sewage recycling method. Microbial reduction due to sewage recycling has been reported.

Prawn fishery

A number of publications deal with prawn culture techniques and associated problems. Monoculture, bispecies culture, and composite culture have been described. Prawn eye stalk ablation technique, spawning, seed resource, seed production, seed selection, larval rearing, larval feed, stocking rate, etc., have been discussed in some papers.

Site selection, pre-farming activities, species selection, Harvesting, marketing, harvesting gears, and stock assessment have been given in a number of publications. Prawn distribution, taxonomy, biology and length weight relationship have been studied. Prawn behavior like burrowing habit, diurnal activity, nocturnal activity, and random activity have been studied. Prawn metabolism, oxygen consumption, and ammonia excretion have been estimated.

The biochemistry of prawns related to lipid enrichment, HUFA requirement, feed stimulants glycine betaine and DMPT, proximate composition, vitamins, ascorbic acid content, folic acid, pyridoxine etc., have been studied.

Prawn diseases like white spot and black spot disease have been reported. Prawn fishery, landing data, catch composition, fishing gears and crafts, annual landing, white prawn fishery, tiger prawn fishery etc., have been elucidated. Socioeconomic studies related to prawn fishery have been given in detail. The role of fisherwomen in prawn hand picking, middlemen problem, seasonal fishing etc., have been discussed.

Remote sensing and GIS

Remote sensing techniques for coral reef mapping and reef complex mapping have been done and reported. Chlorophyll content of seawater has been assessed using OCM-DAS. Near shore turbidity, near shore bathymetry, habitat composition, and fishing grounds have been identified and discussed. Oceanographic studies include surface water temperature and bathymetry as reported in a paper.

A GIS based atlas for mariculture sites is given in one publication. GIS based information system for microbiology, plankton, and benthic fauna of Gulf of Mannar has been reported. GIS application for conservation and sustainable utilization of coral reef resources has been reported in one paper. A GIS based information system for critical marine habitat of the Gulf of Mannar area has been developed and discussed. Detection of land use pattern in Tuticorin using GIS has been discussed. Two doctoral degree theses have been completed on remote sensing and GIS application in the Gulf of Mannar.

Seacucumbers

Many publications have dealt with biodiversity, resource potential and conservation aspects of seacucumber. Status of coastal aquaculture with special reference to seacucumber has been discussed in many papers. A few publications have dealt with breeding biology, spawning and larval rearing of seacucumbers. The resources, industrial quality and the export value of *Beche-de-mer* have been discussed. The impact of physico-chemical parameters on larval growth, survival and development of seacucumber has been described. Novel chemicals like Triterpene glycoside and steroid glycoside from seacucumbers have been extracted.

The management strategies for seacucumber conservation have been discussed in some articles. Financial improvement of fisherwomen in *Beche-de-mer* industry has been suggested.

Holothurians are of great importance, because of their export potential. Holothurians are in the list of protected animals under Indian Wildlife (Protection) Act, 1972. Holothurians are considered a delicacy in some of the Southeast Asian countries. The annual production quantity is about 30,000 kg at present and is entirely exported, as it is not consumed locally.

Generally skin divers collect Holothurians at a depth of 2 to 6 fathoms. It is a seasonal fishery. Length weight relationship and landing data of sea cucumbers have been reported in many papers. Integrated coastal farming for holothurian culture has been given in one report.

Seagrass

Studies on primary productivity in seagrass beds have been discussed in many of the papers. The study on the growth and intensity of some seagrasses, *Halodule uninervis* and *Halophila ovalis* in the culture pond have been reported in an article. Seagrass beds have been reported as feeding grounds for sea turtles and sea cows. Antagonistic bacteria have been isolated from sea grasses. Application of GIS to estimate seagrass bed surface area and resource potential has been given.

Seahorses

There are only a few articles on seahorse research. Captive rearing, breeding and spawning of seahorse, *Hippocampus kuda,* have been studied. The growth and reproduction of seahorse, *Hippocampus kuda* have been reported in an article.

Sea Birds

The occurrence of sea birds in the mangrove ecosystem has been reported. Data on seabird capture and their poachers have been discussed in a few papers. The birds *Numenius arquata, Numenius phaeopus* and *Limosa lapponica* have been found to be the regular winter visitors of Gulf of Mannar. One paper has dealt with bird ringing studies. Data on ringed Russian sandwich tern, *Sterna sandvicensis,* caught in the Gulf of Mannar have been discussed in an article.

Sea Snakes

Publications on seasnakes of the Gulf of Mannar are scarce. One study indicates the association between the sea snake and Gnathanodon fish.

Seaweeds

Extensive research has been carried out on the seaweeds of Gulf of Mannar. Distribution and biodiversity of seaweeds throughout the Gulf of Mannar from Dhanuskodi to Kanyakumari have been reported. Seaweed associated fauna have also been listed. Intertidal ecology of seaweeds has been studied. Seaweed exploitation, conservation and utilization are discussed. The reproduction and propagation characteristics of seaweeds are reported.

Many reports are available on the cultivation of seaweeds for sustainable utilization. The major culturable species identified are *Gracilaria edulis, G. crassa, G. acerosa, G. verrucosa, Turbinaria crenata, Hypnea valentina, Acanthophora spicifera, Laurencia papillosa, Enteromorpha compressa, Ulva lactuca, Culerpa recemosa,* etc. Seaweeds of Gulf of Mannar are commercially importance as they are used in the production of agar, algin and carrageenan. These products are having high market value and are used as softening agents in the preparation of creams and pastes. Seaweeds are also used as liquid fertilizer, manure, cattle feed, etc. The agar producing seaweeds are *Turbinaria crenata, Gracilaria edulis, G. crassa, G. acerosa, G. verrucosa* and *Sargassum* spp. Export quality agar production is also possible. The chemical and organic constituents of seaweeds have been estimated. This includes Iodine, fatty acid, bromine and mineral content. Medicinal uses of seaweeds such as anti-tumor effect and anti-oxidants like Tocopherol, Vitamins A, C and E have been established. Antioxidant properties were found in the seaweeds *Padina boergesenii, Sargassum polycystum, Dictyota dichotoma, Enteromorpha compressa, Caulerpa racemosa, Caulerpa sertularioides, Gracilaria edulis* and *Gracilaria foliifera*. Free radical scavenging assays have been reported.

Bioactive substances from seaweeds have been extracted. Diterpenes have been isolated from *Dictyota bartayresiana* and *Stoechospermum marginatum.* Antivenom properties of some seaweeds are found. Antimicrobial property was tested in the seaweeds *Caulerpa racemosa, Ulva fasciata, Ictyota dichotoma, Padina gymnospora, Gracilaria corticata, Enteromorpha compressa, Cladophoropsis zoolingeri, Sargassum wightii and Sarconema furcellata.* Antifungal property has been tested using *Caulerpa* sp and *Hypnea valentiae* against *Candida albicans, Candida krusei, Candida tropicalis, Candida parapsilosis, Trichophyton mentagrophytes, Aspergillus niger, Aspergillus javus* and *Aspergillus jumigatus.*

Edible oyster Fishery

A number of articles emphasize the economic importance of edible oyster, *Crassostrea madrasensis*. Seed production and hatchery techniques involved in edible oyster culture have been reported. Valuable economic products such as oyster soup, oyster pickles and oyster curry made of edible oyster have been described. Larval rearing and induced breeding of *Crassostrea madrasensis* have been described. The quality assessment of edible oyster products during processing, transport, purification, storage, freezing and canning have been discussed.

Cuttlefish Fishery

Morphometric measurements of cuttlefish have been discussed in some publications. Cuttlefish resource exploitation and taxonomy have been given. Cuttlefish spawning and breeding biology have been described in some papers.

Crab fishery

A number of publications deal with the morphometry and distribution of crab species like mud crabs, spider crabs, blue swimming crabs, porcellanid crabs, brachyuran crabs, shore crabs etc. Crab breeding biology, sex ratio, brood stock selection, eye stalk ablation, spawning, larval rearing, larval maintenance, larval development, gonad condition, etc., have been discussed in some papers. Culture aspects of crabs like pond selection, pen culture, cage culture, brackish water culture, monoculture, polyculture, seed stocking, culture survival rate, crab fattening etc., are given in some articles. Crab fishery information including fishing gears, landing data, processing methods, economic value, etc., have been reported. Behaviour of burrowing crabs, sexual dimorphism, mating behavior and moulting in crabs have been discussed.

Socio-economics

Socio-economics of the reef related resource utilization and resource management have been discussed. Socio-economic details of oyster farmers and chank fishermen have been given. The involvement of NGOs for socio-economic uplift of traditional fishermen communities have been discussed. Marketing problems of fishermen due to middleman exploitation have been described. Issues like exploitation by middlemen, coral mining, resource depletion and alternative employment to fishermen communities have been discussed. Socioeconomic monitoring of reef resource users in Tuticorin coastal areas has been done. Financial improvement of fisherwomen in *Beche-de-mer* industry has been discussed. The employment and income patterns of traditional fishermen communities have been given.

Tourism (Eco-tourism)

There are only a few articles on tourism and eco-tourism. The importance of ecotourism on economic stability and well being of local people has been discussed. Impact of tourism contributing to

increased microbial load in seawater has been reported. Biological and ecological significance of Balanoglossus in Ecotourism to Krusadai island has been stressed.

Seaturtles

The morphology, distribution and reproductive behaviour of sea turtles have been reviewed in an article. The morphometry, biology and feeding habits of a Green turtle have been discussed in another article. Laboratory rearing of olive ridley turtle, *Lepidochelys olivacea* under controlled temperature and their feeding habits have been reported. The problems behind captive rearing of the turtles *Lepidochelys olivacea* and *Eretmochelys imbricata* have been discussed. The nesting behaviour of turtles in an island of Gulf of mannar has been studied.

Scientific Gap Areas Identified

1. Although information on the existence of various species of corals are available, the extent of their distribution needs to be assessed as done in the case of forests. Long term monitoring of the corals is essential.
2. Research on coral reef ecology particularly the interaction of other animal species with corals needs to be carried out, in order to understand their contribution to fishery.
3. Coral biology with particular reference to reproduction, spawning seasons and patterns should be studied.
4. Rehabilitation of corals in reef denuded areas, especially around all the 21 islands, must be done.
5. The impact of Sethu Samudram Ship Canal Project (SSCP) on the coral reef ecosystem needs to be studied especially in the context of the southwest and northeast monsoons influencing the underwater current patterns.
6. The concern raised by a few publications on bio-invasion due to the SSCP and the operation of foreign vessels in future in the region needs to be addressed. Bio-monitoring of invasive and introduced species also should be carried out.
7. Although the endangered dugong has drawn the attention of a number of scientists, not much valuable research has been carried out to study *in-situ* the biology, behavior, ecology, reproduction and population structure of this rare and endangered species and hence needs immediate attention.
8. Exclusive surveys may be conducted to assess the status of endangered and threatened species such as sea turtles, seahorses, dolphins, dugongs, molluscs, corals, etc.
9. Although some information is available on the morphometry of the Dolphins based on their carcasses, more efforts may be spared to study their biology, ecology and behavior in nature.
10. Research on sea turtles especially about their nesting grounds and breeding populations needs to be carried out.
11. Although the technology of seacucumber culture has been demonstrated it needs to be extended to the field, so that the fishermen can take it up as an alternate livelihood option since it has great export potential.
12. The technology of pearl culture is available but has not penetrated the field very well and hence needs attention.
13. Seagrass ecosystem which is important for the endangered dugongs needs to be studied properly. It is also necessary that the availability, extent of distribution, diversity and biomass potential of seagrass in the Gulf is assessed. Long term monitoring of the seagrass ecosystem may be considered.

14. Although the extent of distribution of mangroves in the Gulf of Mannar is limited, their ecology in terms of their support to fisheries, land protection and significance as feeding and breeding grounds for sea birds, sea snakes and other organisms needs to be studied.
15. Although a GIS based Resource Information System is available with the DOD to give baseline information, current underwater surveys should be carried out to locate pearl oyster beds, chank beds, seaweed grounds, seagrass beds and coral reef distribution. A resource map should be prepared based on such underwater surveys.
16. The vast majority of scientific information available with us is based on studies carried out in the northern part of the Gulf of Mannar encompassing the chain of 21 islands. Information on the southern part of the Gulf is only limited and hence attempts must be made to cover the southern parts also and identify any new grounds of living resources.
17. Although pollution is known to be a cause for concern in the Gulf of Mannar, a thorough understanding of the situation is lacking. Hence it is necessary to conduct research to find out the impact of pollution and the polluting sources, including domestic, municipal and industrial discharges, on the marine living resources of the Gulf. A thorough coastal survey between Dhanushkodi and Kanyakumari should be conducted to identify and map the pollution sources using GIS.
18. A complete assessment of the destructive fishing practices and the number of fisherfolk involved should be done and rectification measures should be adopted.
19. A thorough understanding and estimates of the fishery resources harvested by various fishing sectors, such as mechanized and non-mechanized vessels, and the people involved are required.
20. Socio-economic status of the Gulf of Mannar based, dependent human population should be studied to understand their problems and the prospects of using the human resource to protect and conserve the marine resources.
21. Although training programmes are conducted and extension activities carried out periodically by scientific institutions in order to disseminate information and spread aquaculture technology such as pearl culture, seaweed culture, seacucumber culture etc., to local people including fishermen, not many success stories are reported mainly because of lack of follow up and encouragement both technically and financially. Therefore efforts should be made to develop entrepreneurship training facility.
22. Remote sensing should be used, including aerial surveys and photography, to assess the current status of the topography, geomorphology, and land and forest cover of the islands in the Gulf of Mannar. The same technique may be used for surveying the coastal area also.
23. Research on the impact of climate change and sea level alterations in the Gulf of Mannar may be initiated.
24. The total number of fauna and flora in the Gulf of Mannar is said to be 3600 which needs to be updated and consolidated.
25. A collection of information based on traditional knowledge may be useful.
26. Commercially viable short term programmes such as crab fattening, lobster fattening, and marine ornamental fish rearing may be introduced as alternate livelihood options.
27. Fishery dynamics and stock assessment are to be done for the Gulf of Mannar.

A Scientific Information on Gulf of Mannar : A Bibliography

001. **Abdussamad, E.M., S. Dharmaraj and K.R. Somayajulu** 2003. Growth and pearl formation in the pearl oyster, *Pinctada fucata* in onshore culture tanks. *1st Indian Pearl Congress & Exposition*, 5th to 8th February 2003. pp. 82-84.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnau, India.

Abstract : Pearl oysters were transported from Tuticorin to Kakinada in Andhra Pradesh to study the suitability of the area for their growth and survival. Mode of transportation, their adaptability and growth in Kakinada Bay were reported earlier (*Mar. Fish. Inf. Serv. No.* 152). Mother oysters and nucleated oysters were reared in 85 tonne cement tanks (l0x5x1.7m size) filled with seawater to 5 feet height. Oysters were placed over a netted platform arranged about 20 cm above bottom. Spats were reared initially in 50 x 50 cm velon screen bags suspended from cross bars in 85 tonne cement tanks. After 45 days they were transferred to circular FRP tanks. Aeration was provided to maintain the oxygen level in the water. 15-20% of the water was replaced daily and total water exchange once in a week with sedimented/de-silted raw seawater. Oysters were fed initially with *Chaetoceros* and later with mixed algae (70%) and *Isochrysis* (30%) at 100 million cells per oyster per day for mother and nucleated oysters and one million cells per day per spat. This ration was split and fed four to six times a day. Feed was adjusted based on the concentration of algal cells in the rearing medium. Feeding rate increased with growth of oysters and spat. The spat exhibited good growth throughout the period. They have grown from an initial size of 3.9 mm (DVM) to 28.6 mm in 140 days. Profuse growth of shell process was also observed in all the spat. Two dominant shell colouration varieties were observed. One variety had pale brown colour, and the other had pale cream with dark patches.

002. **Abideen, S., M.Y. Syed Ali, S.H. Liakath Alikhan, E. Rajabudeen, S. Ravikumar, M. Babuselvam and S. Prakash** 2005. Studies on the termicidal property of seaweeds from South India. *Proceeding on National seminar on Bioprospecting and Bioresources,* December, 8-9, 2005. St. Xavier's College, Palayamkottai, (ed). N. Nagarajan.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Tamilnadu, India.

Abstract : Termites are social and can form large nests or colonies, consisting of very different looking individuals. Signs of termite infestation include swarming of winged forms in fall and spring and evidence of tunneling in wood. Successful termite management requires many special skills. Chemicals currently used in pressurized treatment are toxic to termites and discourage new kings and queens from establishing colonies in it. Applying chemical agents around and under buildings can cause soil and water contamination, which leads to human health problems. Control of termites through biological agents could prevent the undesirable changes in the ecosystems. Marine plants are the specially adopted group of plants, which could tolerate high salt. Screening of termiticidal compounds from marine plants have just been started by the present study and found that, *Chetomorpha indica, Chetomorpha antennina, Amphiroa anceps* showed 100% mortality with in 5 days at a LD_{50} concentration 2.5g.l^{-1}. Cultivation technology and other *in vitro* condition for testing the termicidal compounds from marine halophytes have been standardized. It indicates that, the use fo antibiotics *viz.,* Nalidixic acid (1 mg. l^{-1}) Actidione (4mg. l^{-1}) and Nystatin (0.8 mg. l^{-1}) could prevent the microbial contamination under *in vitro* cultivation of termites.

003. **Abraham, T.J and P. Jayachandran** 1992. Microbial characteristics of Prawn pickle. *Third Asian Fisheries Forum,* 26th to 30th October 1992. p. 207.

Address : Department of Fish processing technology, Fisheries College, Tuticorin-623 008, Tamilnadu, India.

Abstract : Microbiological characteristics of Prawn pickle stored at ambient temperature, 30°C, was studied. In Prawn pickle with a pH around 4.75, the total viable count decreased by 15 folds over 60 days and the count ranged between 10^2 and 10^3/Gram. No lactic acid bacteria, coliforms, *Staphylococcus aureus, Salmonella, Vibrios, Clostridium perfringens* were encountered. Anaerobic spore formers and anaerobic gas producers count increased with increased in storage period. The Prawn pickle contained highly salt and acid tolerant groups at the end. The product was microbiologically sound and did not show any visible signs of spoilage for a period of 180 days.

004. **Abraham, T.J., G. Sugumar, D. Sukumar and P. Jeyachandran** 1992. Bacterial profile of fresh and spoiled fish mince from *Johnius dussumieri* at refrigerated storage. *Fish.Technol.,* 29(1):53-56.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Fish mince from *Johnius dussumieri* was examined for the changes in the bacteriological profile in fresh and spoiled condition at refrigerated storage 4 ± 1°C. The percentage composition of bacterial flora was found to vary with fresh fish, fresh mince, and spoiled mince. *Acinetobacter* and *Aeromonas* which were dominant in fresh fish decreased drastically upon mincing, washing and storage. In fresh mince 71.0% of the bacterial population comprised of gram-positive group of which *Micrococcus* was the dominant. Flora of the spoiled mince was dominated by gram-negative group (80.0%) comprised mainly of *Vibrio* followed by *Pseudomonas*.

005. **Abraham, T.J and T.M. Rudrasetty** 1993. Studies on the optimization of salt and lactic starter inoculum levels for the development of fermented shrimp pickle. *Asian Fish. Sci.,* 6(2): 193-202.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : A study was conducted to develop a new fermented shrimp pickle using lactic starter cultures, viz., *Lactobacillus plantarum* and *Lactobacillus acidophilus*, and to optimize the salt and inoculum levels. Salt concentration at 8% and 10% and inoculum at greater than or equal to 10^4 and greater than or equal to 10^7 cells/g of pickle were tried. In the salted spicy pickle, the lactic acid bacteria (LAB) acquired resistance and grew after initial inhibition. The generation time and number of generations of LAB were affected in pickles with higher salt and lower inoculum levels. Salt at lower level (8%) and LAB inoculum at higher level (greater than or equal to 10^7 cells/g) resulted in a better product in terms of fermentative and sensory characteristics *Lactobacillus plantarum* was more resistant than *Lactobacillus acidophilus* and showed better fermentative activity.

006. **Abraham, T.J., S. Balasundari, G. Indra Jasmine and P. Jeyachandran** 1994. Influence of antioxidants on the sensory quality and oxidative rancidity of frozen edible oyster. *J. Food. Sci. Technol. Mysore.* 31(2):168-170.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : Sensory acceptability and oxidative rancidity of antioxidant-treated edible oyster, frozen at -40° C and held under frozen storage (-18° C) condition, were investigated. The sensory acceptability declined steadily during storage and was accompanied by an increase in the oxidative rancidity of the product. Untreated and butylated hydroxy toluene (0.2% w/w) treated samples developed dark discolouration after two months of storage. Addition of clove powder (0.20% w/w) significantly reduced the oxidative rancidity, measured as thiobarbituric acid reactive substances, and improved the sensory acceptability of the product.

007. **Abraham, T.J and R. Manley** 1995. Luminous and non-luminous *Vibrio harveyi* associated with shell disease in cultured *Penaeus indicus*. *Indian J. Fish.,* 49(3): 273-276.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : Bacteria associated with melanized fissures of cultured *Penaeus indicus* were investigated. Smooth, circular, cream-coloured luminescent and non-luminescent colonies isolated from melanized fissures were identified as *Vibrio harveyi*.

008. **Abraham, T.J., G. Sugumar and P. Jeyachandran** 1995. Effect of potato tuber extract on the bacteriological quality of fish mince. *Fish. Technol.,* 32(1): 39-44.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : The effect of crude potato tuber extract (PTE) the keeping quality of fish mince at +4 and –4° C storage was studied with a view to retard the proteolytic activity in fish mince. There was significant reduction in trimethyl amino-nitrogen and total volatile base nitrogen levels in PTE treated sample than in control. The growth and activity of the bacteria were suppressed in fish mince by the addition of even small amounts of crude PTE. Incorporation of PTE and storage of fish mince at sub-zero and refrigerated temperatures enhanced the keeping quality of fish mince. A marked difference in the composition of bacterial flora on treatment with PTE was observed. The growth of Pseudomonas appeared to be suppressed in the treated fish mince. Vibrio spp. were the dominant flora in both samples at the end.

009. **Abraham, T.J., S.A. Shanmugam and P. Jeyachandran** 1995. Influence of certain parameters in the lactic fermentation of underutilized fish. *FAO Fish Report.* 514: 141-146.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : Studies were conducted to evaluate the parameters that favour a rapid lactic fermentation in fish-salt-carbohydrate mixtures, using frozen shrimp (*Penaeus indicus* and *Parapenaeopsis stylifera*). The initial pH and

textural characteristics of meat markedly affected the period of fermentation. Higher concentration of salt decreased the rate of acid production and pH reduction in meat as well as in liquid medium. There was a significant difference in the rate of fermentation when glucose or sucrose was used as a fermentable carbohydrate source for *Lactobacillus plantarum*.

010. **Abraham, T.J[1]., R. Palaniappan[2] and K. Dhevendaran[3]** 1999. Simple taxonomic key for identifying marine luminous bacteria. *Indian J. Mar. Sci*., 28(1): 35-38.

Address: [1]Fisheries College and Research Institute, Tuticorin - 628 008, India, [2] Department of Microbiology, Sri Paramakalyani College, Manonmaniam Sundaranar University, Alwarkurichi 627 412, Tamil Nadu, India; [3]Dept. of Aquatic Biol. and Fisheries, University of Kerala, Trivandrum 695 007, Kerala, India; Faculty of Fishery Sciences, W.B.U.A.F.S., Mohanpur 741 252 West Bengal, India.

Abstract: A simple key which provides faster identification of marine luminous bacteria based on 10 biochemical tests is presented. It is able to distinguish among closely related marine luminous bacteria. Using this new key, luminous bacteria of Tuticorin (India) coastal and shrimp farm environments were distinguished into 5 different species, *viz*., *Vibrio fischeri, V. harveyi, V. orientalis, V. splendidus and Photobacterium leiognathi. Vibrio harveyi* was the dominant species, constituting 88.66 - 90.93% of the total luminous population followed by *V. orientalis* (4.43 - 4.46 %) and *V. splendidus* (2.11 - 3.35%).

011. **Abraham, T.J and R. Palaniappan** 2002. Chemotherapy and drug resistance in luminous bacteria from penaeid shrimp hatchery. *Indian J. Fish.,* 49(3): 255-260.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : *In-vitro* activities of chloramphenicol, ciprofloxacin, nalidixic acid and oxytetracycline against antibiotic-sensitive luminous *Vibrio harveyi, V. orientalis* and *V. splendidus* from penaeid shrimp hatchery were evaluated. The antibiotic resistance rates for *V. harveyi, V. orientalis* and *V. splendidus* to chloramphenicol ($l.92x10^{10}$-$9.38x10^{8}$) and ciprofloxacin ($l.92x10^{10}$-$2.45x10^{9}$) were very low at 5 and 10 times of their respective minimal inhibitory concentration (MIC) than at 2 times the MIC. The resistance rates for luminous bacteria to nalidixic acid ($4.02x10^{9}$-$1.45x10^{2}$) and oxytetracycline ($1.92x10^{10}$-$3.95x10^{2}$) were found to be higher than chloramphenicol and ciprofloxacin. Although ciprofloxacin was effective in terms of MIC and induction of low level of resistant isolates, chloramphenicol was more active in its ability to control antibiotic-sensitive luminous bacteria.

012. **Abraham, T.J., S.A. Shanmugam, R. Palaniappan and K. Dhevendaran** 2003. Distribution and abundance of luminous bacteria with special reference to shrimp farming activities. *Indian J. Mar. Sci.,* 32(3): 208-213.

Address : Department of Fishery Pathology and Microbiology, West Bengal University of Animal and Fishery Sciences, Mohanpur, Nadia 741 252, West Bengal, India.

Abstract : Quantitative and qualitative distribution of planktonic luminous bacteria in aquaculturally affected region of Tuticorin Bay, along southeast coast of India was studied. Luminous bacterial abundance ranging from 20 to 1050 cells/ml in nearshore seawater and 100 to 8,150 cells/g in inshore sediment were recorded. A significant positive correlation was observed between the luminous bacterial counts and total viable counts of seawater in areas having intensive shrimp farming activities. Five different species of luminous bacteria namely *Vibrio fischeri, V. harveyi, V. orientalis, V. splendidus* biotype 1 and *Photobacterium leiognathi* were identified during this study with *V. harveyi* as the dominant species, comprising greater than or equal to 82-97% of the total luminous population. These results suggest that intensive shrimp farming which largely contributed to luminous bacterial population strongly influences the distribution of planktonic luminous bacteria in nearshore seawater and probably alters the balance of autochthonous microflora in areas affected by shrimp farming.

013. **Achuthankutty, C.T., S.R. Sreekumaran Nair and M. Madhupratap** 1979. Pearls of the windowpane oyster, *Placuna placenta. Mahasagar,* 12(3): 187-189.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : The paper states that pearls of high value have been cultured using *Pinctada fucata* at Tuticorin.

014. **Adolph, C.** 1968. Observations on allometric growth and regeneration in palinurid lobsters. *J. Mar. Biol. Assoc. India,* 10(2): 388-391.

Address : Department of Zoology, Malabar Christian College, Calicut.

Abstract : During routine examination of palinurid lobsters from Mandapam a few large male specimens of *Panulirus ornatus, P. versicolor* and *P. homarus* (Linn.) were found to show a striking phenomenon of allometric growth of peraeopods II and I. In these male specimens due to the increased lengthening of the merii and propodii considerable difference in the length of the 2nd and 3rd peraeopods from that of the 1st and 4th was noticed. There is not much difference in the length of peraeopods of 2nd and 3rd legs in females of corresponding size. Length of merus and propodus of legs I to IV and the total length of the specimens examined and their sex are given in the table. Gordon (1960) noticed this phenomenon of allometric growth in two male specimens of *P. ornatus* from Zanzibar and suggested the possibility of the occurrence of the same in other tropical species of the genus *Panulirus.*

015. **Agastheesapillai, A and R. Thiagarajan** 1979. Biology of the green turtle *Chelonia mydas* (Linnaeus) in the Gulf of Mannar and Palk Bay. *J. Mar. Biol. Assoc. India,* 21(1&2): 45-60.

Address: Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract: This paper deals with various aspects of the biology of the green turtle *C. mydas* of Mandapam region caught during 1971-1976. The major food items observed in the stomachs are sea grasses and seaweeds. The relationship or morphometric measurements with plastron width, which is used here as standard measurement, showed linear regression with best correlation. The relationship of carapace length (straight) with other body measurements were also examined. The plastron width-weight relationship for 316 turtles were worked out. The regression coefficients of the same for the sub adults (weighing less than 71 kg), males and females were found to differ significantly. Females greatly outnumber males in all the years. Plastron length and weight frequencies for females and males were analyzed. Using annual weight frequencies for 6 yrs from 1971 to 1976, the modals were traced. The highest weight increment, 18.64 kg is in the 7th year of age and highest plastron width, 15.2 cm in the 2nd year.

016. **Agastheesapillai, A.** 1986. Observations on the olive ridley turtle *Lepidochelys olivacea* hatched and reared under laboratory conditions. *Proc. Symp. Coastal Aquaculture,* 4: 1267-1274.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : One hundred and thirty four eggs of Olive Ridley turtle *Lepidochelys olivacea* (Eschscholtz) were incubated at an average temperature of 30.5°C under laboratory conditions. Thirty baby turtles emerged in three consecutive nights after 53 days of incubation. Of the remaining eggs, 69 did not hatch out and 35 failed to complete the development. Out of the 30 turtles that emerged, 28 died during the first 4 months, probably due to overcrowding and adverse conditions of the aquarium. The two turtles which survived, were reared in the aquarium for II years, feeding with the meat of *Donax* sp., *Sepia* sp. and *Sardinella* sp. The morphological changes undergone and behaviour pattern of the turtles during the period of rearing were presented.

017. **Agastheesapillai, A.** 1996. Turtle export from the south east coast of India during 1945-64 period. *Mar. Fish. Infor. Serv. T & E. Ser.,* 145: 16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : The quantity and number of turtles exported from Pamban and Keelakkarai during 1945-64 is discussed.

018. **Ahamed, A.B., P.P. Ramaswamy and V. Ramadhas** 1993. Distribution of organic matter in Tuticorin coastal waters. *Indian J. Ecol.,* 20(1): 59-62.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : Temporal variation of the chemical and biochemical oxygen demand was investigated in four ecologically important biotopes of Tuticorin coastal waters. BOD_5 did not show quantitative relationship with COD in all the four biotopes. Highest value of oxygen demand due to non-biodegradable organic matter invariably coincided with the highest value of COD in all the biotopes. Significant quantitative relationship existed between oxygen demand due to non-biodegradable organic matter and COD. In all the biotopes, COD functioned as a better indicator of the availability of non-biodegradable fraction of organic matter.

019. **Ahilan, B and N.V. Sujathkumar** 1990. Seaweed, is it really useful?. *Seafood Export J.,* 22(9&10): 23-25.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : Seaweeds are valuable aquatic products. In India seaweed production is 75 tons per year. Seaweeds

are distributed in many coastal areas such as Mandapam, Kathiawar, Bombay, Rathnagiri, Goa, Karwar, Varkala, Vizhijam, Visakhapatnam, Lakshadeep, Andaman and Nicobar Islands. Seaweed collection is an important source of income in coastal villages. Highest income is earned from *Gelidiella* and lowest from *Sargassum* spp. Utility of seaweeds in the natural ecosystem, protection of fish breeding products, use of species such as *Ulva, Gracilaria, Laminaria* etc. in food, nutritive components such as cellulose, proteins, minerals, lipids and protein contents in seaweeds, use of seaweeds spp. like *Ulva, Laminaria* etc, in livestock food, use in fertilizers for agriculture, textiles and plastering, and the use in alginic acid industries and medicine are discussed.

020. **Ahilan, B and K. Veeraputhiran** 1991. Breeding of fighter fish. *Seafood Export J.*, 23(2): 24-25.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : The aquarium-keeping hobby is recent in India. It is not only a means of recreation but also a source of education and employment. Much attention has been paid to ornamental fishing due to its export potential. Breeding fish in an aquarium adds greatly to the enjoyment and is not even very expensive. Equipment for breeding is usually very simple and limited breeding can be achieved with only one spare tank. This paper discusses the breeding of fighter fish and environmental conditions governing the breeding in an aquarium.

021. **Ahilan, B and M.J. Prince Jeyaseelan** 2004. Effect of bio-filter on the environmental parameters and growth of goldfish (*Carassius auratus*). *Indian J. Fish.*, 51(3): 371-374.

Address : Fisheries College and Research Institute, Tuticorin - 620 008, Tamilnadu, India.

Abstract : The investigation was aimed at determining the effect of biofilter on the environmental parameters and growth of goldfish. The goldfish were reared in the flowthrough circular cement cisterns connected with biofilter unit and without biofilter. The important environmental parameters were estimated for a period of two months. The water pH and DO levels showed diurnal variation. The mean gross fish production was higher in the tank fitted with biofilter (291g /5m^3) than the tank without biofilter (260g / 5m^3).

022. **Alagaraja, K.** 1962. Observations on the length-weight relationship of pearl oysters. *J. Mar. Biol. Ass. India*, 4(2): 198-205.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The data taken up for analysis are from Results obtained at the Pearl oyster Farm, Krusadai Island, Gulf of Mannar, and their application to problems relating to pearl fisheries in the Gulf of Mannar-Part I, by Devanesan and Chidambaram (1956), which shall hereafter be referred to simply as the Report. Several appendices of measurements and body weights are appended to this report not only for reference but also with the object of stimulating other interested workers to try and isolate more precious metal from the inadequately assayed ore. It is found from the report that the analysis done was only on age and length, age and body weight and age, length and body weight and that too limited to oysters up to the one and half year age group only. Direct analysis on length-weight relationship alone had not been attempted. Since not much of work has so far been done on the length weight relationship of Indian oysters, some of the raw data given in the report were taken up for detailed analysis in an attempt to see whether any relationship exists between length and weight and if so, whether the relationship was the same for different groups and, if different, the probable reasons for the same and also to provide a better yardstick for predicting the time for pearl fishing.

023. **Alagaraja, K and M. Srinath** 1987. Assessment of the resources of important species of catfishes. *CMFRI Bulletin*, 40: 70-87.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The stocks of the four species of catfish considered here other than *O. militaris* were under heavy fishing pressure. It is hence indicated that in order to get MSY from these stocks either the fishing pressure is to be reduced at the existing level of *'C'* (the index of the size at first capture) or the present level of *'C'* is to be increased considerably at the existing level of fishing pressure. Suggestion to increase mesh size so as to increase *'C'* may not be appreciated as the trawl fishery is mainly aimed at shrimp fishing and shrimp fishery may not be profitably exploited at the increased level of mesh size. However, effort pressure may be brought down 50 as to attain MSY from these stocks. Instead of studying catfish fishery from trawl landings in isolation, it would be better to study this fishery along with other stocks particularly the shrimps to arrive at final conclusion on the suitable levels of mesh size and effort pressure. As indicated above, so far as *O. militaris* is concerned present level of exploitation at Veraval appears to be ideal. Annual catch estimates (in tonnes) for Waltair are based on the years 1978-80, for Mandapam on 1972-'76, for Cochin on 1981, Mangalore on 1982-'83, and for Veraval on

1981 and 1982. But for Mandapam, at other centres the estimates on average annual stock and average standing stock are comparable as these are based on the recent years. For *T. thalassinus* Waltair region appears to be better when compared to other areas. However, for *T. tenuispinis* Managalore region indicates the maximum average annual stock. Regarding other species though region-wise comparison is not possible, from the present database it can be said that the Veraval region hosts *T. dussumieri* and *O. militaris* more in abundance than *T. thalassinus.* Similarly Cochin region appears to be more favourable to *T. tenuispinis* than to *T. thalassinus* and *T. serratus*.

024. **Alagaraja, K.** 1988. A brief appraisal of marine fisheries in India. *CMFRI Spec. Publ.,* 40: 101.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Using Relative Response Model and Maximum Contribution Approach, estimates on potential yield from the 0-50 m depth area of Indian coastal waters are obtained as 2.20 and 2.00 million tonnes respectively. Basing on productivity estimates, potential yield from 50-200 m depth area is expected to be one million tonnes. It is suggested that no further increase in effort at 0-50 m depth is advisable. Instead, mechanisation of indigenous craft and/or replacement of existing small mechanised ones by medium sized vessels may improve the yield to 2.00 million tonnes. In the case of 50-200 m depth, introduction of 400 large vessels of length above 10 m is suggested.

025. **Alagaraja, K.** 1994. Assessment of seacucumber resources of India. *CMFRI Bulletin,* 46: 32-33.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : Holothurian resources are of great importance, because of their export potential. Due to their restricted distribution, it is feared that these resources are over-exploited and hence size restriction has been imposed on processed material exported. This has affected the *Beche-de-mer* industry in India very much. The need for collecting basic data on catch, effort and biological details of these resources, in order to assess their resources potential, availability and level of exploitation for obtaining MSY, is emphasised.

026. **Alagarswami, K.** 1965. On pearl formation in the venerid bivalve, *Gafrarium tumidum*. *J. Mar. Biol. Assoc. India,* 7(2): 345-347.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623 520, India.

Abstract : Bolman (1941) in his work 'The Mystery of the Pearl' has elaborately dealt with all aspects of the pearl as the pearl producing molluscs, the structure of the pearl, its classification, chemical composition, culture, pearl fisheries of the world, the fossil pearls and the vegetable pearls. The marine lamellibranchs, gastropods, and freshwater bivalves of the superfamily Unionaceae are known to produce pearls in nature. Among these, the species under the genus *Pinctada* Roding are well known as the gem pearl producing molluscs and well-established and traditional fisheries exist for these species in some parts of the world. Other marine bivalve molluscs from which pearls have been obtained are *Modiolus, Mytilus, Malleus, Pinna nigra, P. squamosa, P. nobilis, Placuna placenta, Tridacna gigas, Venus margarifica* and *Ostrea edulis* (Bolman, 1941; Alexander, 1951; Cooke, 1959). Other genera which do not possess any mother-of-pearl layer, but in which sometimes porcellanous pearls are found are *Spondylus, Pecten, Anomia, Cytherea, Lutraria, Tellina, Mya, Hippopus, Solen, Arca,* and *Glycymeris* (Bolman, *op.cit.).* The present communication records a case of pearl formation in the bivalve species, *Gafrarium tumidum* Roding.

027. **Alagarswami, K.** 1966. Studies on some aspects of biology of the wedge-clam, *Donax faba* from Mandapam coast in the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 8(1): 56-75.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623 520, India.

Abstract : The environment in which the clam *Donax faba* was collected for this study has been described and the fluctuations in salinity and temperature have been recorded for the period, August 1962 to December 1963. The clam completes one year of its life at the modal size of 19.5 mm giving an average growth rate of about 1.6 mm per month. In the first four months of the second year the clam shows a growth rate of about 0.75 mm per month and attains 22.5 mm. Thereafter growth appears to be extremely slow and at the end of two years the size reached is 23.5 mm only. The life span of the species does not seem to exceed 3 years. The relationship between length and height and length and thickness are seen to be of the linear type and that between length and weight follows the cube-law. *D. faba* appears to have a prolonged breeding period extending from November to June with two spawning peaks, November-December and May-June. In clams of 10-1l mm length development of primary gonad has been observed. When the clams reach 13-14 mm they become sexually mature. A close relation has been observed between the percentage edibility and the reproductive cycle of the clam. The values

range from 7.25 to 11.98 and compare favourably with other bivalve species. The population density ranged from 89 to 217 clams per square meter.

028. **Alagarswami, K.** 1966. On the embryonic development of the squid (*Sepioteuthis arctipinnis*) from the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 8(2): 278-284.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam - 623520, India.

Abstract : The egg cluster, egg capsule, egg, developmental stages and the newly hatched young of a squid (*Sepioteuthis arctipinnis* Gould) from the Gulf of Mannar have been described.

029. **Alagarswami, K.** 1968. Pearl culture in Japan and its lessons for India. *Proc. Symp. Mollusca, MBAI.,* 3:975-993.

Address : Research Centre of Central Marine Fisheries Research Institute, Tuticorin, Tamilnadu.

030. **Alagarswami, K.** 1971. Pearl culture. *Seafood Export J.,* 3(2): 9-14.

Address : Reserach Centre of Central Marine Fisheries Research Institute, Tuticorin, Tamilnadu.

Abstract : Indian pearl oyster *Pinctada fucata* occurs in two widely separated areas, the Gulf of Mannar and the Gulf of Kutch. The pearl oyster beds on the Indian side of Gulf of Mannar exist at a distance of 12 to 20 km from the shore and at a depth of about 15 to 20 m. This resource has been the object of the famous Indian pearl fisheries conducted at Tuticorin as the base of operation.

031. **Alagarswami, K and K.A. Narasimham** 1973. Clam, cockle and oyster resources of the Indian coasts. *Proc. Symp. Living Resources of Seas around India,* pp. 648-658.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623520, India.

Abstract : India, faced with the problem of food shortage as it is, has since two decades, been systematically investigating and harvesting the resources of the seas around her with a view to augmenting her food production. But the emphasis laid has been mostly on fishes, and the molluscan shellfish in general have not been given due attention. Besides forming food, the molluscs are a useful source in making lime, mortar and cement for the house building industry and as ornaments and curios. This is a source where relativity little investment can bring in high returns. Among the edible mollusks, clams and oysters abound our coasts. Though the biology of *K. marmorata, Solen kempi, Donax cuneatus, D. faba, Gafrarium tumidum, Anadara granosa* and a few others has been studied from different areas, data on the exploited and potential resources have not been adequately obtained. In the present paper the distribution of clam, cockle and oyster resources of the Indian coasts, including the estuarises and backwaters, based on a survey conducted along the east and west coasts and the published data has been dealt with. The present level of harvesting is given and the scope for future exploitation is indicated. The need for starting systematic culture of these species as well as simple transplantation to bring new areas into production is stressed. The need for educating the public on the food value of the molluscs is also pointed out. This article cannot be said to cover all the above aspects in great detail but it attempts to highlight the importance of the edible bivalve resources in the present situation.

032. **Alagarswami, K and S.Z. Qasim** 1973. Pearl culture - Its potential and implications in India. *Indian J. Fish.,* 20(2): 533-550.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Pearl fisheries of India are of ancient origin. The pearl oyster resources are located mainly in the Gulf of Kutch and Gulf of Mannar. They are subjected to wide fluctuations from year to year, particularly when they are exploited for natural pearls. In 1972, Veppalodai near Tuticorin, was selected as a site for conducting experiment on Pearl oyster farming and on the development of cultured pearls. Modern method of Raft culture was adopted for raising mother oysters. This method proved successful despite the trying sea conditions prevailing during the monsoon months. The potential and implications of pearl culture in India have been discussed in relation to the situations prevailing in the pearl culture industry of other parts of the world.

033. **Alagarswami, K., P. Bensam, M.E. Rajapandian and A. Bastin Fernando** 1973. Mass stranding of pilot whales in the Gulf of Mannar. *Indian J. Fish.,* 20(2): 269-279.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin, India.

Abstract : Many Indian pilot whales, *Globicephala macrorhyncha,* were stranded in a shallow bay in the Gulf of Mannar at Manapad on 14th Jan'73. This is the second recorded instance of stranding of pilot whales on the

Indian coast, in which a casualty of 147 individuals had average range of 220-575 cm. The morphological and diagnostic skeletal features were discussed.

034. **Alagarswami, K.** 1974. Development of Cultured pearls in India. *Curr. Sci.,* 43: 205-207.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin, India.

Abstract : The technology of production of spherical cultured pearls was first developed in Japan in 1907. In Australia, the first experimental production of cultured pearls was reported in 1957. In India, experiments to produce cultured pearls commenced in 1933, but despite prolonged efforts were not successful. The present author, in an earlier communication, described the pearl culture technology of Japan and indicated the prospects of producing cultured pearls in the Indian pearl oyster, *Pinctada fucata*. The successful development of the technology, for the first time in India, is described in this article.

035. **Alagarswami, K. and S.Z. Qasim** 1974. What are pearls and how are these produced? *Seafood Export J.,* 6 (1) : 1-10.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : A pearl is a gem and there is no place better known for pearls than the neck of a beautiful woman. In early poetic collections of Tamil literature, the beauty of Indian pearls has been mentioned so forcefully that pearls formed one of the earliest objects of India's foreign trade with Egypt, Rome, Greece and China. The ancient Indian sculptures depict Indian women wearing pearls on their body. Pliny, the famous Roman naturalist and philosopher (1st century A.D.) mentions that the wealth of Roman Empire was drained by the habit of Roman women who wore pearls not only on their person but also on their shoes. The old Tamil and Sanskrit literature has been profusely documented with the beauty and preciousness of pearls as gems or jewels.

036. **Alagarswami, K**. 1975. Preliminary study on the growth of cultured pearls. *Indian J. Fish.,* 22(1&2): 300-303.

Address : Research Centre of Central Marine Fisheries Rersearch Institute, Tuticorin, India.

Abstract : Preliminary study on the growth rate of cultured pearls at Veppalodai, Tuticorin, suggests that the time taken for the production of a pearl of comparable size is considerably less in the Indian waters than in the temperate areas of pearl culture.

037. **Alagarswami, K and G.S. Sivarajan** 1975. Surgical equipment for pearl culture. *Indian J. Fish.,* 22(1&2): 231-235.

Address : Research Centre of Central Marine Fisheries Rersearch Institute, Tuticorin, India.

Abstract : Special types of surgical instruments required in pearl culture have been developed. The paper describes the equipment and the process of manufacture. It also deals briefly with their uses in the preparation of tissue grafts and in the operation for nucleus insertion.

038. **Alagarswami, K.** 1976. Results of multiple implantation of nuclei in production of cultured pearls. *Indian J. Fish.,* 21(2): 601-604.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, TIndia.

Abstract : Multiple implantation of shell-bead nuclei in the pearl oyster *Pinctada fucata* enhances the rate of production of cultured pearls. From two to five pearls have been produced in individual oysters in experiments carried out at Tuticorin. The rate of retention of nuclei is comparable with single implantations. While the average production with reference to the number of oysters employed is 62.8% in single implantations, it is 80.6% in multiple implantations. Besides single pearls, clusters (twins and triplet) have been obtained. The growth of pearls is as good in multiple-pearl production as in single-pearl production.

039. **Alagarswami, K and A.C.C. Victor** 1976. Salinity tolerance and rate of filtration of the pearl oyster *Pinctada fucata*. *J. Mar. Biol. Assoc. India,* 18(1): 149-158.

Address : Central Marine Fisheries Research Institute, Tuticorin, Tamilnadu, India.

Abstract : Salinity tolerance and rate of filtration of the pearl oyster *Pinctada fucata* were studied during 1975-77. The oysters were experimented in salinities ranging from 14 to 58‰. Although a truly marine form, the pearl oyster has been found to tolerate a wide range of salinity from 24 to 50‰ for short durations of 2-3 days. Salinities below and beyond the above range caused mortality of oysters. The rate of mortality in the dilutions of 16, 15 and 14‰ were 10, 50 and 100% respectively and mortality in higher concentrations of 52, 55 and 58‰

were 67, 100 and 100% respectively. In the normal sea water (salinity 34‰) the removal of neutral red in solution was 52.1 % in 2 hours and 92.6 % in 8 hours. The rate of filtration was low in dilutions and the total filtration was below 25 % in the salinities of 14 and 20‰ in the higher concentrations, filtration was 49.5, 53.7 and 41.8 % in the salinities of 44, 50 and 57‰ respectively at the end of 4 hours. In the Gulf of Mannar, where a pearl culture farm is located, the normal salinity range during 1974-76 was 32.15-35.58 ‰. An unusual incidence of dilution of sea water down to 15.69‰. occurred in the farm at Veppalodai in November 1977 due to heavy rain fall and floods in the rivers caused by an active north-east monsoon. However, this did not affect the oysters as the low saline condition did not last for more than a day.

040. **Alagarswami, K and A. Chellam** 1976. On fouling and boring organisms and mortality of pearl oysters in the farm at Veppalodai, Gulf of Mannar. *Indian J. Fish*., 23(1&2): 10-22.

Address : Research Centre of Central Marine Fisheries Rersearch Institute, Tuticorin, India.

Abstract : Pearl oysters of the species *Pinctada fucata* were reared in the Gulf of Mannar, off Veppalodai, by raft culture, for production of cultured pearls. Observations revealed a heavy growth of fouling and boring organisms on the pearl oysters, necessitating frequent shell-cleaning operations. Barnacles, bryozoans and spats of molluscs, *Avicula* and *Crassostrea* were the significant fouling organisms, and a seasonal trend was observed in their dominance. The spionid polychaete *Polydora* and the clionid sponge *Cliona celata* were the important boring organisms causing considerable damage to the shells. Infection by polychaetes, as observed from the blisters and tumour like growths on the inner aspect of the shells, was 78.4% and by sponge 20.7% among the shells examined. During the period from January 1973 to December 1974, the monthly rate of mortality of oysters varied from 0.9% to 27.5%. This generally followed the trend of fluctuations in average volume of fouling and barnacle load on the oysters. Mortality of two pearls were observed, which coincided with the northeast and southwest monsoons respectively. Possible remedial measures against some of the fouling and boring organisms have been indicated.

041. **Alagarswami, K and A. Chellam** 1977. Change of form and dimensional relationship in the pearl oyster *Pinctada fucata* from Gulf of Mannar. *Indian J. Fish.*, 24(1&2): 1-14.

Address : Research Centre of Central Marine Fisheries Rersearch Institute, Tuticorin, Tamilnadu, India.

Abstract : Samples of the pearl oyster, *Pinctada fucata* collected from Tholayiram, Pulipundu and Kudamuthu paars in the Gulf of Mannar were analysed to study the relationship among the linear dimensions, namely dorsoventral measurement, hinge length, anteroposterior measurement and thickness. A change to form occurs from subquadrate in the young to oblong in the adult oysters. The hinge length is about 1.22-1.26 times the dorsoventral dimension in the youngest size group, but both become equal at a size of about 35 mm. Thereafter, the dorsoventral dimension is always greater than the hinge line. The length-weight relationship is described by the equation $W = 0.00001447\ L^{3.042826}$ where W is the weight and L is the dorsoventral measurement of the pearl oyster. The equation holds good for the entire range of sizes, unlike in the case of the relationship among the linear dimensions.

042. **Alagarswami, K.** 1983. A critical review of progress and problems of pearl culture in India. *Proc. Symp. Coastal Aquaculture,* 2: 574-583.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A major breakthrough was achieved when techniques for the production of cultured pearls in the pearl oyster *Pinctada fucata* were successfully developed for the first time in 1973 at the Central Marine Fisheries Research Institute. Since then progress has been made in several biological and technical areas of pearl culture. Training programmes have been conducted to extend the know-how to the maritime States and Union Territories. The paper recapitulates the recent achievements in pearl culture in India and identifies the areas which require a major thrust to strengthen the technological base. It also outlines the immediate prospects for the development of a pearl culture industry in the country.

043. **Alagarswami, K., S. Dharmaraj, T.S. Velayudhan, A. Chellam and A.C.C. Victor** 1983. Embryonic and early larval development of pearl oyster *Pinctada fucata* (Gould). *J. Mar. Biol. Assoc. India*, 6: 598-603.

Address: Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract: Hatchery production of seed is of great importance in aquaculture, particularly in situations where availability of natural seed is undependable. Besides, the system provides advantages of selective breeding keeping in view the genetic factors. Commercial hatcheries already sustain large-scale production of edible

oysters in several countries. Since the natural production of pearl oysters in the pearl banks of the Gulf of Mannar is characterised by very wide fluctuations, ability to produce pearl oyster seed through hatcheries is of great practical importance for the development of pearl culture industry in India. A major research effort is, therefore, being devoted to this problem. A number of experiments on spawning and rearing of *Pinctada fucata* larvae were conducted during 1978-79. The eggs, measuring 47.5µ develop into straight-hinge veligers of 67.5 x 52.5µ size in 20 hours 40 minutes after fertilisation. The paper describes the different stages of the development of *P. fucata* from fertilisation to the straight-hinge larvae as obtained during the period of study.

044. **Alagarswami, K., S. Dharmaraj, T.S. Velayudhan, A. Chellam, A.C.C. Victor and A.D. Gandhi** 1983. Larval rearing and production of spat of pearl oyster *Pinctada fucata* (Gould). *Aquaculture*, 34: 287-301.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Indian pearl oyster *Pinctada fucata* was spawned in the laboratory and the larvae were successfully reared to spat setting under tropical conditions. The larvae grow through the straight-hinge, umbo, eyespot and pediveliger stages in the pelagic phase before metamorphosing to plantigrade and settling on a substratum as spat, and these stages are described. Large differences were noticed in larval growth within and between four rearing experiments. *Isochrysis galbana* was used as standard food throughout larval rearing at a cell concentration range 80–350 ml. Spatfall occurred on day 24–32 on a variety of substrata. The highest density of 4.71/cm^2 was observed on fibreglass tank bottom. Growth of *P. fucata* larvae appears to be a step function, and that of spat up to 13 weeks describes a curvilinear form.

045. **Alagarswami, K., S. Dharmaraj, T.S.Velayudham, A. Chellam A.C.C. Victor and A.D. Gandhi** 1983. On controlled spawning of Indian pearl Oyster *Pinctada fucata* (Gould). *Proc. Symp. Coastal Aquaculture, MBAI.*, 2: 590-597.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Induced spawning of pearl oysters serves a dual purpose in pearl culture. Besides providing the gametes for the hatchery production of seed, it conditions the oyster for nucleus insertion for the production of cultured pearls. Experiments were conducted on induction of spawning in *Pinctada fucata* using hydrogen peroxide, Tris buffer, sodium hydroxide and combinations of hydrogen peroxide + Tris/NaOH. In other experiments ammonium hydroxide (N/l0) was injected into the adductor muscle or foot of the oyster. Thermal stimulation was also attempted. Spawning response to H_2O_2 treatment was not quite satisfactory. Concentrations of 3-6 mM peroxide was found to evoke some response. Hydrogen peroxide in alkaline medium using Tris gave slightly better results. Tris-buffered sea water with a pH of 9.0 by itself was found to induce 78.6% of the pearl oysters to spawn. Similarly, the alkaline sea water medium with NaOH stimulated spawning in 68.4% of the oysters at pH 9.5. Injections of 0.2 ml of N/10 NaOH resulted in the spawning of 48.1% of the treated oysters. Thermal stimulation by raising the sea water temperature from 28.5°C to 35.0°C, gave good results on the occasion when 87.5% of the oysters spawned. But in several other experiments the response was either nil or poor. The present study has indicated that an alkaline seawater medium (pH 9.0-9.5) would be useful for the controlled spawning of the Indian pearl oyster.

046. **Alagarswami, K., A. Chellam, A.C.C. Victor, S. Dharmaraj and T.S. Velayudhan** 1987. Pearl oyster resources of India. *CMFRI Bulletin*, 39: 37-48.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : An account is given of the pearl oyster (*Pinctada* species) resources of India. The findings of a survey conducted on the oyster beds in the Gulf of Mannar during 1975-86 are examined and population parameters of the oyster discussed.

047. **Alagarswami,K.** 1987. Progress of research under Scheme on Pearl Culture,1974-78. *CMFRI Bulletin*,39:116-119.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : A summary is given of results obtained during implementation of the Pearl Culture Scheme by the government of Tamilnadu during the period 1974-78. Progress in the following aspects of pearl culture is examined: farm establishment; oyster rearing at Tuticorin; farming at Krusadai Island; utility of oysters; planktonology and hydrology of farm area; growth studies; bivalve larvae isolation and rearing; fouling and boring communities; spat collection; nucleus implantation in culture pearl production; indigenous nuclei production; use of Japanese nuclei and instruments for implantation work.

048. **Alagarswami, K and P.V. Sreenivasan** 1987. Chromosome complement of the Indian pearl oyster *Pinctada fucata*. *Indian J. Fish.,* 34(1): 102-104.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : The chromosome number (n=14, 2n=28) of the Indian pearl oyster, *Pinctada fucata* (Gould) is reported for the first time. It conforms with the chromosome no. reported for *P. fucata martensii* from Japan and *P. imbricata* from the Atlantic. It is suggested that as in the cases of *Crassostrea* spp., Genus *Pinctada* may exhibit coservativeness in chromosome number.

049. **Alagarswami, K., A. Chellam, A.C.C. Victor, S. Dharmaraj and T.S. Velayudhan** 1988. Status of the Pearl oyster population in the Gulf of Mannar. *CMFRI Bulletin,* 42(1): 71-78.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The five volumes of Herdman (1903-1906) on the "Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Mannar" and the treatise of Hornell (1922) on "The Indian pearl fisheries of the Gulf of Mannar and Palk Bay" are the works of scientists who had mastery over the subject of pearl fisheries of the Gulf of Mannar on both the Indian and Sri Lankan sides. Subsequent to 1922 the only major contributions, aside the routine survey, have been the use of dredge for fishing of pearl oysters on the Sri Lankan side (Sivalingam 1958) and the survey and charting of "Pearl and chank beds of Gulf of Mannar" on the Indian side by Baschiere-Salvadori and his Indian associates introducing SCUBA-diving for the first time as reported in First through Third Report to the Government of India (FAO 1960, 1962 a, b, Mahadevan and Nayar 1967).

050. **Alagarswami, K.** 1988. Culture techniques and production rates of molluscs in India. *CMFRI Bulletin,* 42(2) : 239-246.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The estimated world production through aquaculture in 1975 was 6.1 million tons, of which the molluscs formed 16.2% (Pillay, 1979). The production of oysters in the above was 591,386 t, mussels 328, 517 t, clams 38,851 t, scallops 62,600 t. and cockles and other molluscs 29,987 t, totalling to 1,051,341 t. In 1980, the estimated world aquaculture production was 8,707,363 t to which the molluscs contributed 3,196,308 t or 36.7% of the total production (Alagarswami, 1986). The production of molluscs in a five-year period appeared to have trebled, whereas the overall increase of fish, shellfish and seaweeds put together has been only 42.7%. The world aquaculture production figures have been cited here only to indicate the aquaculture species group, on which the scope lies for future expansion. Nutritionally speaking, the yield of high-quality protein by bivalves per hectare of surface sea water far exceeds the protein that could be produced on a hectare of land by any known terrestrial plant or animal (Hulse, 1982). But economically speaking, culture of bivalves may not be as attractive as shrimp farming or culture of some choice finfish species.

051. **Alagarswami, K and M.M. Meiyappan** 1988. Prospects for increasing cephalopod production of India. *CMFRI Spec. Publ.,* 40: 21-22.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : From the order of a 1000 tonnes in 1973, the cephalopod production has risen to the order of 30,000 tonnes in 1985. With aimed fishing, it is certainly possible to increase production of squids and cuttlefishes from the presently exploited zone. Under the aegis of the Marine Products Export Development Authority, certain actions have been initiated in this direction in the recent past at experimental fishing level. Squid and cuttlefish resources in the neritic waters appear to be substantial. Octopus production reported from Lakshadweep is very nominal, being about 14 tonnes/annum. Scope, if any, for improving this production and exploring new grounds needs detailed investigation. From the oceanic waters of EEZ and beyond, the prospects are for the oceanic squids, considered next only to the tuna resources in importance.

052. **Alagarswami, K and M.M. Meiyappan** 1988. Prospects and problems of management and development of the marine molluscan resources (other than cephalopods) in India. *CMFRI Spec. Publ.,* 40: 39-40.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : India has a large variety of molluscan resources in the coastal waters and in the estuaries and backwaters. The clam resources consisting of *Meretrix*, *Katelysia*, *Paphia*, *Anadara*, *Villorita* and others have been exploited by fisherfolk from time immemorial for food as also for their shells. Perna forms a moderate resource which is under intense exploitation in certain regions. Oyster resources (*Crassostrea*) are not extensive but collected here

and there. Placenta is restricted in its distribution but is well exploited.

053. **Alagarswami, K and M.M. Meiyappan** 1989. Prospects for increasing cephalopod production of India. *CMFRI Bulletin,* 44(1): 146-155.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : From the order of a 1000 tonnes in 1973 the cephalopod production has risen to the order of 43,000 tonnes in 1986. With aimed fishing, it is certainly possible to increase production of squids and cuttlefishes from the presently exploited zone. Under the aegis of the Marine Products Export Development Authority certain actions have been initiated in this direction in the recent past at experimental fishing level. Going by the data of some of the chartered fishing vessels that operated in the Indian waters during the last five years, squid and cuttlefish resources in the neritic waters appear to be substantial. Octopus production reported from lakshadweep is very nominal being about 16 tonnes per annum. Scope if any, for improving this production and exploring new grounds needs detailed investigation. From the oceanic waters of EEZ and beyond the prospects are for the oceanic squids, considered next only to the tuna resources in importance. However, the information on the resource is more of a qualitative and indicative nature from the operation of research vessels in the Arabian Sea such as R.V. Varuna and R.V. Shaya Mary and presently FORV Sagar Sampada. In the above background, the paper discusses the research and development needs for increasing production of cephalopods in India and suggests an organised cooperative programme among the governmental agencies concerned on the one hand and the industry on the other.

054. **Alagarswami, K and M.M. Meiyappan** 1989. Prospects and problems of management and development of the marine molluscan resources (other than cephalopods) in India. *CMFRI Bulletin,* 44(1): 250-261.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Typical of tropics, India has a large variety of molluscan resources in the coastal waters and in the estuaries and backwaters. The clam resources consisting of species of *Meretrix, Katelysia, Paphia, Anadara, Villorita* and others have been exploited by the fisherfolk from time immemorial for food as also for their shells. Subsoil deposits of shells form a major resource in some of the estuaries and backwaters. The sea mussel *Perna* forms a moderate resource which is under intense exploitation in certain regions. Oyster resources (*Crassostrea*) are not extensive but collected here and there. Windowpane oyster *Placenta* is restricted in its distribution but is well exploited. The pearl oyster resource has been unproductive since the early sixties. The gastropod resources consist mainly of *Xancus, Turbo* and *Trochus,* which are confined to certain regions and are heavily exploited. Other ornamental gastropods used in shell craft industry are thinly spread out. Deep-sea molluscan resources, if any are not known except *Pirufa.* Owing to man made changes including pollution, the distribution and abundance of the molluscan resources, especially those in the estuaries and backwaters, have changed and will be subject to further change, if left unchecked. The level of exploitation has also advanced from subsistence to mechanised operation, though on a small scale on certain resources for industrial uses. During the last five years export of frozen clam meat has increased. Some of the molluscs are emerging as source material for bioactive substances. Taking an overall view of these changes and their probable effects on the resources, the future of the molluscan resources, which were once considered substantial does not appear to be encouraging unless management and conservation measures are evolved and implemented. Many States have considered the shells as a mineral resource and are operating them under leasing/licensing arrangements. Based on the available data on exploitation of shellfish resources an attempt has been made to estimate the all-India production of molluscs which approximates to about 70,000 t per annum (excluding cephalopods). The paper lays stress on adopting a national policy on management and development of the shellfish resources and bringing them under the mainstream of fisheries development programmes. Resource inventory, environmental monitoring, depuration of shellfish, transplantation, sea-ranching, market research and screening for bioactive substances are indicated as future research and development needs. Management measures required are outlined as legislation on shellfisheries, holistic review of leasing policies of State Governments and control on export of clams and ornamental molluscs.

055. **Alagarswami, K., S. Dharmaraj, A. Chellam and T.S. Velayudhan** 1989. Larval and juvenile rearing of black-lip pearl oyster, *Pinctada margaritifera* (Linnaeus). *Aquaculture,* 76(1&2): 43-56.

Address : Central Institute of Brackishwater Aquaculture, 12 Leith Castle St., Santhome, Madras 600028, India.

Abstract : The black-lip pearl oyster, *Pinctada margaritifera*, has been cultured in the experimental shellfish

hatchery at Tuticorin, India. The flagellates *Isochrysis galbana* and *Pavlova lutheri* were used independently as larval food at a concentration of 5 cells/ ml up to day 5 and the ration was doubled thereafter until spat setting. *I. galbana* promoted faster growth and early spat setting as compared to *P. lutheri*. 6.3% of the initial larval population metamorphosed as spat. Juveniles cultured in the laboratory showed a growth rate of 0.09 mm/day. On transplantation to the culture raft in the farm, growth rate increased to 0.4 mm/day. The juveniles suffered heavy mortality after 4 months. It remains to be tested whether *P. margaritifera* juveniles would have a greater chance of survival in oceanic Island conditions, as the natural distribution of the species in India is confined to the Andaman and Nicobar Islands.

056. **Alagarswami, K.** 1991. *Production of cultured pearls.* Indian Council for Agriculture and Research Publications, New Delhi, 111 pp.

057. **Alagarswami, K and A. Krishnan** 1993. Studies on larval nutrition in the pearl oyster *Pinctada fucata*. *CMFRI Spl. Publ.*, 56: 29-34.

058. **Alavandi, S.V., B.P. Gupta, K.O. Joseph, K.K. Krishnani, M. Muralidhar, G. Sivakumar and P.S. Susheesh** 2003. Observations on soil, water and biological conditions of shrimp farms. *Appl. Fish. Aquac.*,3(1&2): 13-17.

Address : Central Institute of Brackishwater Aquaculture, 75, Santhome High Road, R.A. Puram, Chennai - 600 028, India.

Abstract : In the present study, three shrimp farms were selected along the Kandaleru creek at Pudiparthi area of Nellore District of Andhra Pradesh and one seawater based farm at Tharuvaikulam area of Tuticorin, Tamil Nadu, India where shrimp culture was being practiced. Samples of soil, water, plankton and benthos were collected from the shrimp culture ponds at monthly intervals during the culture period. The soil and water quality parameters were found to be within safe permissible levels. Textural class of soil was sandy clay loam and clay loam, which are suitable for brackishwater aquaculture. Plankton bloom and benthos at both the places were moderate. The bacterial population in water in shrimp farm was found to be relatively very high at the time of harvest period (235 nos. x $10^4 ml^{-1}$) than during the culture (31-77 nos. x 10^4 ml^{-1}) and the population of bacteria in the soil sample was higher during culture period (44-57 nos.x 10 10^4 ml^{-1}) than at the harvest time (26 nos.x 10 10^4 ml^{-1}).

059. **Alikunhi, K.H.** 1942. Notes on the occurrence of Archiannaelids at Krusadai Island together with a description of an undescribed species of *Saccocirrus*. *Proc. 29th Indian Sci. Congr.*, 3:140.

060. **Alikunhi, K.H.** 1942. On some archiannelids of the Krusadai Island. *Proc. Nat. Inst. Sci. India*, 14: 373-383.

061. **Alikunhi, K.H.** 1943. Note on the consequence of Archiannelids at Krusadi together with description of an undescribed species of *Asccocirrus. Proc. 29th Indian Sci. Congr.* pp 149.

062. **Amala Jayaseeli, A., T. Prem Anand and A. Murugan** 2001. Antibacterial activity of four bivalves from Gulf of Mannar. *Phuket Mar. Biol. Cent. Spl. Publ.*, 25(1): 215-217.

Address : Sugandhi Devadason Marine Research Institute, 44, Beach Road, Tuticorin, India.

Abstract : Four filter feeding bivalves, *Donax faba, Dosinia modesta, Circe scripta* and *Gafrarium pectinatum* were screened for antibacterial activity. The whole body ethanol, heptane and water extracts were prepared and tested against nine pathogens, viz. *Staphylococcus aureus, Klebsiella pneumoniae, Salmonella typhi, Escherichia coli, Bacillus subtilis, Proteus vulgaris, Proteus mirabils, Vibrio cholerae* and *Shigella flexneri*. The ethanol extract of *Circe scripta* showed prominent activity against *Bacillus subtilis*. The ethanol extract of *Gafrarium pectinatum* exhibited activity against *Proteus vulgaris*. The heptane extract of *Donax faba, Gafrarium pectinatum,* and *Dosinia modesta* exhibited significant activity against *Vibrio cholerae*. The water extract of *Circe scripta* showed significant activity against all nine pathogens. In general, the water extracts showed wide spectral activity against all nine pathogens and further isolation of active compounds is in progress.

063. **Amala Jayaseeli, A and A. Murugan** 2002. Mangrove in Punnakayal, Tuticorin, Southeast coast of India: A study on socioeconomic conditions. *SDMRI Res. Publ.*, 2: 69-72.

Address : Sugandhi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: antoamalajaya@yahoo.co.in

Abstract : A survey was carried out to assess the socioeconomic status of the people depending on Mangroves

in Punnakayal, south of Tuticorin in Gulf of Mannar region. Information regarding the family, educational status, occupation, fishing including craft and gear, marketing, village infrastructure, etc., were collected through personal interviews of the village leaders, members of the fishermen society, middlemen and the fishermen. The mangroves in Punnakayal are predominantly occupied by *Avicennia* sp. Due to high saline conditions and lack of freshwater inflow except during the monsoon, the *Avicennia* sp appears as a bushy plant. Around 80 families depend on the mangroves for their livelihood. About 50 men are involved in fishing activities in the mangrove area and about 30 women are involved in collecting firewood from the mangrove. The mangrove destruction is estimated to be at a higher rate. Awareness creation is considered very much necessary among the villagers in order to conserve the mangroves from destruction and to safeguard its resources for posterity. Replantation of the mangrove is another option, which has to be considered after studying natural regeneration and have to be carried out with the participation of the local people.

064. **Amala Jayaseeli, A and A. Murugan** 2003. Diversity of bivalve in Tuticorin coast of Gulf of Mannar: Resources status and exploitation. *SDMRI Res. Publ.*, 3: 137-141.

Address : Sugandhi Devadason Marine Research Institute, 44- Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: antoamalajaya@yahoo.co.in

Abstract : Seventy seven species of bivalves belonging to 2 subclasses, 5 orders and 21 families were collected from Tuticorin coast of Gulf of Mannar. The order Veneroida was found dominant. *Donax* sp. belonging to family Donacidae is abundant throughout Tuticorin Coast, Tamil Nadu, India. The survey has indicated the main use of these bivalves as food, source of lime and for ornamental purpose. About 300 men are involved as middlemen in seashell trade and about 30-35 women are engaged in bivalve collection.

065. **Amalore, E.** 1981. Kattumarams, remarkable craft which account for 70% of Tamil Nadu's marine fish catch. *Bay of Bengal News*, (Sep' 1981). p. 8.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : In the Gulf of Mannar area, near the Cape comorin region, boat Kattumarams are in use. The Palk Bay and the Gulf of Mannar are sheltered areas from where the fishermen operate their indigenous canoes or vallams. Two distinct types of Kattumarams are used in Tamil Nadu. They are raft and boat kattumarams.

066. **Ambrose Fernando, S.** 1966. Cure dried fish trade with Ceylon. *Seafood Exporter*, 1(1): 21-22.

067. **Ameer Hamsa, K.M.S.** 1972. Foraminifera of the Palk Bay and Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 14(1): 418-423.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu India.

Abstract : In this study of Foraminifera, 12 spp have been described and illustrated along with a list of 34 spp reported from the beach sands of Palk Bay and Gulf of Mannar. This includes 6 new records from the Indian region. Details regarding the morphology of the test and the world-wide distribution of the different spp have been given. Of the 34 spp, the diagnostic characters of 12 spp, which are of special interest, have been included along with illustrations. Of the 12 spp described, 6 spp in the following list are recorded for the first time from the Indian coasts: (*Marginulina cf. crepidula, Elphidium frigidum, Rosalina concinna, Asterorotalia pulchelia, Pararotalia armata,* and *Amphistegina gibbosa*).

068. **Ameer Hamsa, K.M.S and M.N. Kutty** 1972. Oxygen consumption in relation to spontaneous activity and ambient oxygen in five marine Teleosts. *Indian J. Fish*., 19(1&2): 76-85.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu India.

Abstract : Some metabolic adaptations of 5 species of south Indian marine teleosts, namely *Caranx carangus* (Bloch), *Chorinemus lysan* (Forskal), *Chanos chanos* (Forskal), *Synagris furcosus* (Day) and *Gerres lucidus* (Day) were studied. The fishes were acclimated to and tested in average temperature of 30°C and 35‰ salinity.

069. **Ameer Hamsa, K.M.S.** 1973. Abnormality in the right chela of the Portunid crab, *Portunus pelagicus* Linnaeus. *Indian J. Fish*., 20(1): 231-232.

070. **Ameer Hamsa, K.M.S and P. Nammalwar** 1977. Some planktonic foraminifera from the Gulf of Mannar. *Indian J. Fish*., 24(1&2): 232-237.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Seven species of planktonic foraminifera collected at a depth of 180 fathoms off Mandapam in the Gulf of Mannar are recorded for the first time from Indian waters. They are (1) *Orbulina bilobata* (d'Orbigny), (2) *Globigerina triloculinoides* Plummer, (3) *G. parava* Bolli, (4) *G. protolata* Bolli, (5) *Globorotalia pseudobulloides* (Plummer) (6) *Globorotalia pseudomenardii* Bolli and (7) *Globorotalia opima* Bolli. These are pelagic forms, which are found to be abundant in the tropical warm waters at great depths. Details regarding the morphology and the distribution of the species have been given.

071. **Ameer Hamsa, K.M.S.** 1978. On the meat content of *Portunus pelagicus* with some observations on lunar periodicity in relation to abundance, weight and moulting. *Indian J. Fish*., 25(1&2): 165-170.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu India.

Abstract : Study shows that the male crabs of *P. pelagicus* contain more meat than females. Crab catches were relatively good during the new moon phase than during the full moon phase. The variation in the weight of *P. pelagicus* during the 2 moon phases is much less. The recently moulted crabs in the commercial catches were relatively more during the new moon phase than in full moon period.

072. **Ameer Hamsa, K.M.S.** 1978. Fishery of the swimming crab *Portunus pelagicus* Linnaeus from Palk Bay and Gulf of Mannar. *Indian J. Fish*., 25(1&2): 229-233.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu India.

Abstract : Fishery of *P. pelagicus* along the Palk Bay and Gulf Mannar is by a type of gill net locally known as Nandu valai . They are also caught in large numbers in trawls operated by mechanised boats. The monthly catch per unit effort at the 3 major crab fishing centres Devipattanam, Vedalai and Mandapam is estimated for 3 yr and Vedalai is found to be the most productive centre for crabs. Some information regarding the marketing, disposal, longevity of life outside seawater and sound production are also given.

073. **Ameer Hamsa, K.M.S.** 1978. Chemical composition of the swimming crab *Portunus pelagicus* Linnaeus. *Indian J. Fish*., 25(1&2): 271-273.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu India.

Abstract : The results of the biochemical analyses (moisture, ash, fat and protein) of the male and female crab of *P. pelagicus* with shell and meat are given. The differences in the composition between the whole crab and edible meat and the economic uses of crab are also given.

074. **Ameer Hamasa, K.M.S and V. Gandhi** 1978. Foraminifera collected off Mandapam (Gulf of Mannar). *J. Mar. Biol. Assoc. India*, 20(1&2): 162-166.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This note deals with the recent foraminifera from the mud samples collected at 200 m off Mandapam (Gulf of Mannar). Fourteen species belonging to 11 genera and 8 families are described and illustrated, of which 4 species are new records. Foraminiferan species recorded for the first time from the Indian region are (1) *Bulimina elegans* d' Orbigny var. *exilis* H.B. Brady, (2) *Bolivina subtenuis* Cushllan, (3) *Bolivina subreticulata* Parr and (4) *Streblus catesbyanus* (d' Orbigny).

075. **Ameer Hamsa, K.M.S.** 1979. On the moulting of *Portunus pelagicus* Linnaeus. *Indian J.Fish.*, 26(1&2):247-249.

Address : Regional Centre of Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, India.

Abstract : Some interesting information on the moulting of laboratory-reared crabs of *Portunus pelagicus* Linnaeus are given with illustrations.

076. **Ameer Hamsa, K.M.S.** 1982. Observations on moulting of crab *Portunus pelagicus* Linnaeus reared in the laboratory. *J. Mar. Biol. Assoc. India*, 24(1&2): 69-71.

Address : Central Marine Fisheries Research Institute, Research Centre, 90 N. Beach Rd., Tuticorin-628 001, India.

Abstract : Young crabs of *Portunus pelagicus* of the size group between 11 and 44 mm in carapace width were collected from the inshore waters off Mandapam and were reared. Crabs measuring between 11 and 25 mm in carapace width attained marketable size of 140-145 mm at the twelfth moult after a period of fourteen months. Moulting occurred frequently in the young crabs measuring between 11 and 75 mm and thereafter, the interval between the two successive moults increased. The weight of the reared crabs at different sizes was comparable to that of freshly caught from the sea. Regeneration of chelipeds and legs was studied in *P. pelagicus* by removing a single appendage at one time. After about 4 to 7 days rudiment appendage was found to develop from the base and it completely regenerated to normal size at the next moult.

077. **Ameer Hamsa, K.M.S and G. Arumugam** 1982. A record of the snake mackerel *Gempylus serpans* Cuvier from Gulf of Mannar. *Indian J. Fish.*, 29(1&2): 255-257.

Address : Central Marine Fisheries Research Institute, Research Centre, 90 N. Beach Rd., Tuticorin-628 001, India.

Abstract : A snake mackerel *Gempylus serpans* Cuvier (837 mm in total length) has been collected from Podivalai (drift net) on 22nd June 1982 from Kayalpattinam (Lat 8° 34'N, Long. 78° 07'E) and reported, this being the first record of the species from Gulf of Mannar.

078. **Ameer Hamsa, K.M.S., M. Najimuddin and P. Nammalwar** 1986. Oxygen consumption of the young ridley turtle *Lepidochelys olivacea* (Eschscholtz). *Symp. Ser. Mar. Biol. Assoc. India*, 6: 1295-1298.

Address : Central Marine Fisheries Research Institute, Research Centre, 90 N. Beach Rd., Tuticorin-628 001, India.

Abstract : The metabolic rates (oxygen consumption) and corresponding activity were studied in young *Lepidochelys olivacea*. Experiments were also conducted to study the influence of ambient oxygen on activity and oxygen consumption. The turtles of the size group between 67 and 95 mm in carapace length (curved) were acclimated and tested at an average temperature of 30°C and 30.37 ppt salinity. Immediately after handling, the metabolic rates and corresponding activity were found to be as high as 1110.13 mg/kg/hour and 24 L/15 min. The asphyxial oxygen level ranged between 4.15 and 4.84 mg/l.

079. **Ameer Hamsa, K.M.S and H. Mohamed Kasim** 1989. Some aspects of morphometric relationship and food and feeding in *Caranx carangus* (Bloch) from Tuticorin waters (Gulf of Mannar). *Indian J.Fish.*, 36(3): 205-210.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : The paired comparisons of morphometric characters of *Caranx carangus* reveal that all the four variables; for length, body depth, eye diameter and wet weight have a very high significant relationship with total length. Regression equations are given for the four pairs of comparisons, along with the correlation coefficient 'r' and students 't'. The food and feeding study reveals that the dominant food was fish followed by crustaceans like prawns and crabs. Stolephorus was the dominant food and well preferred by *Caranx carangus*, followed by sardines, Leiognathus, *Metapenaeus* spp., Thrissocles, *Penaeus indicus* and *Portunus pelagicus* as indicated by the index of preponderance. Except in certain months there was a high correlation between the relative condition (Kn) and the volume of food. The young ones measuring up to 149 mm sustain themselves only on prawns and those bigger than 150 mm thrive mainly on fish, prawn and crab in the order.

080. **Ameer Hamsa, K.M.S., H. Mohamed Kasim, S. Rajapackiam and T.S. Balasubramanian** 1991. On the rare landings of the Dogfish shark species from Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 107: 17-18.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu India.

Abstract : Dogfish sharks, often occur in shoals and are caught by trawlers at greater depths. On 17-07-90, a catch of 820 kg of deep-sea dogfish shark was landed by a single boat which operated drift gillnet off Veerapandianpatnam at a depth of 200 meters. And the diagnostic characters, length frequency and length-weight relationship are discussed in detail.

081. **Ameer Hamsa, K.M.S and H. Mohamed Kasim** 1992. Growth and production potential of young grouper *Epinephelus tauvina* (Forskal) reared in fixed net cages. *J. Mar. Biol. Assoc. India*, 34(1&2): 271-276.

Address : Central Marine Fisheries Research Institute, Cochin - 682 0181, India.

Abstract : Growth of *Epinephelus tauvina* was studied in the fixed cage culture system in Mandapam (Gulf and Mannar) coastal water employing net cages of 5 x 5 x 2 m dimension made of HDPE net material with 20 mm mesh size. The fishes were fed with trash-fish once in 2 days and the culture period varied from 163 days to 334 days. The average growth increment in length was 145.5 mm in 8.71 months at the rate of 16.3 mm/month and the average growth increment in weight was 413.9 g at the rate of 47.5 g/month. The basic growth data were subjected to various statistical analysis and different parameters have been estimated. The asymptotic growth L α is 671 mm, the growth constant *K* is 0.4619 and the age at 0 length t_0 is assumed to be O. The life span is estimated to be 10.7 yrs and the natural mortality coefficient M is 0.4333 at 1% survival level. The optimum age for harvesting is estimated to be 3 yrs and the optimum culture period which can yield the highest production for this species is 28 months for the prevailing age at stocking of 8 months.

082. **Ameer Hamsa, K.M.S and H. Mohamed Kasim** 1994. The perch fishery by traditional traps at Kilakkarai (Gulf of Mannar) and some aspects of biology of *Lethrinus nebulosus* (Forskal). ***In* :** *Perch fisheries in India.*

(eds) K. Rengarajan and P.S. Bennet. CMFRI, Cochin, India. *CMFRI Bulletin*, 47: 98-105.

Address : Central Marine Fisheries Research Institute, Cochin- 682 018, India.

Abstract : Exploitation of perch resources off Kilakkarai in the Gulf of Mannar, by traditional traps is studied. The increase in perch landings and the change in succession of species are attributed to the change in mode of operation, area of operation and increase in the usage of prawn peelings predominantly as baits in place of traditional baits. The biology of the dominant species *Lethrinus nebulosus* is studied. The age and growth of this species is described from the length frequency data collected from the landings of perch traps. The length-weight relationship and food and feeding are dealt in detail. The mortality coefficient namely natural (M), total (Z) and fishing (F), exploitation rate (U) and yield per recruit in relation to different F, M/K ratios keeping the age at first capture constantly at the prevailing level (0.2913 yr) have been estimated to assess the present status of the fishery of this species. It is inferred that this species is exposed to higher fishing intensity by the perch trap units as the prevailing fishing mortality coefficients are higher than the F_{max} which can bring about the Y_{max} for the prevailing M/K ratio. This finding is attributed as one of the possible reasons for the continued decline in the percentage composition of *L. nebulosus* in the perch trap landings since 1950s.

083. **Ameer Hamsa, K.M.S., H. Mohamed Kasim and G. Arumugam** 1994. The fishery, biology and stock assessment of *Nemipterus delagoae* Smith off Tuticorin, Gulf of Mannar. ***In :*** *Perch fisheries in India.* (eds) K. Rengarajan and P.S. Bennet. CMFRI, Cochin, India. *CMFRI Bulletin*, 47: 112-120.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Nemipterus delagoae* is the dominant threadfin-bream landed at Tuticorin. An estimated 158.15 t and 226.9 t were landed by trawl net at the catch rate of 6.31 and 10.13 kg/unit in 1987 and 1988 respectively constituting on an average 3.6% of the total catch by trawl net. The peak period of fishing season is during September-December. The estimated growth parameters from length frequency data are L α = 362.0 mm, K = 1.0586 (annual) and t_o = 0.007 yr. The sexwise length-weight relationship did not exhibit any significant difference and hence a common length-weight relationship is proposed. Fishes (25.6%), prawns (21.9%), crabs (14.3%) formed the dominant food items of this species in addition to brittle-stars, cuttlefishes, gastropods, bivalves, Squilla, polychaetes, alphids, isopods and amphipods. The natural mortality coefficient (M) is 1.625 and the average annual total mortality coefficient (Z) is 3.29 by trawl net. The yield per recruit studies indicate that the prevailing F i.e., 1.665 by trawl net which is well below the F_{max} which can produce highest yield (Y_{max}) for the prevailing age at first capture 0.4687 yr for M/K ratio 1.535. This indicates that the fishery of *N. delagoae* is not exposed to higher fishing pressure and there is scope for further increase in the fishing effort of trawl net.

084. **Ameer Hamsa, K.M.S., H. Mohamed Kasim and S. Rajapackiam** 1994. Length-weight relationship of *Lutjanus rivulatus* off Tuticorin, Gulf of Mannar. ***In :*** *Perch fisheries in India*. (eds) K. Rengarajan and P.S. Bennet. CMFRI, Cochin, India. *CMFRI Bulletin*, 47: 128-129.

Address : Central Marine Fisheries Research Institute, Cochin - 682 014, India.

Abstract : Length-weight relationship of *Lutjanus rivulatus* exhibits isometric growth since its regression coefficient did not significantly differ from 3. The relative condition factor K_n indicates that the older specimens measuring above 420 mm were more healthy and robust than younger individuals.

085. **Anand, C., S. Edwin, R. Jeya Shakila and G. Jeyasekaran** 2002. Bacteriological Quality of Seafoods Landed in Tuticorin Fishing Harbour of Tamil Nadu, India. *J. Food Sci. Technol.*, 39(6): 694-697.

Address : Department of Fish Processing Technology, Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tuticorin- 628 008, India; E-mail: ttn_jerosh99@sancharnet.in

Abstract : Bacteriological quality of finfishes, shrimps and cephalopods landed in Tuticorin fishing harbour of Tamil Nadu, India was studied. Total bacterial counts were in the range of 10^4-10^8 cfu/g. The MPN total coliforms ranged from 7 to 1100/g and MPN faecal coliforms from 4 to 1100/g. Seafoods had the *Escherichia coli* counts ranging from 0 to 10^2 cfu/g. The *Staphylococcus aureus* counts were between 0 and 10^6 cfu/g. The MPN anaerobic sulphite reducers varied from 0.60 to 140/g. Finfishes and cephalopods were free from bacterial pathogens, *Salmonella*, *Vibrio cholerae* and *Listeria monocytogenes*, while one of the shrimp samples contained these pathogens. The results indicated that an improvement in bacteriological quality of seafoods landed in Tuticorin fishing harbour is essential to meet the International quality standards.

086. **Ananda Rao, T., K.R. Aggarwal and A.K. Mukherjee** 1963. Ecological studies on the soil and vegetation of Krusadai group of Islands in the Gulf of Mannar. *Bull. Bot. Surv. India*, 5(2): 141-148.

Address : Botanical Survey of India, Calcutta

Abstract : The account presents the plant ecology with a description of soils and other related features of the krusadai group of Islands situated in the Gulf of Mannar.

087. **Ananda Rao, T., K.R. Aggarwal and A.K. Mukkerjee** 1963. Ecological account of the Vegetation of Rameswaram Island, *Bull. Bot. Surv. India*, 5: 301-323.

088. **Ananth, V., S. Palraj, G. Subramanian, P. Chandrasekaran and M. Sundaram** 1989. Effect of sodium chloride on atmospheric corrosion on steel. *Proceedings on dock and Harbour Engineering, 6-9, December, 1989.* pp. 823-826.

Address : Corrosion Testing Centre, Central Electro Chemical Researh Institute Unit, Mandapam Camp - 623 519, India.

Abstract : Investigations on the effect of sodium chloride on corrosion of steel were conducted by incorporating different amounts of sodium chloride on the surface of steel by spraying or by immersion of panels in solutions of different concentrations. The corrosion rates were determined by weight loss method. The corrosion rate of steel was found to increase with the amount of NaCl incorporated on the surface, through its catalytic activity. The exponential decrease of corrosion rate with duration of exposure, according to the empirical equation rktn is attributed to the availability of oxygen at the reaction front for the formation of stable corrosion product. The increase in corrosion rate in special cases is attributed to the increasing amount of NaCl on the steel surface with duration of exposure.

089. **Ananthanarayanan, R.** 1967. The fouling organisms of the pearl oyster farm, Krusadai Island, Gulf of Mannar. *Madras J. Fish.*, 3: 145-146.

Abstract : The pearl oyster farm of the Krusadai Biological Station, is erected in a land locked area of the Kundugal channel; situated in the head region of Gulf of Mannar. The sea is not always rough and the hydrobiological conditions are also favourable for the existence of the oysters.

090. **Anantharaj, M and V. Venkatesalu** 2002. Studies on the effect of seaweed extracts on *Dolichos biflorus*. *Seaweed Res. Utiln.*, 24(1): 129-137.

Address : Department of Botany, Annamalai University, Annamalai Nagar 608 002 India.

Abstract : The present study deals with the effect of seaweed extracts prepared from *Caulerpa racemosa* and *Gracilaria edulis* on growth parameters and biochemical constituents of *Dolichos biflorus*. The seeds soaked with aqueous extract of seaweeds showed better results when compared to the water soaked treatment. In both the treatments, cent percent germination has been recorded. The ten per cent concentration of aqueous extract of both the seaweeds enhanced the seedling growth, fresh and dry weight, chlorophyll content, protein and sugar content in *Dolichos biflorus*. Among the two seaweeds, *Caulerpa racemosa* showed better results.

091. **Anantharaj, M., V. Venkatesalu, M. Chandrasekaran, S. Sivasankari** 2004. Screening of fatty acid methyl esters of marine algae for antibacterial activity. *Seaweed Res. Utiln.*, 26(1&2): 87-92.

Address : Department of Botany, Annamalai University, Annamalainagar 608 002 India.

Abstract : Fatty acid methyl esters (FAME) from ten species of marine macro algae collected from Rameswaram Coast, Tamil Nadu, India and belonging to the classes *Chlorophyceae*, *Phaeophyceae* and *Rhodophyceae* were screened against bacterial strains viz., *Bacillus subtilis, Micrococcus luteus, Staphylococcus aureus, Salmonella typhimurium, Pseudomonas aeruginosa, Klebsiella pneumoniae* and *Escherichia coli*. The FAME from all the selected algae inhibited the growth of all the tested bacterial strains.

092. **Anbazhagan, C., K. Sivakumar and R. Rengasamy** 2002. Electron microscopic studies on *Padina* from Gulf of Mannar. *Phykos*, 41(1&2): 97-104.

Address : Department of Botany, Annamalai University, Annamalainagar 608 002 India.

Abstract : The brown seaweed *Padina boergesenii* Allender and Kraft collected from Pamban, Gulf of Mannar, southeast coast of Tamil Nadu, India, was investigated by light and transmission electron microscopes. The mature and basal region of the thallus was three layered in thickness. Presence of well developed hair in *P. boergesenii* may be a diagnostic feature. The TEM studies on vegetative cells of *P. boergesenii* revealed the electron translucent acirclea on the cell wall with three distinct layers. Based on the shape, outer layer and the occurrence of substances such as granular, electron transparent, electron dense and fibrillar reticulate contents,

9 different types of vesicles were identified. Apart from these vesicles, three lamellated thylakoidal chloroplast, chloroplast, endoplasmic reticulum (CER), stalked pyrenoid on the chloroplast, Golgi apparatus and nucleus were also observed.

093. **Angel, C.** 1989. Artemia culture in the Bay of Bengal region. *BOBP news, June'89, 20* pp.

Abstract : A small crustacean inhabiting natural and man-made saltpans from the sub-arctic to the arid tropics has long attracted the attention of zoologists. Science was fascinated by the ability of Artemia to thrive in the inhospitable super saline environment of its native saltpans. This small crustacean, about 1 cm long, ensures its survival by enclosing its offspring in an amazingly resistant egg or cyst. Cysts known to be 10,000 years old have hatched into viable larvae. These cysts are scattered by the wind and carried far and wide by birds such as the beautiful flamingos that frequent saltpans. But they can only survive in water so saline that no other creature, save salt-loving bacteria, algae and a few insect larvae can live there.

094. **Angusamy, N and G. Victor Rajamanickam** 1996. The distribution and nature of heavy minerals along the beaches of southern Tamil Nadu. *Proceedings of the Eighth and the Ninth Convention of Indian Geological Congress and National Symposium on Acquisition of Modern Techniques for the Development of Geosciences.* (eds.) G.V. Rajamanickam and O.P. Varma. Roorkee India Indian Geol. Congr. pp. 38-43.

Address : Department of Earth Sciences, Tamil University, Thanjavur 613 005, India.

Abstract : The southern coast of Tamil Nadu from Kanyakumari to Mandapam (India) is known for the occurrence of enriched beach placers. About 150 sediment samples, collected from tidal and berm regions of this area, were studied for its heavy mineral content. The result shows the predominant distribution of opaques, followed by zircon, garnet, chlorite, biotite, muscovite and monazite, whereas the accessory minerals like rutile, kyanite, hypersthene, hornblends, andalusite, apatite, topaz, silimanite, constitute the heavy mineral assemblages. The abundance of dominant minerals is noticed to be changing from place to place. Based on the observed predominance of heavy minerals, the area is divided into five mineralogical provinces (1) Kanyakumari province (2) Manappad province (3) Tuticorin province (4) Valinokkam province (5) Mandapam province. From the nature of heavy minerals and their etched surface markings, it is inferred that the heavy minerals are derived from basic igneous rocks, acid charnockites and medium to high grade metamorphic rocks and their distribution is controlled by geomorphology, tectonic regime and littoral processes.

095. **Angusamy, N., P. Udayaganesan, G. Victor Rajamanickam** 1998. Wave refraction pattern and its role in the redistribution of sediment along southern coast of Tamilnadu, India. *Indian J. Mar. Sci.,* 27(2): 173-178.

Address : Department of Earth Sciences, Tamil University, Thanjavur - 613 005, India.

Abstract : Wave convergent zones are identified at Manappad, Tiruchendur, Tamirabarani river mouth, Turicorin, Kallar, Vaippar, Vembar and Valinokkam beaches. Wave divergent zones especially from Mandapam to Chinna Ervadi are marked by strong progradational activities in the prevailing low energy environment. Textural parameters of the sediments show a characteristic variation in mean size and sorting in the zones of wave divergence and convergence. At wave divergent zones, sediments are of fine, moderately sorted, negatively skewed and mesokurtic in nature. Coarse sediments of well sorted, negatively skewed and mesokurtic nature are the characteristics of sediments in convergent zones.

096. **Angusamy, N and G. Victor Rajamanickam** 2000. Beach morphology and the inferences from heavy mineral assemblage of Mandapam to Kanyakumari coast, southeast coast of India. *Indian J. Mar. Sci.,* 29 (4): 283-294.

Address : Department of Earth Sciences, Tamil University, Thanjavur-613 005, TN, India.

Abstract : On the basis of heavy mineral distribution, the southern coast of Tamil Nadu has been divided into five blocks namely Mandapam, Valinokkam, Tuticorin, Manappad, Kanyakumari blocks. The heavy mineral concentration by wt % varies from 2 to 87%. Zircon, colourless garnet, pink garnet, chlorite and biotite are the predominant minerals. The abundance of these minerals varies in each block. Chlorite, sillimanite, mica, few hornblendes and kyanite are characteristic of Mandapam block while biotite and glaucophane for Valinokkam block, euhedral zircon, hypersthene, tourmaline for Tuticorin block, broken zircon, andalusite and topaz for Manappad block and rounded zircon, rutile and monazite for Kanyakumari block. Chlorite, mica and other flaky minerals are dominant in Mandapam and Manappad blocks, whereas in Kanyakumari and Valinokkam block, minerals like zircon, garnet and other denser heavy minerals are abundant. Granular minerals like zircon and garnet, are presumed to have been derived from the recycled sediments. However, the immediate hinterland has not shown any presence of ancient sedimentary formations which are likely to be the source for recycled sediments.

The minerals, not specified under recycled sediments, are expected to have been originated from the rocks of igneous and metamorphics of the hinterland. On the other hand, the presence of prolific flaky minerals mainly from the derivatives of green schist facies point out the presence of metamorphic rocks in the hinterland. However, the hinterland is primarily occupied by Quaternary sediments. Such incompatibility of heavy mineral assemblage of Kanyakumari, Manappad and Mandapam blocks, enables to infer the deposition of sediments primarily by littoral transport, in addition to the terrigenous contribution. This is well supported by the presence of well rounded garnets, zircons and strongly etched flaky minerals. The source for the heavy mineral assemblage is attributed to a mixture of low-grade metamorphic rocks, reworked sediments, charnockite, granite and granite gneiss. This inference is also supported by the results of Q-mode factor analysis.

097. **Angusamy, N and G. Victor Rajamanickam** 2000. Distribution of heavy minerals along the beach from Mandapam to Kanyakumari, Tamil Nadu. *J. Geol. Soc. India*, 56(2): 199-211.

Address : Department of Earth Sciences, Tamil University, Thanjavur - 613 005, Tamilnadu, India. E-mail: vrajamanickam@yahoo.com

Abstract : Frequency distribution of heavy minerals along the southern Tamil Nadu coast, India from Mandapam to Kanyakumari shows selective deposition of heavies with respect to their densities. In Kanyakumari sector in the south, the heavies are concentrated in coarser sands, in the central Tuticorin sector in medium sands, and in the northern Mandapam sector in fine sands. Weight percentage distribution of heavies shows poor concentration at Mandapam that can be ascribed to strong progradational activity and wave-divergent conditions. A higher concentration of heavies in the ephemeral stream mouths in Tuticorin sector is due to the arcuate nature of the coastline, strong convergence of orthogonals and a basinal structure, all of which enable trapping of sediments carried by littoral currents. The poor concentration of heavies in Manappad sector, despite wave-convergent condition, is due to the straight alignment of the coastline without any arcuate bays. The enrichment of heavies in Kanyakumari sector is attributable to the arcuate coastline and a downwarped basinal structure.

098. **Angusamy, N and G. Victor Rajamanickam** 2001. Mineralogy and chemistry of ilmenites from the beach placers of Mandapam to Kanyakumari region, Tamil Nadu. *Hand book of placer mineral deposits*. pp 158-170.

Address : Department of Earth Sciences, Tamil University Thanjavur - 613 005, Tamil Nadu India.

Abstract : Microscopic study of ilmenites from the beach placers of Mandapam- Kanyakumari, Tamil Nadu, India has shown five types of integrowth patterns viz., ilmenite-hematite, magnetite-ilmenite, ilmenite-hematite-rutile, hematite-ilmenite-rutile and ilmenite-rutile in all the samples. At Kuttankuli and Kuduthalai areas, ilmenites are predominantly of unexsolved nature whereas at Kallar, Vaippar and Vembar stations they are more of exsolved nature with wide spectrum of textural patterns, among which seriate texture is more abundant. These exsolved and unexsolved phases of ilmenite in different stations are confirmed by x-ray diffraction study. Major element variations of ilmenites show a close correlation with the nature of integrowth pattern. REE patterns of ilmenites show a strong negative Eu- and Ce- anomalies indicating the prevalence of redox conditions at the time of crystallisation. On the basis of modal analysis, viz. which of integrowth lamellae of ilmenite - hematite phase and unexsolved ilmenite percentage, and major, trace and rare earth element composition, these ilmenites are inferred to have been derived from metamorphic rather than igneous source, with prevalence of a common source to the entire study region.

099. **Angusamy, N., V.J. Loveson and G. Victor Rajamanickam** 2001. Shoreline configuration and the distribution of Quaternary coastal placers of southern Tamil Nadu, India. *Proceedings of the International Seminar on Quaternary Sea Level Variation, Shoreline Displacement and Coastal Environment.* (*Eds*.) G. Victor Rajamanickam and M.J. Tooley, New Academic Publ, Delhi, India. pp. 132-139.

Address : Department of Earth Sciences, Tamil University, Thanjavur - 613 005, Tamilnadu, India.

Abstract : The coastal region of Mandapam, Tamil Nadu, India to Kanyakumari has been surveyed for the exploration of beach placers. About 385 samples had been collected upto 1 m depth using hand auger from foreshore to backshore areas and even to the zone of dune. Heavy mineral analysis of the samples shows an enrichment of placer deposits in two sectors along the coastline i.e., (1) Kallar-Vaippar river mouth (63.66%) and (2) Kanyakumari and Kuttankuli region (62.37%). Different scientific factors are looked into for identifying the reasons of variation of heavy minerals. One of the factors is identified as shoreline configuration of the coastal region. Among the four different configurations of coastal region namely E-W, N-S, NE-SW, and NNE-SSW direction, the wave refraction patterns reveal a number of zones having convergence that too varying in different seasons. Prevalence of convergence is found in the zones of heavy mineral accumulation. On the basis

of geomorphic factors and well developed lineaments, the existence of five different blocks has been identified. It is observed from the field evidences that the areas between Kanyakumari - Kuttankuli and Kallar - Vaippar are located at the point of junction of two different convergent blocks leading to the formation of a depositional basin in these areas. It aids the trapping of sediments and protect the heavy minerals from the longshore drift, though there is a clear cut displacement along the shoreline. In the studied coast, neither a particular configuration nor the littoral transport could support the segregation of heavy minerals. The results direct that only a shoreline encircled around a basin in combination with shoreline configuration and converging wave dynamics can influence or control the placer enrichment.

100. **Anitha Mary, G and S. Lazarus** 2000. Biodiversity of marine Sponges. *Proc. Nat. Sem, Mar. Biodiversity.* 3: 31-38.

Address : Institute of Coastal Area Studies, Manomaniam Sundaranar University, Nagercoil, India.

Abstract : Sponges are evident as encrusting masses or projections growing on rocky surfaces or larger seaweeds. Because of their apparent vegetative appearance and lack of cell layers, they were once classified under plants until the naturalist John Ellis showed their true animal relationships. It is estimated that about 5000 species of sponges are represented in our present seas and the share of the Indian seas is only 500 species. Among the various orders of sponges, siliceous sponges constitute the bulk with 95 % of the total number of species. So species belonging to this order are distributed well in the inshore areas of the sea. These sponges often grow to massive size and hence are commonly used for chemical studies all over the world.

101. **Anjaneyulu, A.S.R and C.V.S. Prakash** 1995. New sesqui and diterpenoids from the soft coral *Nephthea chabroli* of Indian coast. *Indian J. Chem. B Org. Med.*, 34(1): 32-39.

Address : Andhra University, Visakhapatnam 530 003, India.

Abstract : Chemical examination of the soft coral species of *Nephthea chabroli* collected at Mandapam Coast furnishes seven new secondary metabolites (NSE1-NSE7), four of which are sesquiterpenoids (NSE1-NSE4), two diterpenoids (NSE5 and NSE6) and one dihydroxysterol (NSE7). Based on a study of their physical and spectral characteristics (UV, IR, ^{1}H and ^{13}C and EIMS), the structures of the terpenoid derivatives have been established as 1(S)-acetoxygermacra-3Z, 10(15)-diene (4), 1(S)-acetoxygermacra-3Z, 5E, 10((15)-triene 9), 1(S), 4(R), 5(S)-guia-6, 9-dien-4-ol (13), 1(S), 5(R), 6(R)-guia-3, 10(15)-dien-7, 11-epoxy-6 beta-acetate (16), Nephthol-A (17) and nephthoxide (Nephthol-B; 18). An initial screening of the ethanolic extract of the soft coral species shows strong diuretic activity.

102. **Anjaneyulu, A.S.R and K.V.S. Raju** 1995. Secondary metabolites of a new soft coral of the genus *Sinularia* of the Mandapam coast. *Indian J. Chem. B. Org. Med.*, 34: 463-465.

Address : Andhra University, Visakhapatnam 530 003, India.

Abstract : A detailed chemical examination of the ethyl acetate extract of a new soft coral species of the genus *Sinularia* collected from the Mandapam Coast in Tamil Nadu, India furnishes four cembranoid diterpenes and three polyhydroxysteroids. One of the cembranoids, sinulariadione, is a new and uncommon 1,3-diketone (4).

103. **Anjaneyulu, A.S.R., K.V.S. Raju and G.V. Rao** 1995. A new steroid glycoside from the sea cucumber *Holothuria scabra* off Mandapam coast. *Indian J. Chem. B Org. Med.*, 34: 666-668.

Address : Andhra University, Visakhapatnam 530 003, India.

Abstract : A new steroidal glycoside has been isolated along with 22,25-oxidoholothurinogenin (1), holothurinogenin (2), 25-methoxyholothurinogenin (3) and 25-hydroxyholothurinogenin (4) from the methanolic extract of the sea cucumber Holothuria scabra. The structure of the new glycoside has been determined as 24-26-dimethylcholest-5-ene-3 beta -O-xylopyranoside (5) by a study of its physical and spectral data (UV, IR, $^{1}HNMR$, $^{13}CNMR$ and Mass) and chemical degradation.

104. **Anjaneyulu, A.S.R and K.V.S. Raju** 1996. A new triterpene glycoside from the sea cucumber *Holothuria atra* off Mandapam Coast. *Indian J. Chem.*, 35 (8): 810-814.

Address : School of Chemistry, Andhra University, Visakhapatnam 530 003, India.

Abstract : A new lanostane-type triterpene diglycoside has been isolated from the ethanolic extract of the sea cucumber Holothuria atra collected from the Mandapam Coast and characterised as 3-O[μ-L-rhamnopyranosyl (1-2)-μ-D-xylopyranosyl]-3μ, 12μ, 17μ, 20(S)-tetrahydroxylanost-9(11)-en-18, 20-olide (7) on the basis of its

physical and spectral (UV, IR, 1H NMR, 13C NMR and mass) data and chemical degradation. 22, 25-Oxidoholothurinogenin (1), holothurinogenin (2), 3µ-acetoxy-12µ-methoxy-7, 8-dihydroholothurinogenin (3), 3µ-acetoxy-12µ-methoxy-7, 8-dihydro-22, 25-oxidoholothurinogenin (4), 3µ, 12µ-diacetoxy-7, 8-dihydroholothurinogenin (5) and 3µ, 12µ-diacetoxy-7, 8-dihydro-22, 25-oxidoholothurinogenin (6) have also been isolated and characterized.

105. **Anjaneyulu, A.S.R., P.M. Gowri and M.V.R.K. Murthy** 1999. New sesquiterpenoids from the soft coral *Sinularia intacta* of the Indian Ocean. *J. Nat. Prod*., 62(12): 1600-1604.

Address : School of Chemistry, Andhra University, Visakhapatnam-530 003, India.

Abstract : Chemical examination of the soft coral species *Sinularia intacta* collected from the Moyli Island of the Gulf of Mannar of the Indian Ocean resulted in the isolation of three new sesquiterpenoids, 1, 2, and 3, along with the known compounds 8, 9-secoafricanane-8, 9-dione (5), â(9(15)) -africanene (6), 1-O- hexadecyl-2, 3-dihexa decanoyl glycerol, batyl alcohol, (24R)-24 - methylcholesterol, gorgosterol, a mixture of two monohydroxy-4á- methyl sterols, 4á,24-dimethylcholestan-3â-ol, 4á,24î- dimethyl-23î-ethylcholestan-3â-ol, a mixture of ceramides, and ergost-24(28)-ene-3â,5á,6â-triol. The structures of the new sesquiterpenoids were established as (9R)-africanane-9, 15-diol (1), (9R)-9-methoxyafricanan-15-ol (2), and (9S)-africanane-9, 15-diol-15-monoacetate (3) by a study of their spectral data and partial synthesis.

106. **Anjaneyulu, A.S.R., V.L. Rao, V.G. Sastry and D.V. Rao** 2005. A novel rearranged sesquiterpenoid from Indian Ocean soft coral. *Proc. Ap Akad. Sci.,* 9(2): 139-142.

Address : School of Chemistry, Andhra University, Visakhapatnam 530 003 India.

Abstract : A novel rearranged sesquiterpenoid, trocheliophorin (1) was isolated from the soft coral *Sarcophyton trocheliophorum* besides the known sarcophytin, methyl arachidonate, and two polyhydroxy steroids (24S)-24-methylcholestane-3 beta, 5 beta, 6 beta, 25-tetrol-25-monoacetate and (24S)-24-methylcholestane-3 beta, 5 beta, 6 beta, 25-tetrol. Its structure was elucidated from its spectral data.

107. **Annam, V.P and S.K.D. Raja** 1981. Trends in the catch of silverbellies by mechanised boats in Tamil Nadu during 1971-75. *Indian J. Fish*., 28(1&2): 87-95.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Silverbellies (*Leiognathus jonesi*) form an important demersal fishery of India particularly on the coasts of southern maritime states, the annual average catch amounting to about 3% of the total marine fish catch in India. In Tamil Nadu, mechanised boats predominantly operate at Royapuram (Kasimedu), Cuddalore, Portonovo, Adirampatnam, Mandapam, Rameswaram and land considerable quantities of silverbellies. The catch trends of silverbellies landed by the mechanised boats in Tamil Nadu during the period 1971 to 1975 and the relation between the index of abundance and the total fishing effort both in respect of total landings and landings of silverbellies are dealt with in the present paper.

108. **Anon.** 1958. Pearl fisheries off Tuticorin. *Cur. Aff. Bull. Indo. Pacif. Fish. Coun.,* 21: 13-14.

109. **Anon**. 1959. Pearl bank and chank bed survey: A note on the general trend of marine fish catches in India. *Indian Fish. Bull.,* 6:11-12.

110. **Anon.** 1978. Estimation of marine fish landings in India. *Mar. Fish. Infor. Serv. T & E Ser.,* 2: 1-2.

Abstract : The present exploitation of marine fisheries in India is limited to only a narrow belt of the continental shelf, harvesting about 1.35 million tonnes of fish.

111. **Anon.** 1989. Indians try breeding sea-cucumbers. *Fish farming International,* 16(7): 93.

112. **Anon.** 1999. Dolphin rescued. *The Hindu,* Saturday 1st August,1999.

Abstract : A group of 12 dolphins including spotted and spinner Dolphins stranded 10 km from Tuticorin were rescued on 8th August 1999.

113. **Anon.** 1999. Four dead dolphins washed ashore. *The Hindu,* Wednesday 11th August,1999.

Abstract : Four dead dolphins believed to be of the above group were washed ashore near the Roche Park area, Tuticorin.

114. **Anon.** 2006. Whale washed ashore – stranding of a sei whale near Pamban. *The Hindu* (English Daily) July 18, 2006 in p4; and *Dhina Malar* (Tamil Daily) July 18, 2006.

Abstract : A 50 feet long sei whale of about 20 to 25 tonnes was found washed ashore near Kundhukal on Kannupadu beach of Pamban in the Rameswaram island on the Gulf of Mannar side in the early morning hours of 17th July 2006. The stranded whale was alive only for a few hours and the exact cause of stranding and subsequent death was not known immediately according to the Wildlife Warden of the Gulf of Mannar Marine National Park.

115. **Anto, J.T.** 2005. Passage to India? *Dredging and Port Construction.* pp. 19-23.

Abstract : The union government of India has approved the construction of the Sethusamudram Ship Canal Project (SSCP), a massive channel designed to liberate the country's shipping industry. This project involves the establishment of a route, which will link the Palk Bay to the Gulf of Mannar, by dredging through the 29km Adams Bridge chain of shoals that link India with Sri Lanka. The Tuticorin Port Trust is the nodal agency responsible for the implementation of SSCP and it has set up a special project vehicle (SPV) to raise the capital. The 20km, 300m-wide stretch between Tuticorin and Adams Bridge will be constructed by dredging a shallow area of the Bridge to 12m. A report by National Environmental Engineering Research Institute (NEERI), Nagpur, India, predicts that dredging activities will permanently destroy flora and fauna in Adams Bridge and Palk Bay. Several organizations led by Greenspace and Colombo-based Environmental Foundation Ltd. (EFL) have raised questions regarding environmental issues concerning the project. Despite posing the environmental dangers, SSCP provides several economic advantages also, such as enabling easy sail of ships from India's west to east coast. SSCP thus signals a major boost for India's shipping industry and the rapid development of its ports.

116. **Antony Basil, J and M. Peter Marian** 1987. Preliminary studies on the culture of *Artemia salina* using renewable organic wastes. pp. 275-278. ***In*** : *Artemia Research and its Applications Vol.3. Ecology and culturing; Use in Aquaculture* (*eds*.) P. Sorgeloos, D. A. Bengston, W. Decleir and E. Jasper. University Press, Wettern, Belgium.

Address : School of Biological Science, Madurai Kamaraj University, Madurai-625 021, India.

117. **Antony Basil, J and M. Peter Marian** 1987. Survey of Artemia resources in South India. p. 279 ***In*** : *Artemia Research and its Applications Vol.3. Ecology and culturing; Use in Aquaculture* (*eds*.) P. Sorgeloos, D. A. Bengston, W. Decleir and E. Jasper. University Press, Wettern, Belgium.

Address : School of Biological Science, Madurai Kamaraj University, Madurai-625 021, India.

118. **Antony Basil, J and G.T. Pandian** 1991. Culturing Artemia (Tuticorin strain) in organic and agricultural wastes at different salinities. *Hydrobiologia,* 212: 11-17.

Address : Department of Biochemistry, School of Biological Sciences, Madurai Kamaraj University, Madurai-625 021, India.

Abstract : *Artemia* sp (Tuticorin strain) was cultured at a density of 250 individuals/L at 35 ppt, 45 ppt, 60 ppt, 75 ppt salinity using five combinations of groundnut oil cake, decayed cabbage leaves, single superphosphate and Baker's yeast as feed. Effects on survival, growth, and fecundity were noted.

119. **Antony Basil, J and V. Sivakumar** 1992. Nutritional evaluation of selected plant leaves in culturing of Artemia (Tuticorin Strain). *Third Asian Fisheries Forum,* 26th to 30th October 1992. p. 110.

Address : School of Biological Science, Madurai Kamaraj University, Madurai-625 021, India.

Abstract : An experiment was designed to explore the possibilities of utilizing leaves of *Erythrina*, *Morus indica* and *Basella rubra* individually as supplementary feed in the culture of *Artemia* (Tuticorin strain). The main ingredient of the feed include fish meal (20%), Soyabean (20%), groundnut oil cake (20%), and rice bran (20%). Plant leaves constitute 10% of the feed tested 50 animals/L were maintained for each set and a separate control set was also maintained in which the animals fed with only rice bran (50g/L). The parameters growth and survival were recorded every three days in addition to fecundity. The protein profiles of 1st and 7th day nauplii, sub-adult and adult were evaluated in each set. In addition lipid, protein and carbohydrate content of the adult were also studied. The released eggs in each set were allowed to hatch to estimate the hatching percentage and variations in the electrophoretic protein pattern of 1st day naupli. Each test feed was tested at 2 different salinities, 50 and 100 ppt.

120. **Antony Basil, J., V.K.S. Nair and A.J. Thatheyus** 1995. Laboratory studies on the culture of the brine shrimp Artemia using organic wastes. *Bioresource Technol*., 51 (2-3), pp. 265-267.

Address : School of Biological Sciences, Madurai Kamaraj University, Madurai 625 021, India.

Abstract : Three different Artemia strains (Belgian, USA and Tuticorin) were tested for their culture potential when offered five different diets comprising cabbage leaves, cow dung, poultry manure and pig dung in varying proportions at 45, 60, 75 and 100 ppt salinities. One mixture of the ingredients gave the best results among the five diets tested, while the optimum salinity was found to be 75 ppt. Among the three strains the Tuticorin strain gave the best results.

121. **Antony Raja, B.T and S. Lazarus** 1975. A description of *Sardinella dayi* Regan (Pisces: Clupeidae) of Indian seas with remarks on its close similarity with *Sardinella maderensis* (Lowe) and *Sardinella jussieui* (Valenciennes). *Indian J. Fish.,* 22(1&2): 113-125.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : Since the existing descriptions of *S. dayi* are based on very few specimens, a detailed account of its morphometric and meristic characters on the basis of 50 specimens collected from Karwar (type locality), Vizhinjam and Tuticorin of the Indian coast, is presented. It is concluded that the material from Mauritius figured and included by Fowler (1941) under *S. dayi* is referable to *S. jussieui*. Drawing attention to the close similarity between these two species and *S. maderensis*, it is recommended that future studies should assess how far the differences between these species justify distinction at species level.

122. **Antony Raja, B.T.** 1980. Current knowledge of fisheries resources in the shelf area of the Bay of Bengal. *BOBP/WP/8.* 23 p.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : An attempt is made to calculate the potential yield for the east coast of India on the basis of values of tertiary production.

123. **Antony Raja, B.T.** 1981. Fisheries resources in the Bay of Bengal: What do we know about them? *Bay of Bengal News.* (May, 1981). p. 22.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : Production from the Bay of Bengal Shelf region- 3.2 tons per square kilometre is reasonably good, considering the low output from the Indian Ocean area and the fact that the most productive Bay of Bengal areas are yet to be exploited optimally.

124. **Antony Raja, B.T.** 1984. High- opening bottom trawling in Tamilnadu, Gujarat and Orissa, India. *BOBP/REP/37/GCP/RAS/040/SWE.* 22 p.

Address : Bay of Bengal Programme, Chennai, India.

Abstract : The Bay of Bengal Programme (BOBP) introduced new trawling techniques in Tamil Nadu during 1980/81, principally through the two-boat high-opening bottom fish trawl (TF), two boat mid-water trawl (TMW), one boat high-opening bottom fish trawl (OF) and one-boat high-opening bottom fish-cum-shrimp trawl (OSF). The fishing trials with the trawls were carried out from Mandapam, Mallipatnam, Tuticorin and Madras. The main objectives were to investigate the technical feasibility and the economic viability of these techniques; to identify and develop possible improvements to the fishing boats for more efficient, comfortable and safer fishing operations and trawl handling; and to train counterparts, fishermen and net-makers in the design, construction and use of the fishing gear, equipment and methods.

125. **Antony Raja, B.T.** 1984. Improved trawling techniques in Palk Bay and Gulf of Mannar: Have they affected fishery resources? *BOBP News, Sep'84, 20 pp.*

Address : Bay of Bengal Programme, Madras, India.

Abstract : Popularized in India by the Bay of Bengal Programme, high-opening bottom trawls have attracted wide notice. Early this year BOBP conducted an-impact study on the biological effects of this technology. The article on these pages reports the study's findings - that there is no immediate need for management measures.

126. **Appana Sastry, Y and H. Mohmed Kasim** 1987. The fishery and catch statistics of cat fishes. *CMFRI Bulletin,* 40: 12-57.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The catch statistics, species composition and seasonal abundance of catfish fishery are dealt with in this chapter based on studies conducted for varying periods during 1971-82 at seven different centers along the east and west coasts, *viz*., Waltair, Mandapam, Cochin, Calicut, Mangalore, Bombay and Veraval.

127. **Appukuttan, K.K.** 1972. Coral-boring bivalves of Gulf of Mannar and Palk Bay. *Proc. Symp. Corals and Coral reefs*, MBAI, 379-398.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Among coral boring animals the bivalves are the most destructive. The present account deals with the coral-boring bivalves of the Gulf of Mannar and Palk Bay with observations on their effect on the reef.

128. **Appukuttan, K.K.** 1972. *Pseudopythina subsinuata* (Lischke) a commensal bivalve of *Squilla nepa* (Latricelle) and *Squilla raphidea* Fabricius. *J. Mar. Biol. Assoc. India*, 14(1): 412-414.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *P. subsinuata*, an erycinacean bivalve, is reported as a commensal of *S. nepa* and *S. raphidea* from Palk Bay and Gulf of Mannar. This is the first report of an erycinacean bivalve commensal to a stomatopod from Indian waters. In the present note a brief description of the species with taxonomic details are given.

129. **Appukuttan, K.K.** 1973. Distribution of coral boring bivalves along the Indian coasts. *J. Mar. Biol. Ass. India*, 15(1): 427-430.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In the present note 22 species of boring bivalves belonging to 11 genera have been recorded from Indian Coast. This information is mainly based on the collections from Mandapam southeast coast of India, Quilon, Minicoy and Andaman Islands. The list of species with their distribution in Indian Coast is also briefly discussed.

130. **Appukuttan, K.K.** 1974. Rediscovery of *Clavagella* (Bryopa) *lata* (Clavagellidae, Bivalvia) from the Gulf of Mannar, Southeast Coast of India. *J. Malacol. Soc. Aust.*, 3(1): 19-24.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : The rediscovery of *C.* (Bryopa) *lata* from Gulf of Mannar, southeast coast of India and its anatomical features are discussed and described. The present report of this species from Gulf of Mannar establishes a precise locality for the first time. This species is regarded as a true borer buried in massive scleractenian corals. Distinctive characters placing *C. lata* in the subgenus Bryopa are discussed in detail.

131. **Appukuttan, K.K.** 1976. On *Lithophaga* (Diberus) *bisulcata*, a mytilid borer causing damage to the commercially important gastropod shells. *Indian J. Fish*., 23(1&2): 194-200.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Lithophaga* (Diberus) *bisulcata* was found to bore into the gastropod shells, *Xancus pyrum* and *Fasciolaria trapezium* causing destruction to the shells. The taxonomy, shell structure and the details of the burrowing habit of this species are discussed in detail. The present report is the first record of this species from the Indian Ocean and it is for the first time reported to bore into *Xancus* and *Fasciolaria*. Since this borer causes damage to commercially important gastropod shells, much attention is paid to understand the details of boring mechanism. It is assumed that they make a burrow initially by chemical means and later by a mechanical rotating movement of the shell within the burrow.

132. **Appukuttan, K.K**. 1978. Studies on the developmental stages of hammerhead shark *Sphyrna* (Eusphyrna) *blochii* from the Gulf of Mannar. *Indian J. Fish*. 25(1&2): 41-51.

Address : Central Marine Fisheries Research Institute, Vizhinjam, India.

Abstract : Various stages of intra-uterine embryos of S. blochii collected from the Gulf of Mannar are described and discussed. Uterine compartments are formed in this species which exhibit multiple pregnancy. An embryonic membrane store chamber is present in each uterine compartment. The placenta of this species is of yolk-sac type and is formed at the stage in between 125 mm and 210 mm; yolk persist in the yolk-sac even when the placental connection is established with the mother. The placentation process observed in this species is almost similar to that of *S. tiburo* and *Carcharhinus dussumieri*. The probable gestation period and other details of placentation are discussed.

133. **Appukuttan, K.K.** 1996. Marine molluscs and their conservation. pp. 66-79. ***In*** : *Marine biodiversity conservation and management.* (*eds*) N.G. Menon and C.S.G. Pillai, CMFRI. 205 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 628 018, India.

Abstract : Marine invertebrates in general, especially molluscs are able to withstand fishing pressure, because of their high fecundity, reproductive capacities and planktonic larval life. Whereas there are cases of depletion of stock due to over exploitation by commercialized fishing and indiscriminate collection of rare species. Appropriate conservation measures are to be taken for judicious exploitation of the existing reserve and to impose precautionary measures to resist over exploitation of rare specimen leading to extinction.

134. **Appukuttan, K.K.** 1996. Recent development in molluscan aquaculture in India. *Seafood Export J.*, 27(1):13-20.

135. **Appukuttan, K.K and P. Muthiah** 1996. Technology of edible oyster culture. *CMFRI Bulletin*. 48: 64-69.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Oysters, mussels, clams, scallops, cockles and abalones are major groups of molluscs, which are cultured in different parts of the world. Edible oysters are the most important among them, as they are great delicacy and there is growing demand. There is an increasing interest in oyster culture in tropical countries in recent years. Apart from the edibility of meat, the shells have various industrial and agricultural uses. Considering the oysters as a renewable resource of much needed animal protein and the employment potential oyster culture offers to the rural communities, its culture has been taken up as an R & D programme of the Central Marine Fisheries Research Institute. The studies carried out since 1970, have resulted in developing simple culture methods suitable for Indian conditions.

136. **Appukuttan, K.K and K. Ramadoss** 2000. Edible and ornamental gastropod resource. In: *Marine Fisheries Research and Management,* (eds.) V.N. Pillai and N.G. Menon, CMFRI, Kochi, pp.525-535.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Mandapam, India.

Abstract : Out of 1900 species of gastropods catalogued from Indian waters, only 15 species are edible, while, a large numbers are commercially important ornamental / curios shells in handicraft trade. Sacred chanks, to turban shells are widely exploited from their distributional range. Their flesh and shell are in great demand. The paper reveals the commercial importance of gastropods in export and handicraft trade and gives the distribution details, abundance and habitat of ornamental gastropods along Indian coast. The paper reviews the status of molluscan shell handicraft trade in India and the potential for domestic and export trade.

137. **Appukuttan, K.K., M.R. Nair and T.S. Velayudhan** 2004. An overview of pearl farming in India. *J. Shellfish Res.*, 23(1): 305.

Address : USDA Land Grant, Cooperative Research and Extension, College of the Marshall Islands, PB-1258, Majuro, MH 96960, Republic of the Marshall Islands; E-mail: manojnair999@yahoo.com

Abstract : India is well known for the production of beautiful natural pearls. India has a wealth of pearl producing oysters. The main ones among these are the Akoya oyster *Pinctada fucata* distributed from the famous Gulf of Mannar, Palk Bay, and Gulf of Kutch (mistakenly identified and wrongly reported by many even now as *Pinctada radiata*) and the Black lip pearl oyster *Pinctada margaritifera* in the Andaman and Nicobar Islands. Pearl culture in India was first conducted on an experimental scale in the early 1970s by the Central Marine Fisheries Research Institute (CMFRI) at its Tuticorin research center on the southeastern Coast of India. The institute had initiated experimental pearl production in 1972 and the first Indian cultured pearl produced the following year. Hatchery technology was developed by CMFRI for *P. fucata* and *P. margaritifera* in the early (1982) and late eighties (1987) respectively. With the technology, being standardized after repeated experimentation, sea farming of pearl oysters, cultured pearl production, hatchery production, etc was taken by private entrepreneurs and coastal community groups on both coasts of India. This paper, in addition to giving an overview of evolution of the Indian marine pearl farming, also discusses the recent innovations like onshore pearl culture.

138. **Arjan Rajasuriya, K. Venkataraman, E.V. Muley, H. Zahir and B. Cattermoul** 2002. Status of Coral Reefs in south Asia: Bangladesh, India, Maldives, Sri Lanka. ***In***: *Status of coral reefs of the World: 2002.* AIMS, Townsville (Australia), pp. 101-121.

Address : Global Coral Reef Monitoring Network, South Asia Component, Sri Lanka.

Abstract : Coral reefs in South Asia are either oceanic atolls such as those of Lakshadweeps, Maldives and

Chagos or growing adjacent to the high Islands of Andaman and Nicobar, the Gulf of Mannar and Gulf of Kutch in India and around Sri Lanka. In Bangladesh, the only coral reef is St. Martin's Island, and there are only scattered corals. There are no reefs in Pakistan. Recovery of corals killed during the 1998 *El Nino* bleaching event is slow, but should continue if there are no further major high temperature events. Other damaging impacts, such as the crown-of-thorns starfish, coral mining, destructive and unmanaged resource harvesting, sedimentation and pollution continue on the reefs in South Asia and reduce their capacity for recovery. This report contains more data on reef status, as a result of major increases in capacity for monitoring and more donor assistance. However, rarely are the monitoring data used in management decision making. Marine protected areas management continues to be weak, with a lack of government will, funding and capacity for conservation, as well as a lack of income generating alternative livelihoods for the user communities. A large Ramsar site has been established in Chagos, however, augmenting several Strictly Protected areas. Progress in designating more protected reef areas is also slow. This report highlights the increasing need to adapt policy and mechanisms for reef management to adequately reflect the local social, cultural and environmental conditions. This can only be achieved if the researchers and scientists produce information that can effectively inform and influence management and policy. More specific recommendations for improved use of information for management, sustainable use and conservation of coral reefs in South Asia are identified.

139. **Arora, H.L.** 1951. A contribution to the biology of the silver belly, *Leiognathus splendens* (Cow). *Proc. Indo-Pacific. Fish Coun., 3rd meeting*, pp. 75-80.

140. **Arumugam, G., T.S. Balasubramanian and S. Rajapackiam** 1990. On the occurrence of chimaeroid egg capsule of Tuticorin, Gulf of Mannar. *Indian J. Fish.*, 37(2): 167-168.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The occurrence of two chimaeroid egg capsules off Tuticorin, Gulf of Mannar from commercial, deep-sea catch at a depth of 250-400 m during January 1990 is reported. A brief description of the morphometric characters of the egg cases is also given.

141. **Arumugam, G., S. Rajapackiam and T.S. Balasubramanian** 1992. On the landing of Hump-back Dolphin *Sousa chinensis* at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.*, 115: 19.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of a Hump-Back Dolphin which was stranded at Tuticorin North landing centre are listed in this article.

142. **Arumugam, G., T.S. Balasubramanian and S. Rajapackiam** 1993. Impact of cyclone along the Tuticorin coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 122: 25-26.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : On 13th Nov' 1992, 19 villages were affected by a cyclone. Among them, 3 villages Therespuram (Tuticorin North), Punnakkayal and Tharuvaikulam were the worst affected. The loss suffered by the fisherfolk was estimated at Rs. 1.17 crores.

143. **Arumugam, G., T.S. Balasubramanian and M. Chellappa** 1994. On the largest sunfish ever caught from the Indian seas. *Mar. Fish. Infor. Serv., T & E. Ser.*, 128: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A male sun fish *Masturus lanceolatus* (Leonard) measuring 1,535 mm total length was caught at a depth of 60-90 m in the drift gill net operated off Tuticorin on 24-08-1993. The records of sun fishes made by different workers at different places along the Indian coast from 1953 to 1993 are given.

144. **Arumugam, G., T.S. Balasubramanian and M. Chellappa** 1995. A note on the foetus of the hump-back dolphin from Tuticorin coast, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 134: 14-15.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : A female hump-back dolphin was accidentally caught in drift gillnet off Tuticorin. When the dolphin was cut open a foetus was obtained from it. Morphometric measurements were made and discussed.

145. **Arumugam, G.** 1996. Reappearance of oil sardine along the Tuticorin coast. *Mar. Fish. Infor. Serv. T&E. Ser.*, 143:25-26.

Address : Central Marine Fisheries Research Institute, Tuticorin, India.

Abstract : The estimated fishing effort and catch in kg of oil sardine at Tuticorin during 1990-95 is discussed.

146. **Arumugam, G.** 1996. Sardines landed with eye missing. *Mar. Fish. Infor. Serv. T & E. Ser.,* 143: 26.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : During routine observations for sardines at the Tuticorin south landing centre on 2nd Feb' 1996, an unusual occurrence of eyeless sardines was noticed.

147. **Arumugam, G**. 1997. On the oil sardine landings along the Tuticorin coast during 1996. *Mar. Fish. Infor. Serv. T & E. Ser.,* 149: 15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Every year a few tonnes of oil sardines used to be landed at Tuticorin. In this paper, the total fishery in December 1996 was estimated and given, and compared with the previous years.

148. **Arumugam, G.** 2002. On a giant devil ray, *Manta birostris* (Walbam) landed at Tuticorin fishing harbour. *Mar. Infor. Serv., T&E Ser.*, 171: 9.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : On 24.03.2001 a giant male devil ray *Manta birostris* (Walbaum) was caught at 50 m depth off Tuticorin in a trawl net. This ray locally called, 'Kombu thirukkai' measured 331 cm in total length and 576 cm breadth, weighed approximately 1,850 kg. The specimen was sold for Rs. 875/ - at the landing centre. In India, a special and organised harpoon fishery exists for devil rays in Androth and Kalpeni islands of the union territory of Lakshadweep. Other than this, little information is available about the species and its fishery.

149. **Arumugam, G and T.S. Balasubramanian** 2003. Whaleshark, *Rhincodon typus* (Smith) landed at Tuticorin, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 175:14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The male Whaleshark, *Rhincodon typus* (Smith) got entangled in a nylon net at a depth of 90-100 m, operated for tuna and allied species. The same was brought to Thirespuram shore. The total length was 445 cm weighing approximately 1.5 t. The other morphometric measurements of the specimen are presented in this article. The shark was auctioned for Rs. 1,150.

150. **Arumugam, G., T.S. Balasubramanian and M. Chellappa** 2004. Whaleshark, *Rhincodon typus* (Smith) landed at Tuticorin, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 180: 14-15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A whaleshark, *Rhincodon typus* was landed near Tuticorin fisheries harbour. The total length of the shark was 478 cm weighing around 1.7 tons and was auctioned for Rs. 1,200. The morphometric measurements are further discussed.

151. **Arunachalam, S.** 1952. The history of the pearl fishery of the Tamil Nadu Coast. *Annamalai University Historical series 8. Annamalai University*: 206 pp.

152. **Asha, P.S and J. Xavier Rodrigo** 2001. Spawning and larval rearing of the sea cucumber, *Holothuria* (*Theelothuria*) *spinifera* Theel at Tuticorin. *Mar. Fish. Infor. Serv., T&E Ser.,* 169: 11-13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In India, the *Beche-de-mer* industry is mainly depending on *Holothuria scabra* (vellai attai). A hatchery technology for the species has already been developed in 1988. In addition to this, another species *Holothuria spinifera* (chinna attai or raja attai) is also being fished in large quantities and widely processed along the coast of Gulf of Mannar and Palk Bay. *H. spinifera* was once rated high in the market and are in good demand in China. Every year from India, *Beche-de-mer* worth more than one crore rupees is being exported to Singapore, which is the major market from where it is marketed to other countries.

153. **Asha, P.S and P. Muthiah** 2005. Effects of temperature, salinity and pH on larval growth, survival and development of the sea cucumber *Holothuria spinifera* theel. *Aquaculture,* 250(3&4) : 823-829.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstraact : For large-scale seed production of sea cucumbers through a hatchery system, it is imperative to know the effects of environmental parameters on larval rearing. Auricularia larvae (48 h post-fertilization) were obtained from induced spawning of *Holothuria spinifera* and used in experiments to ascertain the effects of temperature, salinity and pH on the growth and survivorship of the larvae. The larvae were reared for 12 days at temperatures of 20, 25, 28 and 32° C; salinities of 15, 20, 25, 30, 35 and 40 ppt; and pH of 6.5, 7.0, 7.5, 7.8, 8.0, 8.5 and 9.0. The highest survivorship and growth rate and fastest development of auricularia indicated that water temperature of 28-32°C, salinity of 35 ppt and pH of 7.8 were the most suitable conditions for rearing larvae of *H. spinifera*.

154. **Asha, P.S and K. Diwakar** 2006. A note on the exploitation of Starfish, *Protoreaster lincki* (Echinodermata; Asteroidea) in Tuticorin. *Mar. Fish. 1nfor. Serv., T&E Ser.,* 187: 20.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : *Protoreaster lincki* commonly called red general star or red spined star is collected and processed in huge quantities at Tuticorin mainly for ornamental purpose and also for curios along Kalavasal area.

155. **Ashok, V., N. Vijay Anand and S. Rathinavel** 2004. Biofertilizing efficiency of seaweed liquid extract of *Hydroclathrus clathratus* on *Sorghum vulgare. Seaweed Res. Utiln.,* 26(1&2): 181-186.

Address : Centre for Research in Botany, Saraswathi Narayanan College, Madurai- 625 022, Tamilnadu, India.

Abstract : Growth promoting efficiency of seaweed liquid extract was studied in *Sorghum vulgare,* a cereal crop. SLF at different concentrations namely 0.5%, 1.0%, 1.5%, 2.0%, 2.5% and 5.0% was applied as soil drench treatment in potted plants. SLF at low concentrations enhanced the growth parameters viz., shoot length, root length, leaf area, fresh weight, dry weight and moisture content. Biochemical parameters like Chlorophyll-a and b, protein, sugars, starch, ascorbic acid and *in vivo* nitrate reductase activity were also found higher at 1.5%. The higher concentrations like 2%, 2.5% and 5% appeared to be inhibitory for *Sorghum,* as the above parameters were retarded. The data reveal that liquid extract of *Hydroclathrus clathratus* could be used at low concentrations to maximise the growth and yield of agricultural crops.

156. **Ashok, V., N. Vijay Anand and S. Rathinavel** 2005. Alleviation of salinity induced growth and biochemical responses through seaweed liquid extracts. *Nat. Symp. Marine Plants, their chemistry and utilization*, Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. p 34.

Address : Centre for Research in Botany, Saraswathi Narayanan College, Madurai- 625 022, Tamilnadu, India.

Abstract : The influence of NaCl salinity at different levels on growth and biochemical characteristics in *Sorghum vulgare* and the probable role of seaweed extracts (*Hydroclathrus clathratus* and *Ulva lactuca*) on salt induced changes were investigated. Boiled seaweed extract was applied as soil flush. Growth characteristics such as length of shoot and root, fresh and dry weights and leaf area were reduced by salinization at different levels. Further the levels of sugar, ascorbic acid, amino acid, proline and the activity of peroxidase and catalase increased appreciably. But, protein content and nitrate reductase activity decreased in the salinized sorghum plants. The retarding effect was increased with increasing salinity and it was found greater at 6 dsm^{-1} than other saline levels.

157. **Ashok Kumar, B and K. Venkataraman** 2003. Growth forms and status of sponges in Gulf of Mannar Biosphere Reserve. *Nat. Sem. Reef Ecosystem Remediation,* 24th-26th Sep'03, SDMRI, Tuticorin, India. p. 40.

Address : Marine Biological Station, Zoological Survey of India, 130, Santhome High Road, Chennai-600 028, India.

Abstract : Sponges are one of the dominant groups in the Gulf of Mannar Biosphere Reserve when compared to other major reef fauna. Thomas (1987) recorded 275 species in GoMBR and Palk Bay; 82, 25 and 95 species from Lakshadweep, Gulf of Kachchh and Andaman and Nicobar islands respectively. In Gulf of Mannar sponges occur in different life form categories such as massive, digitate, encrusting, globular, lobate, arborescent and plate. Digitate forms are predominant in Poomarichan, Shingle, Krusadai and Manouli islands. Massive forms are common in Nallathanni, Puzhuvinichalli, Mulli, Appa and Anaipar islands. Globular forms are seen in Anaipar and Nallathanni islands. Lobate forms are present only in Hare Island. Quadrat survey shows 72 % of sponges in

the intertidal regions of Poomarichan and Manouli Islands. In the present study brittle stars, crabs, barnacle and bivalves were recorded as associated fauna of sponges.

158. **Asir Ramesh, D.** 1996. Studies on the ecology of coral reefs in Gulf of Mannar and Palk Bay, Southeastern coast of India. *Ph.D. Thesis*, Annamalai University, India, 82p.

159. **Asir Ramesh, D.** 1996. Association of the coral colony (*Montipora digitata*) and the fish fry *(Epinephelus* sp.) on the western side of Pulli Island (Lagoon and reef crest of Gulf of Mannar). *Indian Hydrobiol.,* 2: 21-23.

Address : ENVIS Centre, CAS in Marine Biology, Porto Novo - 608 502.

Abstract : 480 coral colonies of *Montipora digitata* of various sizes (190 - 1,650 gms) were examined for (*Epinephelus* spp.) fish association in Western side lagoon and reef crest of Pulli Island, Gulf of Mannar from April. 1993 to March 1994. 240 colonies from the lagoon were examined. Of them, 49 colonies were identified giving shelter to 61 fish fries of *Epinephelus* spp. 14 out of 240 reef crest colonies gave shelter to 16 fish fries. Three species, *Epinephelus summana* (79%), *Epinephelus undulosus* (12%) and *Epinephelus tauvina* (9%) were distributed on the heads of the branched coral *Montipora digitata.* The association between tile coral head and the fish fry was related with the density of coral head in an area, coral head size, interbranchial space and season.

160. **Asir Ramesh, D and J.K. Patterson Edward** 1996. Studies on the transplantation of corals in Pulli Island of Gulf of Mannar, Southeastern coast of India. *Proc. 8th National Coral Reef Symp. Panama*. p. 9.

161. **Asokakumaran, K.U.** 1976. Four new records of prosobranch gastropods from Mandapam. *Indian J. Fish.*, 23(1&2): 279-282.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Four prosobranch gastropods *Epitonium scalaris*, *Capulus* sp., *Bursa crumena* and *Turris indica*, recorded for the first time, from Mandapam area are described.

162. **Asokan, P.K and K. Alagarswami** 2003. Ultrastructure of the Spermatozoa of the Indian Pearl Oyster *Pinctada fucata* (Gould). *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 37-38.

Address : Calicut Research Centre of Central Marine Fisheries Research Institute, Calicut-5, India.

Abstract : Like other spermatozoon of the class Bivalvia, the pearl oyster spermatozoon is of primitive or ect-aquasperm type. Each species of bivalvia however has its specific morphological characteristic, especially the length of the nucleus and shape of the acrosome. The morphology of the spermatozoon reflects both its phylogeny and its function during fertilization. The ultrastructure of *Pinctada fucata* spermatozoon has not been described earlier. Standard procedures were followed for electron microscopy. Ultra thin sections were stained in uranyl acetate and lead citrate for examining in Zeiss electron microscope. For negative staining, the oozing spermatozoa, was suspended into filtered seawater and adsorbed onto a carbon-coated film which is attached to a metal specimen grid. Once the specimen has been adsorbed onto the film surface, the excess sample is blotted off and the grid is covered with a small drop (5 ml) of stain solution of 3% solution of uranyl acetate dissolved in water. This is left on the grid for a few minutes and then blotted off. The sample was dried and examined in the TEM. In *P. fucata*, the head measures on an average 2.4 mm in length and nucleus is almost spherical with an average length of 1.4 mm and width of 1.5 mm. The acrosome measures 0.4 mm in length. The acrosome is conical in shape with smooth margin. The average length of sperm tail is 36.6 mm. The width of the tail is 0.28 mm. The tail has a structure similar to cilia, a pair of axial filament surrounded by a ring of nine double filaments spaced at equal intervals along the margin of the tail. The filaments are surrounded by a matrix of lesser density and are interconnected by delicate strands. The length and width of the sperm head varied from 2.2 mm to 2.5 mm and 1.37 mm to 1.48 mm respectively. The centriole is a hollow cylindrical structure located directly under the nucleus and surrounded by large mitochondrial bodies. The width of the centriole measured 0.22 mm. The mitochondrial bodies are of typical appearance and consist of a number of twisted lamellae enclosed in a membrane. From the negative stained spermatozoa, the length of the tail was measured to have an average of 36.6 mm. The nuclei of *Pinctada fucata* are somewhat ellipsoidal in the early stage of differentiation, but by late spermiogenesis they become spheriodal.

163. **Athithan, S., N. Ramanathan, T. Francis and V. Ramadhas** 2005. Polyculture of tiger shrimp and carps in hard water seasonal ponds. *Indian J. Fish.*, 52(3): 339-343.

Address: Fisheries College and Research Institute, Tuticorin, 628 001, Tamilnadu, India.

Abstract : Experiments were carried out to assess the growth of tiger shrimp *(Penaeus monodon)* and carps under polyculture practice particularly in hardwater seasonal ponds. The growth of tiger shrimp and carps were recorded for a period of 110 and 180 days respectively during December, 2002 to May, 2003. The growth rate of *Penaeus monodon* and carps under poly culture practice were 32g and 298g respectively. The production of shrimp and carps registered under polyculture practice were 25.750 kg/0.1 ha/110 days (a low stocking density of 1.5 nos/m^2) and 135.450 kg/0.l ha/180 days respectively.

164. **Avelin Mary, P., Sivasakthi and Vitalina Mary** 1991. Effect of organic extracts from *Sargassum ilicifolium* and *Sargassum wightii* on four marine microalgae. *Seaweed Res. Utiln.,* 13(2): 175-183.

Address : Sacred Heart Marine Research laboratory, St. Mary's College, Tuticorin-628 001, Tamilnadu, India.

Abstract : The methanol extract of marine brown seaweed *Sargassum llicifolium* enhanced growth rate of marine microalgae *Dunaliella tertiolecta*, *Isochrysis galbana* and *Synechocystis salina* by 160.3%, 23.4% and 28.8% respectively at the concentration of 10 mg/ml and by 210.2%, 2.8% and 28.8% at 0.5 mg/ml based on original wet weight. There was 26.4% reduced growth during exponential period of growth in *Nitzchia* sp. in methanol extract of *S. ilicifolium* (0.5 mg/ml). Methylene chloride extract enhanced the growth rate to 63.4% in *Nitzchia* sp. at 10 mg/ml and 30.9% at 0.5 mg/ml. The methanol extract of *S. wightii* showed a sharp inhibitory effect (40.5%) at 10 mg/ml while it stimulated growth (67.6%) at 0.5 mg/ml in *Nitzchia* sp. while methylene chloride extract of the same showed 77.5% and 64.8% enhanced growth in *D. tertiolecta* at 10 mg/ml and 0.5 mg/ml respectively.

165. **Avelin Mary, Vitalina Mary, R. Sarojini and R. Nagabhushanam** 1994. Bacteriostatic compounds in extracts of marine animals from the Indian Ocean. ***In*** : *Recent Developments in Biofouling control.* (eds) M.F. Thompson, R. Nagabhushanam, R. Sarojini and M. Fingerman. Oxford and IBH, New Delhi, India. pp. 229-239.

Address : St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Eighteen bacterial isolates from five genera, *Aeromonas, Alcaligenes, Flavobacterium, Pseudomonas,* and *Vibrio,* were isolated from biofilm associated with *Perna* sp. These marine bacteria were tested for sensitivity to extracts from sponges, anemones, and a polychaete worm. The sponges, *Spirastrella inconstans* and *Spongia officinalis*, were found to be bacteriostatic. Antimicrobial assays showed that thin-layer chromatography fraction 6 of *S. inconstans* and fraction 7 of *S. officinanlis* inhibited the growth of the bacteria at an extract concentration equivalent to 10 mg original wet weight of tissue per disc. Methylene-chloride extracts of *Anemonia* sp. and *Nereis versicolor* were fractionated by vacuum liquid chromatography. Antimicrobial testing of these fractions demonstrated that fractions 2 and 3 of *Anemonia* sp. were potent against *Pseudomonas* and *Vibrio*, with zones of inhibition exceeding 12 mm radius; fraction 4 of *N. versicolor* inhibited the growth of *Aeromonas*, *Pseudomonas*, and *Vibrio*. In the future, we shall use natural products as tools to study the interactions of bacteria and the settlement of barnacle larvae.

166. **Avelin Mary, Vitalina Mary, R. Sarojini and R. Nagabhushanam** 1994. Broad spectrum natural products from the Indian Ocean octocoral *Euplexaura nuttingi*. ***In***: *Recent Developments in Biofouling control*. (eds) M.F. Thompson, R. Nagabhushanam, R. Sarojini and M. Fingerman. Oxford and IBH, New Delhi, India. pp. 241-249.

Address : St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Compounds from the soft coral *Euplexaura nuttingi* inhibited barnacle settlement in the laboratory. The EC_{50} value for the methylene-chloride extract of *E. nuttingi* was 0.68 mg original animal wet weight/ml. Of the seven ultraviolet quenching thin-layer chromatographic fractions, fractions 6 and 7 were potent with EC_{50} values of 0.55 and 6.57 µg/ml, respectively, based on dry weight of the fractions. These compounds were tested against 8 bacteria in five genera - *Aeromonas, Alcaligenes, Flavobacterium, Pseudomonas*, and *Vibrio* - found in the biofilm associated with the macrofouler *Perna* sp. Fractions 6 and 7 were bacteriostatic. All 8 bacterial isolates inhibited barnacle settlement in the laboratory.

167. **Awati, P.R.** 1927. An account of the pearl fisheries of Tuticorin March and April, 1927. *J. Bombay. Nat. Hist. Soc.,* 32(3): 524-531.

168. **Awati, P.R and H.S. Rai** 1927. A note on the development of *Ostrea cucullata. Proc. Indian, Sci. Congr.,* : 191.

169. **Ayyakkannu, K., C. Regunathan and T. Rajakumar** 1991. Socioeconomic profiles of fishermen communities from the southeast coast of India. *Phuket Mar. Biol. Cent., Spl. Publn.*, 9: 49-55.

170. **Ayyakkannu, K.** 1992. Socioeconomic profile of the Mandapam and Tuticorin sectors, southeast coast of India (Gulf of Mannar), with special reference to the fishing villages of Vethalai and Thirespuram. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biological Cent.*, 10: 39-43.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of studies conducted in the villages of Vethalai and Thirespuram in India in order to obtain information as to the socioeconomic status of the fisherfolk. These 2 villages were observed to be the major landing centres of *Chicoreus ramosus*, which is gaining acceptance among the fishermen community as a chief seafood.

171. **Ayyakkannu, K.** 1994. Status of coastal aquaculture in India. The present trend and future prospects. IV Workshop of the Tropical Marine Mollusc Programme (TMMP), Phuket (Thailand), 27th Oct to 2nd Nov 1993. *Spec. Publ. Phuket Mar. Biol. Cent.*, 13: 45-52.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Aquaculture is being viewed as the only alternative to augment fish production due to over-exploitation of culture. The world demand for fish in 2000 AD is expected to be 130 million tons against the present production of about 100 million tons. In 1991-92, India has exported 171,820 tons of marine products. India is endowed with rich natural resources in the coastal zone with ample scope for the development of aquaculture. The technology for culture of mud crab, sea weeds, edible oyster and sea cucumber has also been developed, but the commercial farming of these has not kept pace with the demand because of the lack of awareness of, and the information needed to divert the attention of people from the lucrative business of shrimp culture. Though great advances have taken place in India in the technology involved in culturing pearls with the pearl oyster *Pinctada fucata*, it has not attracted potential entrepreneurs and is awaiting development of suitable locations in Gulf of Mannar, Andaman and the Nicobar Islands.

172. **Ayyappan, S and R.S. Biradar** 2002. Fisheries education in India. *Fish. Chimes*, 22(1): 45-50.

Address : Central Institute of Fisheries Education (Deemed University), Versova, Mumbai-400 061, India.

Abstract : Human resource development (HRD) is a critical input for sustainable utilisation of fisheries resources. Recognising the importancae of HRD, two training centres, one at Barrackpore for Inland Fisheries and other at Mandapam for marine fisheries were started in India in 1945. The major step in HRD in fisheries however was the establishment of Central Institute of Fisheries Education (CIFE) at Mumbai, India in June 1961, to provide professionally trained manpower, for the upcoming fisheries industry. Fisheries education under the State Agricultural University (SAU) system started only in 1969 with the establishment of the first fisheries College at Mangalore under the auspices of the University of Agricultural Sciences, Bangalore, India. Presently, 11 SAUs one Central Agricultural University and the CIFE, Mumbai (Deemed University) offer fisheries education in the country. Recognising the need for maintaining high standards in Agricultural education including fisheries, Indian Council of Agricultural Research (ICAR), New Delhi, India initiated several measures, such as uniform curricula, strengthening of infrastructural facilities and faculty, external evaluation, development of instructional material and accreditation. In the light of changing needs of fisheries sector and globalisation, Undergraduate (UG) and Postgraduate (PG) course needs and aspects of Distance Education, Vocational Education and training and extension programmes to provide professionally qualified and trained manpower to the fishing industry have been outlined.

173. **Azariah, J and H.S.H. Hussainy** 1982. Ecosystem analysis and management. International Symposium on Utilization of Coastal Ecosystems: Planning, Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982. *Atlantica*, 5(2): 9-10.

Address : Department of Zoology, University of Madras, Madras - 600 005, Tamilnadu, India.

Abstract : Environmental awareness with special reference to coastal Tamilnadu has been created with the presentation of two core papers and a thesis. These works relate to a) the River Cooum and coastal ecosystem at Madras, b) Point Calimere Wild Life Sanctuary, Tanjavur, and c) Krusadai Island and neighbourhood ecosystem, Gulf of Mannar. Taking the city of Madras as an ecosystem, the paper outlines a few project activities in ecosystem analysis on an interdisciplinary basis. The study is concerned about evolving a strong database for identifying

other problem areas. The sensitive compartment of the study is movement of pathogenic bacteria through the city ecosystem, via marine organisms. The study will cover bacterial typing in marine and cultured organisms that are commercially important. A historical and environmental overview of the unique combination of ecosystems at Point Calimere Wild Life Sanctuary has been provided.

174. **Azariah, J and S.B. Pillai** 1985. The role of Hemichordate *Ptychodera flava* in the preservation of species diversity in the Gulf of Mannar, Marine Park. *Proc. Symp. Endangered Marine Animals and Marine Park, MBAI*, 1: 389-400.

175. **Azariah, J.** 1995. Tuticorin Bay of the Gulf of Mannar. The proposed marine national park in crisis. *Symposium on the large marine ecosystems of the Pacific Rim, Qingdao (China), 8-11 Oct 1994. The large marine ecosystems of the pacific rim. A report of a symposium.* (eds) Q.Tang and K. Sherman. Gland-Switzerland, IUCN 1995 p.115.

Address : University of Madras, Guindy Campus, Madras- 600 025, Tamilnadu, India.

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176. **Babu, M.M and M. Peter Marian** 2001. Advantages of microfilter evacuator in evacuation and encapsulation in adult Artemia. *Aquacul. Engg*., 24 : 26-28.

Address : Department of Marine Science and Technology, M.S. University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

177. **Babu, M.M., M. Peter Marian and M. R. Kitto** 2001. A cradle aeration system for hatching Artemia. *Aquacult. Engg*., 24: 85-88.

Address : Department of Marine Science and Technology, M.S. University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

178. **Babu, M.M., C. Ravi and M. Peter Marian** 2001. Factors determining spawning success in *Penaeus monodon*, *NAGA*, ICLARM, Manila, 24: 13-15.

Address : Department of Marine Science and Technology, M.S. University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

179. **Babu, M.M., S. Lazarus and M. Peter Marian** 2001. Shrimping - foot prints on the sands of time. *Curr. Sci.*, 80: 101-102.

Address : Department of Marine Science and Technology, M.S. University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

180. **Babu, U.V and H.S. Garg** 1996. Chemical constituents of sea-urchin *Temnopleurus toreumaticus*. *Indian J. Chem. B Org. Med.*, 35(9): 995-997.

Address : Medicinal Chemistry Division, Central Drug Research Institute, Lucknow 226 001, India.

Abstract : MeOH extract of sea-urchin *Temnopleurus toreumaticus* yields a mixture of cholesterol, campesterol, beta -sitosterol, a diglyceride(1) and a fixed oil along with acetanilide. The oil shows moderate order of hypolipidemic activity. The aquous fraction shows the presence of glycine, tryptophan, arginine and taurine as free amino acids.

181. **Babu Rajendran, R., V.M. Karunagaran, S. Babu and A. Subramanian** 1992. Levels of chlorinated insecticides in fishes from the Bay of Bengal. *Mar. Poll. Bull*., 24(11): 567-570.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India.

Abstract : The body burdens of environmentally persistent chlorinated insecticides such as DDT and its metabolites and HCH (BHC) isomers in 14 species of marine fishes collected from Tamil Nadu (Madras, Cuddalore, Nagapattinam and Tuticorin) and Pondicherry coasts of Bay of Bengal in South India were reported. The total HCH was more dominant than total DDT. Moreover á-HCH and p, p-DDT were greater among HCHs and DDTs respectively. Higher concentrations of both the compounds were detected in the tissues of rays (*Dasyatis* sp.), *Lates calcarifer, Scomberomorus guttatus* and *Nemipterus japonicus.*

182. **Babu Rajendran, R., H. Tao, A. Miyazaki, S. Ramachandran and R. Ramesh** 2001. Determination of butyl, phenyl, octyl and tributyl monomethyl tin compounds in a marine environment (Bay of Bengal, India) using gas chromatography-inductively coupled plasma mass spectrometry. *J. Environ. Monit*., 3 (6): 627-634.

Address : National Institute of Advanced Industrial Science and Technology, 16-1 Onogawa, Tsukuba 305-8569, Japan.

Abstract : Organotin compounds (butyl, phenyl, octyl and tributyl monomethyl tin) and inorganic tin were quantified in seawater and sediments from two harbours and several locations on the southeast coast of India using highly sensitive and selective gas chromatography-inductively coupled plasma mass spectrometry (GC-ICP-MS), adopting new extraction and analytical techniques with extremely low detection limits (water, 0.019-0.85 $pg1^{-1}$; sediment, 0.23-0.48 ng g^{-1}). The concentrations of monobutyltin (MBT), dibutyltin (DBT) and tributyltin (TBT) in seawater from Tuticorin harbour varied from 0.64 to 4.97, 3.0 to 26.8 and 0.3 to 30.4 ng $Sn1^{-1}$, respectively. MBT, DBT and TBT in sediments from harbour areas ranged from 1.6 to 393, 1.3 to 394 and ND (not detected) to 1,280 ng Sng^{-1} (dry weight), respectively. Natural methylation in both harbours was established

by quantifying tributylmonomethyltin (TBMMT) residues (seawater, ND-0.19 ng $Sn1^{-1}$; sediment, ND-765 ng Sng^{-1} dry weight). In seawater, octyltins were also determined as mono octyltin (MOT) > di octyltin (DOT) > tri octyltin (TOT). Butyltin contamination in commercial harbours is evident, but other coastal waters are not contaminated with organotin residues. The high concentration of inorganic tin in estuarine sediment indicates an elevated rate of debutylation in the estuarine environment. Both methylation and debutylation of TBT in Chennai harbour were greater than in Tuticorin harbour. A significant correlation (r^2 = 0.75) between total butyltin and organic carbon contents in sediment was found. To our knowledge, this is the first report on the distribution of butyltins and methylated butyltin in seawater and sediment and octyltins in seawater in the Indian marine environment.

183. Babu Rajendran, R., T. Imagawa, H. Tao and R. Ramesh 2004. Distribution of PCBs, HCHs and DDTs, and their ecotoxicological implications in Bay of Bengal, India. *Environ Int.,* 31(4): 503-512.

Address : Institute for Environmental Management Technology, National Institute of Advanced Industrial Science and Technology, 16-1 Onogawa, Tsukuba 305-8569, Japan. babu-ramaswamy@aist.go.jp

Abstract : Analyses of environmentally persistent pollutants like polychlorinated biphenyls (PCBs), hexachloro cyclohexane (HCH) isomers, and dichlorodiphenyltrichloroethane (DDT) and its metabolites in seawater and sediment samples collected from six locations along the east coast of India were carried out using High-Resolution Gas Chromatograph with High-Resolution Mass Spectrometer (HRGC-HRMS). Sediment and water from Chennai harbour and Cuddalore fishing harbour contained higher concentration of all the compounds. The highest concentration (6,570 pg/g dry weight) of total PCB was found in sediment from Chennai harbour followed by sediments sampled in Chennai (opposite to Cooum River mouth) (505 pg/g), Cuddalore fishing harbour (335 pg/g) and Mandapam (251 pg/g). Concentrations in other locations were two orders of magnitude lower than Chennai harbour. A distinct PCB distribution pattern in sediment was observed between harbours and other locations. Greater concentrations of tetra-, penta- and hexachloro biphenyls were observed in sediments of harbours and opposite to Cooum river mouth, but in other locations lower chlorinated biphenyls (di, tri and tetra) were more. In seawater, HCH concentration was greater than DDT, but it was quite opposite in sediments. Elevated levels of DDT in sediment were observed only at highly populated urban locations, reflecting the local usage and input of this pesticide. Based on sediment/water quality criteria/guidelines, some coastal locations of the Bay of Bengal could be designated as being polluted by DDTs and gamma-HCH (lindane), but not by PCBs. This investigation reveals the declining trend on the environmental burden of persistent pesticides in Indian marine environment. Data on the organochlorine concentrations found in this survey can be used as reference levels for future POPs monitoring programme.

184. **Babuselvam, M., G. Ramanathan, S. Ravikumar, S. Babu, K. Muniyandi and I. Essakiraj** 2005. Diversity of Marine filamentous Fungi Associated with Marine Sponges in Pallam coast and Screening of Secondary Metabolites Against Microbial pathogens. *Proc. Nat. Symp. Recent trends in microbial biotechnology*, December 29-30, 2005. Sri Sankara Arts & Science College, Kanchipuram,(ed). R. Balagurunathan.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Tamilnadu, India.

Abstract : Considering the tremendous potential of marine filamentous fungi as a source of new bioactive natural products, the present study has made an attempt to isolate filamentous fungi associated with marine sponges from Pallam coast, Cape Comarin, South India during October 2003 to March 2004. The counts of filamentous fungi were found maximum by 20.6 X 10^2 on March. Seven fungal species *viz., Aspergillus fumigatus, Chrysosporium* sp., *Penicillium oxalicum, Penicillium funiculosum, Aspergillus tamari, Alternaria alternata* and *Aspergillus* sp., were identified and further tested for their antimicrobial potential against chosen pathogens. Among the fungal species , *Penicillium funiculosum* showed maximum sensitivity against all the pathogens. It reveals that, sponge associated filamentous fungi from Cape Comarin coast have enormous potential of bioactivity and thus could be used further for the development of ecofriendly alternative therapeutic drugs for a variety of human diseases.

185. **Badrudeen, M., A. Bastin Fernando, C. Kasinathan, N. Kaliaperumal, S. Krishna Pillai, V.Kunjukrishnapillai, G. Pandian, M. Sivadas and P. Vedavyasa Rao** 1987. An instance of mass fish mortality at Mandapam, southeast coast of India. *Mar. Fish Inf. Serv. T & E. Ser.,* 75: 1-5.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An account is given of an incidence of mass mortality of fish and shellfish that occurred along the

beaches of Mandapam, India on 13th May 1987. Some 20 species of commercially important fish and shellfish were involved; most of the species affected were those inhabiting near the bottom or the reef-dwelling fish. The environmental features of the affected area are described; dissolved oxygen was found to be highly depleted. Phytoplankton blooms were reported a few days prior to the fish kill. Possible causes of the fish mortality are discussed.

186. **Badrudeen, M.** 1995. On the largest sunfish *Masturus lanceolatus* recorded at Periapattinam, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 137: 20.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Sunfishes of the family Molidae are purely oceanic species of the warm and temperate seas having restricted distribution. Though it was not common along the Indian coast, the occurrence of sunfish was recorded at Periapattinam of Gulf of Mannar. The morphometric measurements are given and discussed.

187. **Badrudeen, M and A.D. Diwan** 1997. Note on seasonal fishery of *Holothuria* (metriatyla) *scabra* Jaeger from Pamban Island. *Mar. Fish. Infor. Serv. T & E Ser.,* 149: 14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The sea cucumber fishery of Pamban Island was observed from July to October 1995. Fishing and processing methods are given.

188. **Badrudeen, M and P.K. Mahadevan Pillai** 1997. Food and feeding habits of the big-eyed majarra, *Gerres macracanthus* Bleeker of the Palk Bay and the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 38: 58-62.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Gut contents of *Gerres macracanthus* from the Palk Bay and the Gulf of Mannar landed by trawl net at Rameswaram and Mandapam were analysed. A total of 1,602 fishes from the Palk Bay and 102 fishes from the Gulf of Mannar were examined for stomach content analyses. The points method was followed in the present study. The frequency of various components in the food has been estimated by occurrence method and expressed in percentages. Polychaetes were the most common food item followed by *Penaeus semisulcatus, Parapenaeopsis tennella and Metapenaeus affinis,* in the order of abundance. Much difference could not be noted in the food components of the fishes occurring in the Gulf of Mannar and the Palk Bay.

189. **Badrudeen, M.** 2000. On the occurrence of the cirriped barnacle, *Chelonibia patula* (Ranzani) on the sea snake, *Hydropis cyanocintus* (Dandin). *Mar. Fish. Infor. Serv. T & E. Ser.,* 164: 25.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In this article, the common cirriped barnacle, *Chelonibia patula* (Ranzani) observed as biofouler on the sea snake, *Hydropis cyanocintus* (Dandin) is described.

190. **Bai, C. S., M. Peter Marian and J.A.C. John** 1999. Studies on the cyanobacteria of the salt work of Rajakkamangalam as food for *Artemia franciscana*. *Proc. Cyanobacterial biotechnology.* pp. 409-412.

Address : Department of Marine Science and Technology, M.S. University, Rajakkamangalam - 629 502, Kanyakumari, India.

191. **Bakus, G.J.** 1994. *Coral reef ecosystem.* Oxford and IBH publishing Co. Pvt. Ltd. New Delhi, India, 232 pp**.**

Abstract : The book deals with the distribution, ecology and environmental aspects of coral reefs ecosystem. This includes information on the Gulf of Mannar reefs and their status, based on information available in the scientific literature. There is also information on the anthropogenic threats to the coral reefs of the region.

192. **Bal, D.R**. 1958. Fisheries and Marine Biology in India. *Proc. Indian Sci. Congr., 45th Session:* 134.

193. **Balachandran, S.** 1995. Shore birds of the Marine National Park in the Gulf of Mannar, Tamil Nadu. *J. Bombay Nat. Hist. Soc*., 92(3): 303-313.

Address : Bombay Natural History Society, Hornbill House, Dr. Salim Ali Chowk, Bombay 400 023, India.

Abstract : During the bird migration study conducted during 1985-1988 at the Gulf of Mannar Marine National Park area, a total of 187 species of birds were recorded, of which 84 were aquatic species and the remaining

terrestrial. The status, population, arrival and departure dates (for the migratory species) of the waders, terns and gulls have been described specieswise. The other aquatic birds are listed groupwise and the terrestrial birds recorded are listed in the checklist. At Manali and Hare Islands 23 species of migratory birds were found to oversummer every year. The uncommon waders to India such as knot *Calidris canuta*, eastern knot *C. tenuirostris*, *Numenius arquata*, whimbrel *N. phaeopus*, and bar-tailed godwit *Limosa lapponica* were recorded as regular winter visitors to this area.

194. **Balachandran, S.** 1998. Population, moult, biometrics and subspecies of large sand plover *Charadrius leschenaultii* wintering in southeast India. *J. Bombay Nat. Hist. Soc.*, 95(3): 426-430.

Address : 11/100, Central Street, Agasteeswaram P.O. Kanyakumari District, Tamil Nadu 629 701 India.

Abstract : Based on the results of the bird ringing studies conducted during 1985-1988, along with bird count data, this study provides information on the population, moult, proportion of young birds, measurements and subspecies of the large sand plover *Charadrius leschenaultii* wintering in the Gulf of Mannar Marine National Park in southeast India. About 300-500 birds winter and some individuals spend the breeding season (summer) here. The proportion of "first year" birds was < 30%. Adults complete the primary moult by October, one to two months earlier than in northwest Australia. Birds weighed at departure weigh at least 30% less than in Australia. Two subspecies, *crassirostris* and *leschenaultii*, have been recognised from the wintering population.

195. **Balachandran, T and K.J. Peter** 1988. The role of plankton research in fisheries development. *CMFRI Spec. Publ.*, 40: 24-25.

Address : National Institute of Oceanography, Regional Centre, Cochin 682 018, India.

Abstract : Recent studies on the associations between the plankton community and fisheries illustrate how the biological oceanographic data may be utilized in understanding the mechanisms contributing to the survival of fish. An attempt is made to assess the role that plankton can contribute towards fisheries development. Studies on Indian ocean plankton showed that the most important factor that influences the fisheries of a region is the nature and extent of plankton production because of the fact that the survival of fish and fish larvae in a locality is dependent on the type and availability of food.

196. **Balaji Raghavendra Rao, H., A. Sathivel and T. Devaki** 2003. Antioxidant nature of *Ulva lactuca* on D-galactosamine induced liver damage in rats. *SDMRI Res. Publ.*, 3: 114-117.

Address : Department of Biochemistry and Molecular Biology, University of Madras, Guindy Campus, Chennai 600 025, Tamil Nadu India.

Abstract : Effects of pre-treatment with the alcoholic and aqueous extracts *Ulva lactuca*, a marine green alga on liver antioxidant defense system during acute hepatitis induced by D-Galactosamine (D-GalN, 500 mg dissolved in physiological saline / kg body weight/day for 2 days, intraperitoneally) were investigated through the activities of enzymic antioxidants such as Super Oxide Dismustase (SOD), Catalase (CAT), Glutathione Reductase (GR), Glutathione Peroxidase (GPX), Glutathione-S-Transferase (GST) and the levels of total reduced Glutathione (GSH) and Lipid Peroxidase (LPO) in the liver of normal and experimental groups of male albino rats. Extracts of Ulva lactuca pretreated rats showed protective nature against D-GalN induced oxidative stress as evidenced by a significant increase in the activities of antioxidant enzymes and decrease in the levels of lipid peroxides, suggesting a free radical scavenging property.

197. **Balaji Raghavendra Rao, H., A. Sathivel and T. Devaki** 2004. Effect of *Sargassum polycystum* against acetaminophen induced haematological and biochemical changes in experimental rats. *Seaweed Res. Utiln.*, 26(1&2): 121-126.

Address : Department of Biochemistry, University of Madras, Guindy Campus, Chennai - 600 025, Tamilnadu, India.

Abstract : Effect of alcoholic extract *Sargassum polycystum* (200 mg /kg body wt /day for a period of 15 days), a marine brown alga against single acute dose of acetaminophen (800 mg/kg body, intraperitoneally) induced biochemical and haematological changes in experimental rats was studied with respect to prothrombin time (PTT), haemoglobin (Hb), packed cell volume (PCV), erythrocyte sedimentation rate (ESR), red blood cell count (RBC), white blood cell count (WBC) and glucose. The serum levels of protein, ceruloplasmin, uric acid, creatinine, total bilirubin and cholesterol were also examined. The acetaminophen induction elevated the levels of prothrombin (PTT), erythrocyte sedimentation rate (ESR), creatinine, bilirubin and cholesterol with decrease in the levels of haemoglobin (Hb), packed cell volume (PCV), red blood cell count (RBC), white blood cell

count (WBC), glucose, protein, ceruloplasmin and uric acid. These severe alterations in the haemotological profile will reflect in the liver tissue, which may lead to hepatic damage. Pre-treatment with alcoholic extract of *Sargassum polycystum* significantly reduced the toxic effect of acetaminophen by improving the severely altered haematological and biochemical parameters suggesting a free radical scavenging property.

198. Balakrishnan, M.S. 1946. The morphology and cytology of *Melobesia farinose* Lamour. M.O.P. Iyengar commemoration volume. *J. Indian Bot. Soc.*, pp 305-319.

199. Balakrishnan, S and K.V. Krishnamurthy 1998. Occurrence of calcium oxalate crystals from a brown alga *Padina boergesenii* Allender and Kraft. *Seaweed Res. Utiln.*, 20(1&2): 115-117.

Address : Department of Botany, Bharathidasan University, Trichy-620 024, Tamilnadu, India.

Abstract : Occurrence of Calcium oxalate crystals from the surface cells of *Padina boergesenii* are reported. They are smooth with a matrix of unknown composition in which oxalate deposits are seen.

200. Balakrishnan Nair, N. 1965. Marine timber boring organisms of the Indian Coast. Report on a collection from the South East Coast of India, with notes on distribution in the Indo-pacific area. *J. Bombay Nat. Hist. Soc.*, 62(1): 120-131.

201. Balakrishnan Nair, N. 1979. Incidence of wood boring molluscs in the oyster farms at Tuticorin. *Mahasagar,* 12: 109-113.

Address : Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum- 695007, India.

Abstract : Wooden pilings heavily riddled by molluscan wood borers, pulled out from the oyster farm at Karapad Creek in Tuticorin were examined to assess the species involved and the nature of vertical distribution. *Teredo furcifera* was found to be the most important borer even though others like *Lyrodus pedicellatus, Lyrodus affinis* and *Martesia striata* were also present. The intensity of attack of the shipworms was found to be maximum above the mud line while that of *Martesia* mainly below the low water mark. The nature of organisms in the fouling complex and probable causes for infestation are discussed with suggestions for minimizing the attack.

202. Balakrishnan Nair, N and K. Dharmaraj 1980. Wood boring molluscs of the Palk Bay and the Gulf of Mannar. *Mahasagar,* 13(3): 249-260.

Address : Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum-695 007, India.

Abstract : The incidence and activity of eleven species of shipworms (Bivalvia: Teredinidae) and two species of piddocks (Bivalvia: Pholadidae) in several localities along the coasts of the Gulf of Mannar and the Palk Bay, are reported. The borer activity and nature of timber destruction are noted in aquafarms where *Teredo furcifera* von Martens, *T. fulleri* Clapp. *T. bartschi* Clapp and *Lyrodus pedicellatus* (Quatrefages) are active. In floating timbers from the open sea *Bankia campanellata* Moll & Roch, *B. carinata* (Gray) and *Martesia fragilis* Verrill & Bush are found to be common. Less important forms include such species as *Teredo triangularis* Edmondson, *Teredora princesae* (Sivickis), *Uperotus clavus* (Gmelin), *U. rehderi* (Nair), *Teredothyra excavata* (Jeffreys) and *Martesia flrialll* (Linnaeus). The incidence of these pests and the relative destruction of timber structures in different mariculture farms varied with locality. The possible causes for the severe attack, nature of vertical distribution, factors affecting the spatial variations and the possibilities of prolonging the service life of indigenous timbers in coastal waters arc discussed briefly.

203. Balan, B., N. Sukumaran and R. Suresh 1996. Economics of semi intensive shrimp farming in Tuticorin. *Seafood Export J.*, 27(8): 17-19.

204. Balasingh, G.S.R. 2001. Water Quality and pollution effects of Rajakkamangalam estuary, Kanyakumari District, Tamil Nadu. *National Seminar on marine and coastal ecosytems: coral and mangrove - problems and management strategies, 26-27 Sept 2001, Tuticorin, Abstract,* p.65.

205. Balasubramanian, A. 1994. Squid culture. *Seafood Export J.*, 25(13): 11-12.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Collection and maintenance of adults, spawning and rearing of the squids for their culture are described. Preferred and available species of squids in India are reported.

206. Balasubramanian, T and M.V.M. Wafar 1974. Primary productivity of some Fringing Reefs of southeast India. *Mahasagar,* 7: 157.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Primary productivity of two fringing reefs in southeast India was studied from the diurnal curve method. The rate of production in the waters around the reef was determined by ^{14}C uptake and chlorophyll-*a* estimation. The rates of production and consumption in individual sea-grasses were determined by the light and dark bottle oxygen method. Gross production of the Palk Bay reef ranged from 4.86 gC/m^2/day in March to 9.5 gC/m^2/day in May. In the Krusadai Island reef the rate of gross production was 2.39 gC/m^2/day in November. Phytoplankton production in the Palk Bay reef area ranged from 0.51 gC/m^2/day to 1.62 gC/m^2/day and chlorophyll-*a* values from 0.177 µg/l to 0.695 µg/l. In the Krusadai reef the phytoplankton production was 0.17 gC/m^2/day and the chlorophyll-*a* was 0.163 µg/l. Oxygen production and consumption in individual corals and seagrasses indicate that the individual species is autotrophic with P/R ratios exceeding 1.

207. **Balasubramanian, T and M.V.M. Wafar** 1975. Primary productivity of some seagrass beds in the Gulf of Mannar. *Mahasagar,* 8(1&2): 87-91.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Primary productivity of 2 seagrass beds and 1 algal bed in the Gulf of Mannar was studied by diurnal curve method. The sea grass bed close to Mandapam Camp (*Cymodocea isoetifolia, C. serrulata, Halophyla ovalis, H. stipulacea* and *Diplanthera uninervis*) was found to be autotrophic, with P/R ratios ranging from 1.65 to 3.90. The seagrass (*Enhalus* sp) and algal beds (*Halimeda, Caulerpa, Padina* and *Hypnea*) around Kurusadai Island were heterotrophic. Production of O_2 by individual sea grasses equalled or exceeded their consumption. Chlorophyll-a values in the waters over the seagrass bed ranged from 0.893 to 9.49mg/m^3.

208. **Balasubramanian, T., A.N. Subramanian, N.V. Vinithkumar and S. Kumaresan** 1998. Water Quality in the lagoonal reef flat area of Manuali Island: A case study. *Proc. Technical Workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*. MSSRF Publ. pp.38-48.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Coral reef requires clear water but they thrive well in low nutrient oligotrophic waters. They maintain a high gross primary productivity with an average value of 1500 - 5000 g C/m^2/Yr (Johannes *et al.,* 1972; Smith and Marsh, 1973). Coral reefs have the ability to hold tenaciously all nutrients in the system and cycle them efficiently, acting as a sink for most nutrients. Coral reefs and their rich biodiversity are environmentally sensitive owing to their fragile nature. Wilkinson (1993) reported that 70% of the world's coral reefs are predicted to collapse in the next 10-40 years due to global climate change. Besides, natural and anthropogenic pollutants are causing stress to the coral and associated reef ecosystem. Even nutrients pose a potential threat to corals. Increase in the level of nutrient results in eutrophication, which initiate algal and phytoplanktonic bloom. Consequently, light penetration is reduced, resulting in lower photosynthesis, calcification and net reduction in community productivity. Moreover increased levels of nutrients promote the growth of certain algae, which will grow over the coral, leading to a shift in the community structure.

209. **Balasubramanian, T., L. Kannan, T. Pugalendhi and M. Srinivasan** 2004. Heparin-like anticoagulant from the seaweed *Acanthophora spicifera* (Vahl.) Boergesen. *Proc. Nat. Sem. on New Frontiers in Marine Bioscience Research, January 22-23, 2004.* pp. 377-383.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Heparin, a highly sulphated glycosaminoglycan present in mammalian tissues, is universally used as anticoagulant drug for the past six decades. It has been commercially prepared from porcine intestine and bovine lung mucosa. Due to the demand for these raw materials and side effects exhibited by the synthetic products, investigations are going on for finding out alternative sources for extraction of heparin. The seaweeds (marine macro-algae) which contain sulphated polysaccharides were screened and the Rhodophyte, *Acanthophora spicifera* has been identified as a good source. The seaweed based anticoagulant was identified by the High Performance Liquid Chromatography and its potency was tested by the metachromatic and anticoagulant assays. The metachromatic activity of the anticoagulant ranged from 140 to 180 USP units mg^{-1} and the anticoagulant activity varied from 26.55 to 68.0 USP units mg^{-1}. The infrared spectra of standard heparin and seaweed anticoagulant were compared.

210. **Balasubramanian, T., R. Mohanraju, A. Purushothaman, M. Rajasegar, M. Ravindran, V. Sampath and R. Venkatesan** 2004. Distribution and composition of zooplankton along Tamil Nadu Coast (Bay of Bengal).

Proc. Nat. Sem. on New Frontiers in Marine Bioscience Research, January 22-23, 2004. pp. 469-478.

Address : CAS in Marine Biology, Annamalai University, Parangipettai 608 502, India; E-mail: cdl@sancharnet.in

Abstract : Distribution and abundance of zooplankton in the Bay of Bengal during the 44th cruise of R.V. A.A. Sidorenko (14-24th, April 2002) were studied. 26 samples were collected from 26 stations off Kanyakumari, Parangipettai, Pondicherry and Marakkanam sectors. Totally 86 species of zooplankton belonging to 14 groups were recorded in this study. Among the zooplankton groups, copepods were the dominant forms in all the 26 stations, whereas eggs and larvae and hydrozoa ranked next. In copepods, *Acrocalanus gracilis, Calocalanus pavo, Centropages calanicus, Eucalanus elongates, Euchaeta wolfendenii, Euterpina acutifrons, Copilia vitrea* and *Sapphirina ovatolanceolata* were the most dominant species. *Labidocera acuta* a rare species was recorded only in Marakkanam sector. Copepods were abundant at all depths especially in 50-0m and 100-0m. Night samples contained large numbers of zooplankton. Fish eggs and larvae were the most abundant in all the four sectors. The present study indicates the abundance and distribution of zooplankton at different depths along Tamilnadu coast, India during April.

211. **Balasubramanian, T.S., S. Rajapackiam and G. Arumugam** 1990. New grounds for deep sea prawn explored off Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 105: 8-10.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The estimated catch composition of deep sea prawns and their catch per unit effort (in kg) for the period from November 1989 to January 1990 is discussed.

212. **Balasubramanian, T.S., S. Rajapackiam and G. Arumugam** 1991. Bumper catch of white prawns *(Penaeus indicus)* by Disco-net along the Tuticorin coast. *Mar. Fish. Infor. Serv. T & E. Ser.,* 110: 8-9.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The estimated fishing effort and catch and the estimated species composition of prawns are discussed.

213. **Balasubramanian, T.S., S. Rajapackiyam and G.Arumugam** 1992. An account on the disposal of deep sea sharks and skates at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 116: 10-12.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In recent days additional fish production has been achieved by extending the fishing effort beyond the traditional fishing grounds and by diversification of the fishing effort as well. In view of the very high export potential of shark fins and also the abundance of sharks in the inshore and offshore areas, exploitation of deep sea sharks have attracted many dare-devil fishermen to concentrate on this lucrative fishery.

214. **Balasubramanian, T.S., S. Rajapackiyam, H. Mohamed Kasim and K.M.S. Ameer Hamsa** 1993. On the egg-cases of zebra shark *Stegostoma faciatum* caught off Tuticorin, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 121: 11.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements and the details of egg-cases of zebra shark *Stegostoma faciatum* from Tuticorin waters are discussed.

215. **Balasubramanian, T.S., S. Rajapackiyam, H. Mohamed Kasim and K.M.S. Ameer Hamsa** 1993. On the landing of bramble shark (*Echinorhinus brucus*) at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 121: 13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of *Echinorhinus brucus* landed at Tuticorin Fishing Harbour by deep sea trawlers during May 1991 is discussed.

216. **Balasubramanian, T.S., S. Rajapackiam, H. Mohamed Kasim and K.M.S. Ameer Hamsa** 1995. Emergence of hand jigging for cephalopods along Tuticorin coast. *Mar. Fish. Infor. Serv. T & E Ser.,* 137: 13-16.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Cephalopods, locally known as 'Kanava' have emerged in recent times as one of the prime foreign exchange earners in India. The common jigs used and the experimental introduction of modified jigs are discussed in this paper.

217. **Balasubramanian, T.S., S. Rajapackiam, K.M.S. Ameer Hamsa and H. Mohamed Kasim** 1995. On the bumper catch of balistids from Tuticorin with notes on length-weight relationship and gut contents. *Mar. Fish. Infor. Serv. T&E. Ser.,* 137: 18-19.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The balistids are leather jackets and are locally known as 'Klaathi' in Tamil. During the second week of July 1993, a few trawlers landed Balistids as the catch and other commercially important varities were poor. The number of trawl net units and the total catch are discussed.

218. **Balasubramanian, T.S., A. Chellam and P. Muthiah** 1999. On the mass stranding of dolphins at Vellapatti near Tuticorin in the Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E Ser.,* 163: 10-12.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric details of stranded Dolphins at Vellapatty near Tuticorin in the Gulf of Mannar area are discussed in this article.

219. **Balasubramanian, T.S.** 1999. On a sei whale *Balaenoptera borealis* stranded at Vellappati along the Gulf of Mannar coast. *Mar. Fish. Infor. Serv. T & E Ser.,* 163: 13-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of *Balaenoptera borealis* stranded at Vellappati along the Gulf of Mannar coast are discussed.

220. **Balasubramanian, T.S.** 2000. Marine fishery of Tuticorin. *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI,* pp.27-31.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Tuticorn is considered to be one of the well known vital fishery ports of India from time immemorial, located on southern Tamil Nadu coast and on the western side of the Gulf of Mannar owing to its commercially and economically important fisheries. The coastal line spreads over a distance of 110 Km from Trichendur in the south to Vembar in the north with 19 fishing villages.

221. **Balasubramanian, T.S.** 2000. Modifications of craft and gear in diversified tuna fishery undertaken at Tharuvaikulam, Gulf of Mannar, India. *Mar. Fish. Infor. Serv. T & E. Ser.,* 164: 19-24.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In this article, the estimated catch of tuna and the species composition of Tuticorin coast are listed in tables.

222. **Balasubramanian, T.S. and D.C.V. Easterson** 2000. On the stranding of Risso's dolphins and a sea cow along Tuticorin coast in Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 166: 20.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of *Grampus griseus* stranded at Punnakkayal and Tuticorin, and *Dugong dugon* stranded at Tharuvaikulam were studied.

223. **Balasubramanian, T.S.** 2001. Live stranding of dolphins at Tuticorin, Rescue and Release operations. *Mar. Fish. Infor. Serv., T&E Ser.,* 167: 9-10.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : On 23.04.2000 two dolphins were found, swimming in the shallow waters of Karapad (Tuticorin) bay situated near CMFRI fish culture pond and parallel to the harbour link road, by few fishermen during the early hours of the day. The water in this shallow area is clear, unlike the open bay which is ash ridden. They passed on the information to the CMFRI employees who were on watch duty. Later few nature lovers tried to help the dolphins by scaring them away into open bay.

224. **Balasubramanian, T.S.** 2001. Long stranding of sei whale, *Balaenoptera borealis* Lesson at Tuticorin coast. *Mar. Fish. Infor. Serv., T&E Ser.,* 167: 14.

Address : Central Marine Fisheries Research Institute, Tuticorin, India.

Abstract : On receipt of a message about the stranding of a whale in live condition, on 1-6-2000 a team from CMFRI visited the place to collect information on the stranding of whale.

225. **Balasubramanian, T.S and Jesi Selvarani** 2001. Stranding of spinner dolphins and a whale along Tuticorin coast. *Mar. Fish. Infor. Serv., T&E Ser.,* 167: 15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : On 21.9.99 one spinner dolphin *Stenella longirostris* Gray was accidentally caught at Tharuvaikulam by 'Mural Valai' (a small drift gill net) operated off Vaipar at a depth of 10-12m. The specimen was a male measuring 1.lm and weighing approximately 20kg. On enquiry, it is understood that the said whale was noticed by fishermen around 9:00 PM near the Hare Island where it was struggling for existence.

226. **Balasundaram, C and A.K. Kumaraguru** 1987. Influence of salinity on the growth and fecundity of the brine shrimp *Artemia. Nat. Symp. Environ. Biol.* 2nd to 4th April, 1987, St. Xavier's College, Palayankottai-627 002, India. p. 6.

Address : School of Energy Sciences, Madurai Kamaraj University, Madurai-625 021, India.

Abstract : The effect of salinity on the growth and fecundity of animals fed with a commposit diet was studied at various salinities of 20, 30, 50, 75, 100, 125 and 150 ppt. Brine shrimp Nauplii reared at 20 ppt suffered total mortality on the second day of rearing. The growth did not vary significantly in salinities ranging from 50-100 ppt; but in 30, 125, and 150 ppt, it decreased significantly ($P<0.05$) in a period of 18 days with an average length of 10.24mm and a weight of 4mg. Although viviparous reproduction was dominant at all the tested salinities, the cyst/nauplii ratio revealed an increased oviparity in salinities exceeding 50 ppt. At all salinities the cyst production increased when Ferric EDTA was added at a concentration of 5, 10 and 15 mg/l.

227. **Balasundaram, C and A.K. Kumaraguru** 1987. Laboratory studies on growth and reproduction of Artemia (Tuticorin strain). pp. 331-338. ***In***: *Artemia research and its applications.* (eds) P.Sorgeloos, D.A. Bengtson, W. Decleir and E. Jaspers. Universa Press, Wetteren, Belgium. 556 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai-625 021, India.

Abstract : The growth and reproduction rate of Artemia from Tuticorin (India) were studied at densities of 25 individuals/l seawater of 50 ‰ using six different types of food. Of the diets tested, the composite diet made up of a mixture of rice bran, yeast, algae from saltpans, and decomposed cabbage yielded the best growth. It took 9 days for the ovisac to appear in animals fed with the composite diet, whereas it took 20 ± 2 days in animals fed with other diets. The egg number/brood did not vary significantly ($P<0.05$). The effect of salinity on the growth and fecundity of animals fed the composite diet, was studied at 20, 30, 50, 75, 100, 125, and 150 ‰. Nauplii reared at 20‰ suffered total mortality on the second day of rearing. The growth was the greatest in salinities ranging from 50 to 100 ‰ but was significantly less at 30, 125 and 150 ‰ ($P<0.05$). Artemia reared at 50 ‰ achieved the maximal growth in 18 days (10.24 length and 4.0 mg weight). Although ovoviviparous reproduction was dominant at all the tested salinities, the cyst/nauplii ratio revealed an increased oviparity in salinities exceeding 50 ‰. At all salinities the cyst production increased when ferric EDTA was added at concentrations of 5, 10 or 15 mg/l.

228. **Balasundari, S., T.J. Abraham, G. Indra Jasmine and P. Jayachandran** 1995. Effect of temperature, heating time and chemicals on shucking edible oyster *Crassostrea madrasensis* (Preston). *Fish. Technol.,* 32 (2) : 99-101.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The effects of temperature and heating time and the infleunce of chemicals such as sodium bicarbonate, citric acid and dilute hydrochloric acid in conjunction with heat treatment on shell gaping and meat yield of *Crassostrea madrasensis* (Preston) were investigated. The meat yield decreased with increase in heating period. There existed significant difference in meat yield between the chemical treatments. Loss in meat yield differed significantly between the concentrations of chemicals tested except for bicarbonate treatment.

229. **Banerjee, P.K.** 2000. Holocene and Late Pleistocene relative sea level fluctuations along the east coast of India. *Mar. Geol.,* 167 (3&4): 243-260.

Address : Department of Geological Sciences, School of Oceanography, Jadavpur University, Calcutta, India.

Abstract : Hermatypic coral colonies and intertidal fossil bearing grainstone, packstone and sandstone beds of

Holocene and of a Late Pleistocene highstand are exposed above the present High Tide Level (HTL) at a number of locations along the east coast of India from Cape Comorin to Rameswaram. Being a passive margin boundary, free from indications of Late Quaternary seismogenic movements, this sector provides a benchmark for defining minor relative sea level perturbations during the Late Pleistocene and Holocene highstands along a tropical coast lying between latitudes 5°N and 10°N. A series of marine terraces, carved on and locally blanketted by Late Pleistocene biotic and terrigenous accumulations, occur at different elevations (up to 4.4 m) above LTL at Manappad Point, possibly signifying discrete stillstand episodes followed by abrupt intervals of rising/falling sea level. Sea level indicators of the Holocene highstand occur in this sector, as well as along the fringes of the Godavari delta further north. The Holocene highstand reached nearly 3 m above LTL at 7.3 ka, remained stable for approximately 1.7 kyr and was followed by a relative sea level fall. Between 5.2 and 4.2 ka, there was a second pulse of relative sea level rise of a few metres leading to a fresh spurt in coral growth along the northern coast of Mandapam and Rameswaram. This was nearly contemporaneous with fresh melting of ice sheets of Antarctica. The Little Ice Age (LIA) witnessed a minor (>1 m) relative sea level fall along this coast, resulting in rapid diagenetic hardening and infiltration of goethite into the emerged foreshore sand at Karikovil and its neighbourhood. This was followed by a rise of the sea level during the last few centuries.

230. **Banse, K.** 1959. On marine polychaeta from Mandapam, South India. *J. Mar. Biol. Assoc. India,* 1(2): 165-177.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The new subspecies may be distinguished from *A. hummelincki* by the apices of the thoracic hooks; further, the spatulate bristles commence on the 3rd setiger, and not on the 4th. In living animals, the pigment of the tentacular crown may be useful if it is absent in the type species. If the collarette really has a dorsal gap, the new form can be regarded as new species.

231. **Banumathi, R and K.S. Subbaramaiah** 1990. Diurnal periodicity of spore shedding in *Gelidiella acerosa* (Forskal) Feldman at Hamel of Mandapam coast. *Seaweed Res. Utiln.,* 12(1&2): 137-139.

232. **Bapat, S.V.** 1955. A preliminary study of the pelagic fish eggs and larvae of Gulf of Mannar and Palk Bay. *Indian J. Fish.,* 2(1): 231-255.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : The present paper reports on the occurrence, distribution and fluctuation of pelagic fish eggs in the Gulf of Mannar and the Palk Bay near Mandapam. The results are based on an examination of 43,352 fish eggs from 238 samples of plankton collected from the Gulf of Mannar and the Palk Bay. Experiments conducted in rearing the larvre to a stage when they can be identified did not yield satisfactory results. Artificial fertilisation proved helpful in deciding the identity in one species. Fourteen types of fish eggs and larvre have been described in detail, of which six belong to the suborder Clupeoidei, two to the genus *Caranx,* one to *Cynoglossus* and one to the family Muramidae. Eight types have been tentatively identified up to the genus or species, namely, *Anchoviella* sp., *Thrissocles* sp., *Kowala coval, Dussumieria* sp., *Sardinella fimbriata, Caranx leptolepis, Caranx* sp. and *Cynoglossus* sp. Spawning appears to take place in types *B, D, H,* C and *I* late in the evening or early in the night and in *E* in the early hours of the day. It has been observed that fish eggs occur in both of the areas studied almost throughout the year, the maximum number being taken in the month of March when the surface salinity-temperature in the Gulf of Mannar and the surface temperature in the Palk Bay were fairly low. There was greater concentration of fish eggs in the Gulf of Mannar than in the Palk Bay, although the general trend of their occurrence was similar in the two areas.

233. **Bapat, S.V.** 1988. Role of brackishwater culture in fisheries development. *CMFRI Spec. Publ.,* 40: 44-45.

Address : 6, Swarali Apartments, Near L.I.C. Colony, Paud Rd., Pune 411 038, India.

Abstract : The Seventh plan envisages an export target of Rs. 1000 crores from the fisheries sector. For attaining this target, the emphasis appears to be on exploitation from fishing grounds away from the conventional traditional grounds beyond the 30 fm line. The shrimp component from offshore grounds is negligible, less than 5%. Shrimp is the major component of marine exports and if targets are to be achieved, the shrimp catch has to be enhanced. A saturation point has been reached in exploiting shrimp, from control waters. Therefore the only alternative appears to be culture of shrimp on a large scale.

234. **Barlow, E.W.** 1934. Currents of the Arabian sea and Bay of Bengal: A further investigation into their seasonal variation. *Mar. Obsr.,* 11: 19-22.

235. **Baschieri Salvadori, F.** 1961. Second report to the Govt. of India on the pearl and Chank beds in the Gulf of Mannar. *FAO expanded technical assistance programme* 1323: 12 pp.

236. **Baskar, B.K and P.S.B.R. James** 1989. Size and weight reduction in *Holothuria scabra* processed as *Beche-de-mer*. *Mar. Fish. Infor. Serv. T & E Ser.*, 100: 13-16.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : The changes in the length and weight during processing of *Holothuria scabra* at Rameswaram were recorded and analysed.

237. **Baskar, B.K.** 1994. Some observations on the biology of the Holothurian, *Holothuria scabra*. *CMFRI Bulletin*, 46: 39-43.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Some aspects on the biology of commercially most important holothurian *Holothuria (Metriatyla) scabra* are presented. It subsists on the organic matter present in the mud or sand. An analysis of gut content revealed fine mud (75-125µ), sand particles (250-500µ), molluscan shells, debris and bits of algae. This species spawns in June and October. By external examination and by taking sections of the gonads, five maturity stages such as immature, maturing, early mature, late mature and spent have been fixed. The characteristics of different stages of maturity are presented in detail.

238. **Bastin Fernando, A.** 1983. Nesting site and hatching of the Hawk'sbill turtle along Tirunelveli coast of Tamil Nadu. *Mar. Fish. Infor. Serv. T & E. Ser.*, 50: 33-34.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : The nesting site of the Hawk'sbill turtle near Tuticorin was observed and the rate of hatching was assessed. The carapace length and width was also measured before releasing into the sea.

239. **Bastin Fernando, A., C. Kasinathan, S. Krishna Pillai and N. Ramamoorthy** 2002. An account of abnormal monster ray *Aetobatus narinari* (Euphrasan) exhibiting complete albinism from Gulf of Mannar. *Seshaiyana*, 10(1): 9.

Address : Central Marine Fisheries Research Institute, Vizhinjam Research Centre, Vizhinjam-695 521 India.

Abstract : Incomplete albinism like anticolouration, xanthocromism and melanism are quite frequent among fishes but complete albinism has been recently noted. Some instances of complete albinism were reported from catfish. Already abnormality in different species of rays was reported. The present account deals with abnormality in monster ray *Aetobatus narinari* collected from the Gulf of Mannar.

240. **Batcha, H and M. Badrudeen** 1992. Length-weight relationship and relative condition of *Leiognathus brevirostris* (Valenciennes) from the Palk Bay. *J. Mar. Biol. Assoc. India*, 34(1&2): 269-270.

Address : Central Marine Fisheries Research Institute, Cochin - 682 031, India.

Abstract : The length-weight relationship of *Leiognathus brevirostris* which supports a commercial fishery in the Palk Bay at Mandapam is found to be logarithmic, expressed by the formula: Log W = -4.8512 + 3.004 Log L indicating an isometric growth pattern of the fish in its natural habitat. The mean relative condition of the species is 0.996 which denotes the normal well being of the fish in this region.

241. **Beddome, R.H.** 1906. Note on Indian and Ceylonese species of *Glessula*. *Proc. Malac. Soc. Lond.*, 106-172.

242. **Bell, F.J.** 1888. Report on a collection of echinoderms made at Tuticorin, Madras by Mr.Edgar Thurston, *Proc. Zool. Soc. Lond.*, 1888: 383-389.

243. **Benny, A and K. Ayyakkannu** 1992. Length-weight relationship in *Chicoreus ramosus*. *Proc. Second Workshop Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May,1992. *Spec. Publ. Phuket, Mar. Biol. Cent.*, 10: 199-201. (eds) J. Hylleberg, K. Ayyakkannu,and S. Khokiattiwong. *Phuket Marine Biological Cent.*, 10: 199-201.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, India.

Abstract : The findings are presented of a study conducted to determine the length-weight relationship of *Chicoreus ramosus* collected from the Gulf of Mannar area. Regression analysis showed linear relationship

between length and weight of both sexes; great variations were observed in the length-weight relationship between males and females.

244. **Benny, A and K. Ayyakkannu** 1992. Trace elements (Zn, Mn, Cu and Fe) at three trophic levels in a *Chicoreus ramosus* habitat on the Tuticorin coast, Southeast India- a pilot study. *Proc. Second Workshop Tropical Marine Mollusc Programme (TMMP)* at Phuket (Thailand), 1st to 4th Nov, 1992. *Publ. Phuket Marine Biological Cent.* 11: 157-160.

Address : CAS in Marine Biology, Annamlai University, Parangipettai - 608502, Tamilnadu,India.

Abstract : The findings are presented of a study conducted to determine the concentrations of trace elements (zinc, manganese, copper and iron) in 3 different trophic levels in the *Chicoreus ramosus* habitat at Tuticorin, Tamil Nadu, India. Phytoplankton were taken as the first trophic level; the suspension feeding bivalve *Modiolus metcalfei* was selected as the second, being a preferred food by *Chicoreus ramosus*, with the latter being the final trophic level. The study showed that variations in the concentrations of the metals are very distinct at the different trophic levels; further laboratory trials are necessary to evaluate the rate of uptake of these metals and to what extent the concentrations reflect pollution at each trophic level of the *Chicoreus ramosus* food chain.

245. **Bensam, P and P.K. Mahadevan Pillai** 1968. Regeneration in the flat fish *Cynoglossus macrolepidotus*. *J. Mar. Biol. Assoc. India*, 10(2): 403-405.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : In the course of examining the experimental fish catches of the Government of India Offshore Fishing Station trawlers, M.V. 'Sagarsundari', M.F.V. 'Jheenga' and M.F.V. ' Meenabharati' during 1965-1968 at Tuticorin eight specimens of *Cynoglossus macrolepidotus*, popularly called the large-scaled tongue sole in varying conditions of regeneration were collected from among several hundreds of normal specimens and the observations made on them are given in the present account. In normal specimens the body tapers posteriorly and ends in a somewhat pointed caudal fin formed by 10-12 rays. There are two lateral lines on the ocular side and none on the other side. One of the lateral lines is the usual median one, while the other, situated dorso1aterally may be called the upper lateral line. The caudal fin carries extensions from the two lateral lines and near the tip of the tail the extension from the upper line tends to converge towards the extension from the median one. For the actual length of the regenerating specimens and the estimated length to which they might have grown but for the truncation (calculated from the relationship of the total length to head length) reference may be made. In one specimen, 14% of the posterior part of the body appears to have been amputated (Fig. 2) and the regenerating rays numbering 17 constitute an ill-formed caudal fin. A small portion of the vertebral column anterior to the amputated region has undergone thickening in front of which the median lateral line ends, but the extension from the upper lateral line turns ventrally parallel to the margin of the truncated body and proceeds anteriorly along the ventral region. In another case where 34% of the body seems to have been truncated, the injury appears to have taken place quite recently, as the basal fin buds which regenerate the future rays numbering about 13 are prominently seen along the amputated margin. Four other specimens have undergone less damage. Of them in one case, 18 % of the hind region is affected, while in others 17 % 12 % and 10%.

246. **Bensam, P., S.G. Vincent and P.K. Mahadevan Pillai** 1972. On a rorqual, *Balaenoptera* sp. caught off Tuticorin Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 14(2): 886-887.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : The note records the capture of a baleen whale (*Balaenoptera musculus?*) of 11.26 m in total length from the fishing grounds off Tuticorin on April 2, 1969.

247. **Bensam, P and S.G. Vincent** 1972. Migration of the jew fish *Dendrophysa russelli* from sea to estuaries in the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 14(2): 892-893.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : The note records the occurrence of fully mature specimens of the jew fish, *Dendrophysa russelli* and its spawning periodicities and fecundity based on the collections from some of the estuaries along Tirunelveli coast of the Gulf of Mannar.

248. **Bensam, P.** 1973. Sciaenid fishery resources of the Gulf of Mannar and Palk Bay. *Proc. Symp. living resources of seas around India*, pp. 461-469.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623520, Tamilnadu, India.

Abstract : The Gulf of Mannar-Palk Bay area , forming the southern sector of the east coast of India, harbours many species of sciaenids, including some commercially valuable forms like *Pseudosciaena diacanthus, P. aneus, Otolithes argenteus, Johnius maculates,* etc. Until a decade ago, this resource remained poorly tapped. Offshore fishing station at Tuticorin and Indo-Norwegian project at Mandapam, trawling grounds for sciaenids off the punnakkayal eastuarine region in the Gulf of Mannar and Vaigai reverine area in the Palk Bay have been charted. Catch treands by indigenous and mechanized crafts in centers like Sippikkulam-Vaipar, Vembar and Thakkarai indicate the presence of good fishing grounds for the sciaenids. Further work of charting these grounds in the Gulf of Mannar-Palk Bay area, particularly off river mouths and estuaries, remains to be carried out in order to have an adequate knowledge on the distribution and abundance of this resource. The indication is that the present level of exploitation can be increased further without fear of depletion.

249. **Bensam, P.** 1973. On a few post larval stages and juveniles of the sardine, *Sardinella dayi. Indian J. Fish.,* 20(1): 148-156.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Sardinella dayi* contributes to a minor extent to the sardine fishery of the Tuticorin area in the Gulf of Mannar. A few post larval stages of the species in the size range of 18.70 mm – 20.25 mm and juveniles of 28 mm – 36 mm are described. The food of the post-larvae consisted mainly of copepods; a discussion on the identity of the larvae and juveniles as those of *S. dayi* is given based on circumstantial evidence and characteristic features distinguishing them from similar stages of related species.

250. **Bensam, P., K. Ramadoss and N. Sundaram** 1974. Methods of Mariculture. *Seafood Export J.*, 6(11): 23-32.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

251. **Bensam, P**. 1981. Taxonomic Problems in the Identification of Clupeiform Eggs and Larvae in Indian Waters. ICES Symposium on the Early Life History of Fish, Woods Hole, MA (USA), 2 Apr 1979. *The early life history of fish: Recent studies.* (eds) Lasker, R., Sherman, K. 178: 605-607.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The order Clupeiformes, represented by families Chirocentridae, Clupeidae and Engraulidae in India, is the most important group of commercial fishes, contributing to as high as 23% of the annual marine fish production in recent years. About 65 species have been reported from India; and, although most of them range in length from only 10 to 19 cm, the smaller sizes are caught in large quantities all along the coast. Only a few constitute single-species fisheries while many others form combined fisheries. There are various reasons for the lack of adequate progress in egg and larval surveys of the various species in India, the most important being the imperfect knowledge of the diagnostic features of the eggs and larvae. The present paper seeks to examine these factors and stresses the need for adopting better procedures for their identification.

252. **Bensam, P and R. Marichamy** 1981. An experiment on culture of milkfish *Chanos chanos* (Forskal) in salt-pans at Veppalodai, Tuticorin. *Indian J. Fish*., 28(1&2): 266-269.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Constructing ponds in a primary reservoir storing sea water in production of common salt, an experiment was carried out on culture of *Chanos*, without undertaking much management or supplementary feeding. In one pond with stocking rate of c75 490/ha, survival was c44% and production c857 kg/ha/14 months; in another pond with stocking rate of c7820/ha, survival was c85% but production was only 318 kg/ha/11 months.

253. **Bensam, P.** 1985. Some engineering problems in the construction and maintenance of marine culture ponds at Mandapam. *Indian J. Fish.*, 32(4): 417-430.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A major problem concerning the construction and maintenance of marine culture ponds at Mandapam, Tamil Nadu, India has been that dikes are subject to easy erosion and damage because of the incohesiveness and porosity of earth, which chiefly consists of sand, fragments of corals and molluscan shells. Crests and slopes of dikes are liable to be washed off easily in rains, and dike bases are eroded by wave action in the ponds. To protect

dike bases and to maintain their slopes, turfing is found to be most effective and long lasting. A grass belonging to the genus *Chloris*, which has shown a high rate of propagation and a good earth-binding quality, is found to protect the dikes. Structural work of a simple culvert type sluice, successfully designed and constructed for free flow of water to the ponds, is explained.

254. **Bensam, P.** 1986. A culture experiment on the crab *Scylla serrata* (Forskal) at Tuticorin during 1975-77 to assess growth and production. *Symp. Ser. Mar. Biol. Assoc. India*, pp. 1183-1189.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The green crab *Scylla serrata* is commercially the most valuable in India, with great potentialities for large-scale culture operations. In fact, experiments are being carried out in some southeast Asian countries for evolving a technique suitable for the pond culture of this burrowing and cannibalistic species. The present paper gives an account of an experiment undertaken at Veppalodai, Tuticorin during 1975-77, by rearing in individual plastic cages, for ascertaining their survival, growth and production with artificial food supplied. The results obtained from this exercise are highly encouraging with regard to survival, growth, production, etc. The present paper deals with the above work and the results obtained, along with suggestions for evolving a culture technique for pond culture of this species.

255. **Bensam, P.** 1987. On two postlarval stages of the shad *Hilsa kelee* (Cuvier). *Indian J. Fish.*, 34(1): 105-108.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Two postlarvae of *Hilsa kelee* measuring 5.68 mm and 7.92 mm, collected from Gulf of Mannar off Mandapam, are described. In the smaller larva the larval finfold was prominent and there were 34 preanal and 9 postanal myomeres. In the larger one the finfold was almost absent; all the fins except the pelvic had been developed and there were 27 preanal and 16 postanal myomeres. Pigmentation in both the stages was sparse. The difference in features between present postlarvae and similar stages of allied clupeids from Indian region are discussed.

256. **Bensam, P.** 1987. Eggs and early larvae of the grey mullet *Valamugil seheli*, Forsskal). *Indian J. Fish.*, 34(2): 171-177.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Planktonic eggs collected from Palk Bay and Gulf of Mannar and identified circumstantially as of *Valamugil seheli* were reared in the laboratory up to the 72-h postlarvae. Newly hatched larvae measured 2.179 mm. In the 24-h larva, most of the black pigment spots had migrated to the ventral side of the body. The 48-h-old larva had its mouth formed, eyes pigmented, yolk utilized and pectoral fins developed, and so was in the early postlarval stage. In the 72-h larva there was increase in pigmentation along both dorsal and ventral aspects of body. The eggs could be distinguished from those of the allied species by their size and/or the size of oil globules. By the location of the oil globule as well as by the nature of pigmentation the early larvae could be distinguished from those of *Mugil cephalus*.

257. **Bensam, P., S. Shanmugham and A. Bastin Fernando** 1987. Observations on the fisheries in the estuaries and backwaters along Gulf of Mannar during 1975-77. ***In***: *Perspectives in Hydrobiology*, (eds.) K.S. Rao and S.Srivastava, Vikram University, Vikram.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

258. **Bensam, P.** 1988. On construction and maintenance of marine fish culture ponds along south-east coast of India. *CMFRI Spec. Publ.*, 40: 46.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The most expensive input in coastal aquaculture operations is construction and maintenance of culture ponds and farms. Experience gained on construction and maintenance of culture ponds in three localities along southeast coast of India during 1972-1985 has shown that, since the earth is porous and incohesive in this region, adequate precautions have to be taken. The paper gives an account of the experience gained to minimise and/or counter several problems, in the context of the varying climatic and soil conditions in three localities. Also, the ways and means of applying such techniques for successful management of culture ponds and farms in similar problem-prone areas are discussed.

259. **Bensam, P.** 1988. On the identification of the early developmental stages of clupeiform fishes from Indian waters. *J. Indian Fish Assoc.,* 18: 299-306.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamil Nadu, India.

Abstract : Among about 65 species of clupeiform fishes present in the seas around India, most are distributed along both the east and west coasts and have similar spawning seasons and spawning grounds. The most difficult problem experienced with regard to the identification of their early developmental stages is the overlapping sets of diagnostic features among many species within the same genus as well as among species belonging to two or more genera. From studies carried out recently, the present paper sites a few instances wherein certain subtle characters have been used for distinguishing the early developmental stages of a few allied species.

260. **Bensam, P.** 1990. Eggs and early larvae of the sand whiting, *Sillago sihama* (Forsskal). *Indian J. Fish.,* 37(3): 237-241.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Planktonic eggs of *Sillago sihama* have been identified from Mandapam in the south-east coast, based on similarities in the ripe ovarian eggs as well as other characters. In early embryos, melanophores appear on the oil globule and dorsal side of the head. With more development, the above pigmentation increases on the body also, accompanied by the appearance of diffused xanthophores. Hatching takes place in the afternoon of the day of collection, the newly hatched larva measuring 1.54 mm and its pigmentation is in the form of melanophores and diffused xanthophores. The 24-hour old larva measures 2.42 mm, with melanophores mostly along the dorsal and ventral margins of the body and xanthophores in the form of five vertical bands. By 48-hours (measuring 2.56 mm), the post larval phase has set in, with pigmentation of the eyes, formation of the mouth, etc. The similarities of the present material with those of the eggs and early larvae of *S. japonica* as well as the difference from it, are discussed.

261. **Bensam, P and T.R. Udhayashankar** 1990. Colonisation and Growth of the Seagrasses, *Halodule uninervis* (Forskal) Ascherson and *Halophila ovalis* (R. Brown) Hooker f. in marine culture ponds at Mandapam. *Proc. 2nd Indian Fish. Forum,* dated 27th to 31st May'90. pp. 51-53.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : Observations carried out at Mandapam from 1983 to 1986 on the colonisation and growth of *Halodule uninervis* and *Halophila ovalis* are presented. Dislodged bits of the sea grasses were brought into three ponds of 60 x 30 x lm from Palk Bay due to cyclonic and tidal conditions of the sea at the end of 1983. In pond I, *H. uninervis* alone had established and grown from about 90 plants/m^2 in January 1984 to 800/m^2 in October, reaching the peak abundance of 8100/m^2 during February, 1986. In the other two ponds. both the species got established. *H. ovalis* was the principal species in the order of about 6:1 in pond II, while *H. uninervis* was dominant in pond III, in the order of about 3.4:1. The peak levels of abundance for *H. ovalis* and *H. uninervis* in the former pond were about 7700/m^2 and 1200/m^2 in March and January 1986 respectively.

262. **Bensam, P.** 1991. Increasing the production of *Lab lab* (sic), the ideal food for successful culture of the milkfish, *Chanos chanos* (Forsskal). *Indian J. Fish.,* 38(1): 60-62.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The sustained growth and maintenance of *Lab lab* in culture ponds has been a key factor for high production of milkfish in Southeast Asia. The possibility of this was tested in India at Mandapam, Tamil Nadu. The study indicated that the milkfish can be cultured by sustained growth of *Lab lab* in culture ponds, instead of resorting to supplementary feedings.

263. **Bensam, P.** 1991. Planktonic eggs and early larvae of the sardine *Sardinella dayi. Indian J. Fish.,* 38(2): 89-92.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The specific identity of the eggs of a *Sardinella* sp. collected in March 1967 from Tuticorin waters was established as *Sardinella dayi* on the basis of recent researches on embryonic taxonomy of the sardines. The parameters considered for such specific identification were the diameters of the whole egg, yolk and oil globule. By rearing the eggs up to early postlarval stages and studying the distribution of pigment spots and the number of preanal and postanal myomeres, the identification was further confirmed. The subtle differences with the closely resembling eggs and larvae of *S.* dayi. *S. fimbriata* and *S. longiceps* were also examined.

264. **Bensam, P., N. Kaliaperumal, V. Gandhi, A. Raju, V.S. Rengasamy, S. Kalimuthu, J.R. Ramalingam and K. Muniyandi** 1991. Occurrence and growth of the commercially important red algae in a fish culture pond at Mandapam. *Seaweed Res. Utiln.,* 13(2): 101-108.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The red algae *Gracilaria edulis, Hypnea valentiae, Acanthophora spicifera* and *Sarconema indica* have been observed to occur and grow in a culture pond. Over a period of eight months, the algae grew to 104 kg in the pond of 800 sq m. The hydrological conditions in the pond are compared to those in the sea containing natural beds of these algae during the period of observations. This occurrence and growth may open up the possibility of growing these algae in culture ponds providing the requisite hydrological and nutrient conditions.

265. **Bensam, P.** 1993. Prospects of farming groupers in India. *Mar. Fish. Infor. Serv. T & E. Ser.,* 123: 1-4.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : The morphology of various *Epinephelus* sp are given.

266. **Bensam, P.** 1994. Early juvenile stages of three jew fishes from the south east coast of India. *Indian J. Fish.,* 41(1): 9-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 623 001, India.

Abstract : Three stages each of *Johneiops vogieri, Johnius carouna* and *J. carutta* all collected from bottom trawl catches off Tuticorin and Porto Novo have been described. An account of the changes undergone in the morphology and pigmentation is given. Certain notable differences between two younger stages of *J. carutta* described earlier are pointed out.

267. **Bensam, P.** 1996. Sea fishes. *Handbook on Aquafarming, MPEDA, Kochi*, pp. 9-62.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This handbook deals with the culture technics of milk fish, mullets, pearl spot and sea bass.

268. **Bensam, P. and N. Gopinatha Menon** 1996. Conservation of marine mammals. pp.133-142. ***In***: *Marine biodiversity : Conservation and management.* (ed.) N.G. Menon and C.S.Gopinadha Pillai, CMFRI, 205 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Where economic considerations of the common man mask and overrule his enviromental thinking and rationale as at present, any attempt at protection of these vulnerable resources is possible only through a cooperative spirit and voluntary involvement at protection and conservation, rather than by enforcing legislation.

269. **Bhagan, V.U., V. Selvaraj and P. Srirenganathan** 1996. Physico-chemical characteristics of the water of Manakudy Estuary in Kanyakumari District - Tamil Nadu (India). *Asian J. Chem.*, 8(3): 547-552.

Address : Department of Chemistry, S.T. Hindu College, Nagercoil-629 002, Tamilnadu, India.

Abstract : Physico-chemical characteristics of Manakudy estuary and their seasonal pattern and periodicities were studied from November 1993 to April 1994. The parameters studied were pH, temperature, bicarbonate and carbonate alkalinity, nitrate-nitrogen, nitrite-nitrogen, phosphate and total phosphorus.

270. **Bhalla, S.N and P.K. Kathal** 1998. Recent foraminiferal Thanatocoenoses from the Gulf of Mannar, India. *Neues Jahrbuch fur Geologie und Palaontologie – Abhandlungen*, 207(3): 419-431.

Address : Inst. Mus. F. Geol. Palaontologie, Sigwartstraße 10, D-72076 Tubingen, Germany; Department of Applied Geology, Dr. H.S.G. University of Sagar, Sagar - 470 003, India.

Abstract : Littoral Thanatocoenoses have been studied for the Recent foraminiferal contents. The assemblage comprises forty-three species of Recent foraminifera of which five are being reported for the first time from the Indian waters, twelve are new finds from the east coast waters and sixteen are not known to occur in the beach sands of western India. Latitudinal variations are discussed. A comparison of the Gulf of Mannar foraminiferal assemblage with its western counterpart, facing the Arabian Sea, reveals that the former belongs to the "mixed-zone" of the East African and Indo-Pacific realms while the latter is attributed to the East African realm.

271. **Bhaskar, S.** 1981. Preliminary report on the status and distribution of sea turtles in Indian waters. *Indian For.*, 107(11): 707-711.

Address : Madras Snake Park Trust, Guindy Deer Park, Madras, India.

Abstract : Sea turtles of five of the seven species in existence are known from Indian seas. Their frequency of occurrence, as is presently known, ranges from "rare" (*e.g.* the leatherback (*Dermochelys coriacea*) and the loggerhead (*Caretta caretta*) to "common" the outstanding example being the Ridley, (*Lepidochelys olivacea*). As a first step towards delineating the geographical areas where Indian sea turtles occur and are worthy of study (the prime object being their conservation and rational exploitation), the following locales may be considered individually. The entire western coast of India, which extends from the Pakistan border at Kutch, to Kanyakumari, the entire eastern shoreline of India, extending from Kanyakamari to the Bangladesh border in the Ganges delta, the Andaman and Nicobar Islands, the Lakshadweep Islands.

272. **Bheemasankara Rao, C., C. Satyanarayana, D.V. Rao, E. Fahy and D.J. Faulkner** 1989. Metabolites of *Aplysia dactylomela* from the Indian Ocean. *Indian J. Chem. Sect. B.,* 28B(4): 322-325.

Address : School of Chemistry, Andhra University, Visakhapatnam 530 003, India.

Abstract : From the digestive glands of the mollusc *Aplysia dactylomela* collected in the gulf of Mannar of the Indian Ocean, cholesterol (III), 7-ketocholesterol (V), cholestane-3 beta, 5 alpha, 6 beta -triol (IX), cholestane-3 beta, 5 alpha, 6 beta -triol-3 beta -acetate (VIII), chamigrene derivative (VI), p-hydroxybenzaldehyde (VII) and a mixture of 2,3,5-tribromo-N-methylindole (IIa) and 2,3,5,6-tetrabromo-N-methylindole (IIb) were isolated. In addition a new selinane derivative (IV), a stereo isomer of austradiolacetate (X) and a new 16,16-dichlorohomolaurane (I) are reported. Structural elucidation of the compounds is based mainly on spectral data.

273. **Bheemasankara Rao, C., G. Trimurtulu, C. Sreedhara, D.V. Rao, S.C. Bobzin and D.J. Faulkner** 1994. Diterpenes from the Brown Alga *Dictyota bartayresiana. Phytochemistry,* 37(2): 509-513.

Address : Sch. Chem. Dep. Pharm. Sci., Andhra Univ., Visakhapatnam 530 003, India.

Abstract : The Brown Alga *Dictyota bartayresiana* collected in the Gulf of Mannar of the Indian Ocean yielded Diterpenes consisting of one known Dolastane, five known dolabellanes and five new compounds that were characterized as (1S*,3E,5R*,7E,11S*,12S*) 5-acetoxy-12-hydroxydolabella 3,7-dien-9-one, (1S*,3E,5R*,7Z,11S*,12S*) 5-acetoxy-12-hydroxydolabella 3,7-dien-9-one, (1R*,3Z,7E,11S*)-9-acetoxydolabella 3,7,12-trien-16-al, (5R*,8S*, 9S*,12S*, 14S*) 9-hydroxydolasta-1,3-dien-6-one (1R*,4S*,5R*,8S*,9S,12S*,14R*) trihydroxydolasta-2-en-6-one, by interpretation of high resolution spectral data and chemical interconversions.

274. **Bhupathy, S and S. Saravanan** 2003. Exploitation of sea turtles along the southeast coast of Tamil Nadu, India. *J. Bombay Nat. Hist. Soc.,* 100(2&3): 628-631.

Address : Salim Ali Centre for Ornithology and Natural History, P.O. Anaikatti, Coimbatore 641108, Tamil Nadu India.

Abstract : Five species of sea turtles, the leatherback *Dermochelys coriacea,* hawksbill *Eretmochelys imbricata*, olive ridley *Lepidochelys olivacea,* Loggerhead *Caretta caretta* and green turtle *Chelonia mydas* occur in the Indian seas. All of them are found along the southeast coast, especially in the Gulf of Mannar. Turtle fishing was practised in this region for ages, and chelonians, were exported to Sri Lanka and other countries until a couple of decades ago (Agastheesapillai and Thiagarajan 1979, Frazier 1980). The exploitation and some aspects of the ethnozoology of sea turtles along the southeast coast of Tamil Nadu is reported.

275. **Bierhuizen, B.R.** 2000. Fishing patterns and intensity in Kannyakumari District, India. *BOBP/MM/2.*

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : This document is based on a survey that was conducted in December 1997 by the Bay of Bengal Programme (BOBP), in co-operation with the Coastal Peace and Development Committee of the Kottar Diocese Church in Kanniyakumari district, Tamil Nadu and the Tamil Nadu Department of Fisheries. The survey was meant to provide a qualitative overview of the fishing behaviour of three different groups of fishermen from coastal villages of Kanniyakumari district, who operate kattumarams, vallams and boats. The study may be considered complementary to a study on the infrastructure needs of Kanniyakumari coastal villages, which was also carried out in 1997. Both studies originated from the need for additional information on fishing behaviour and village needs in the district, to be investigated through stakeholder approaches.

276. **Bindhu Sulochanan and K. Muniyandi** 2005. Hydrographic parameters off Gulf of Mannar and Palk Bay

during an year of abnormal rainfall. *J. Mar. Biol. Assoc. India*, 47(2): 198-200.

Address : Regional Centre of Central Marine Fisheries Research Institute, Marine Fisheries PO., Mandapam Camp - 623520, Tamilnadu, India.

Abstract : The results of monthly observations on the hydrographic parameters in the Gulf of Mannar and Palk Bay during the period 2002-03 are reported. The meteorological parameters for the period have also been compiled. The area received 1120mm rainfall during the period as against a normal of 760mm. Maximum wind velocity of 16.2km/hr was in June and humidity of 78% in December. A comparison of the parameters of temperature, salinity, *p*H, dissolved oxygen, primary productivity and biomass of both the ecosystems is presented.

277. **BOBP.** 1981. BOBP tries out high-opening bottom trawls: Good results. *BOBP News, Jan'81, 12 pp.*

Address : Bay of Bengal Programme, Madras, India.

Abstract : The BOBP conducted experiments with high-opening bottom trawls at Palk Bay, off Mandapam and in the Gulf of Mannar off Tuticorin.

278. **BOBP.** 1981. BOBP gear experiments popular in Tuticorin. *BOBP News, Sep'81, 20 pp.*

Address : Bay of Bengal Programme, Madras, India.

Abstract : This paper deals with the experiments of gears at Tuticorin designed by BOBP.

279. **BOBP.** 1983. Shared fish stocks of the Bay of Bengal region. *BOBP News, Sep'83,* pp. 8-12.

Address : Bay of Bengal Programme, Madras, India.

Abstract : A major concern of the recently started UNDP funded marine resources project for the Bay of Bengal region is better understanding and exploration of stocks shared between member countries. The subject was discussed at the first meeting of the project's member countries in Madras mid-August.

280. **BOBP.** 1983. Abstracts of BOBP publications. *BOBP news,* Sep'83, 32 pp.

Address : Bay of Bengal Programme, Madras, India.

Abstract : Published here are abstracts of BOBP papers out in recent months. Earlier papers were abstracted in the issues of January 1981 and December 1982.

281. **BOBP.** 1983. Tree fishing in Tamilnadu. *BOBP news,* Sep'83, 32 pp.

Address : Bay of Bengal Programme, Madras, India.

Abstract : Some weeks ago, an Indian Express photographer asked us to explain a peculiar phenomenon Kattumaram fishermen at the Marina Beach carrying a whole tree out to sea. We explained the use of trees as FADs (fish aggregating devices), and then decided to investigate current trends in this ancient practice. At our request P.V. Ramamoorthy and S. Pandurangan toured some fishing villages near Madras and told us about what they saw and heard.

282. **BOBP.** 1984. Marine small-scale fisheries of Sri Lanka, General description, *BOBP/INF/6.*

283. **BOBP.** 1986. Fishery resources research in the Bay of Bengal: A fact sheet on India. *BOBP News,* June'86, 14 p.

Address : Bay of Bengal Programme, Madras, India.

Abstract : This report deals with the exploratory surveys done in the Bay of Bengal since 1908 by various institutes and organizations.

284. **BOBP.** 2000. Skill gaps and training needs anlysis of the Department of Fisheries, Tamil Nadu, for Sustainable Development and Management of Fisheries. *BOBP/MM/3.* 78 pp.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : The policies for the development of fisheries in the past, present and the future trend are discussed in this article.

285. **BOBP.** 2000. Strengthening, monitoring and evaluation and management information systems in the Department of Fisheries, Tamil Nadu, India. *BOBP/MM/4.* 62 pp.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : Review of current information flow patterns was attempted, and current gaps and impediments were identified. In resource management, vital information on stock assessment needs to be obtained. Likewise, catch data analysis in Tamil Nadu has to be more purposive.

286. **Boby Ignatius., G. Rathore, I. Jagadis, D. Kandasami and A.C.C. Victor** 1999. Observation on spawning and larval rearing of clown fish *Amphiprion Sebae*. *Mar. Fish. Infor. Serv. T & E Ser.,* 162: 25-27.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The clown fish *Amphiprion Sebae* is one of the very few marine ornamental fishes that has been successfully bred in temperate waters. This paper deals with the brood stock maintenance to hatching and larval rearing.

287. **Boby Ignatius., G. Rathore, I. Jagadis, D. Kandasami and A.C.C. Victor** 1999. Observations on captive spawning and rearing of sea horse *Hippocampus kuda. Mar. Fish. Infor. Serv. T & E Ser.,* 163: 1-2.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Syngnathids, comprising sea horses and pipefishes form an important group among the non-food fishes. These fishes are exploited mainly as a source of aphrodisiac and is believed to cure a wide range of diseases such as asthma, atherosclerosis, goitre and lymphnode diseases. The low fecundity, high competition for the juvenile surviva1, sparse distribution mate fidelity and irrational exploitation to meet the ever increasing international demand make the resource unsustainable. Thus propagation under captive conditions become more important and relevant since it would not only enhance the export trade and foreign exchange inflow but also rebuild and conserve the wild population from its destruction. The seahorse *Hippocampus kuda* is one of the species of tropical sea horses, which occurs sparsely in the Gulf of Mannar and Palk Bay of Tamilnadu coast. In India successful complete rearing of sea horse was accomplished at the regional center of CMFRI, Mandapam camp. The technique developed is easy to adopt and commercial sea horse hatcheries can be established in selected centers along the Indian coasts.

288. **Boby Ignatius** 2000. The art of keeping marine aquarium. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp.58-62.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Bringing a small section of the marine environment to your home is a difficult task. But it is being done by more and more by the average aquarist, who wants to try this difficult task. Tremendous progress has been made in the keeping of marine fish over the past decade. Much knowledge has been acquired and many new products have entered market to facilitate the keeping of marine fish. In many ways, a freshwater aquarium and a marine aquarium, are very similar. But the care required by a marine aquarium is more complicated than that demanded by freshwater tank. Pollution and diseases are likely to occur much more quickly and lethally in a marine aquarium than in a freshwater aquarium. Because of these reasons, a successful freshwater aquarist sometimes finds it difficult to keep a marine aquarium.

289. **Boby Ignatius., G. Rathore, I. Jagadis, D. Kandasami and A.C.C. Victor** 2001. Spawning and larval rearing technique for tropical clown fish *Amphiprion sebae* under captive condition. *J. Aquacul. Trop.*, 16(3): 241-249.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Research on breeding and larval rearing of marine ornamental fishes is in its infancy. For the first time in India, successful breeding and larval rearing of Tropical clown fish *Amphiprion sebae* was accomplished at Regional Centre of Central Marine Fisheries Research Institute, Mandapam Camp, Tamil Nadu, India. Adult pairs of clown fishes along with sea anemones collected from the in-shore waters of Gulf of Mannar were maintained in one tonne glass aquarium fitted with bio-filters. The fishes were fed with polychaete worms, clam and fish meat. After three months of maintenance natural spawning took place and the fish deposited its eggs on an asbestos substratum placed in the tank. The temperature and salinity of the water media was in the range of 28-32 ºC and 33-35 ppt respectively. In each spawning the females lay about 300 to 600 eggs, and the incubation period was 6-7 days. Brood stock maintenance, spawning behaviour, and egg development were described. Hatching was effected in a 250 l fibreglass tank containing Chlorella conditioned seawater along with rotifer *Brachionus plicatilis*.

290. **Boby Ignatius and I. Jagadis** 2003. Growth and reproduction of tropical seahorse *Hippocampus kuda* in captivity. *Indian J. Fish.,* 50(3): 369-372.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An attempt was made to maintain a brood stock of seahorse, spawn them under controlled conditions and rear the young ones to maturity. The spawning yielded about 300 baby seahorses with a mean length of 9.0 mm. The young ones reared under controlled condition using copepods and rotifers as feed showed steady increase in the body length and weight. Over a period of 176 days they had grown to a size of 78.0 mm in length and 1.6 g in weight. The size at first maturity of male was estimated as 65mm. The number of babies released at first spawning was found to be 60-70. Development of pouch and their size does not seem to have any relevance to the possible mating and impregnation in the males but is dependent only on the subsequent pairing of seahorse. A description of the developing embryo obtained from 70mm sized seahorse is detailed.

291. **Boby Ignatius and I. Jagadis** 2003. Captive breeding and rearing of grey bamboo shark, *Chiloscyllium griseum* (Muller1839). *Indian J. Fish.,* 50(4): 539-542.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Grey bamboo shark, *Chiloscyllium griseum* was studied for maturity, development of egg case and hatching under captive condition. The live sharks were fed with a diet of chopped sardines. The female shark laid 27 egg cases over a period of 3 months. The egg cases were mostly released in pairs. They were almost oval in shape and equal in size. The time taken for successive release of egg cases ranged from 2 to 9 days. Duration of development of young ones inside the egg cases varied from 67-85 days. Sixty percent of the egg cases hatched. Male: Female ratio of the juvenile shark was 1:0.9. The mean length and weight of the shark at birth were 112mm and 5.0g respectively. The average monthly growth rate observed for the initial 60 days of rearing period was 25.0mm/8.35g.

292. **Boby Ignatius., I. Jagadis, A.C.C. Victor and A. Chellam** 2003. Pearl oyster farm as a device for fish aggregation. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 68-69.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Installation of fish aggregation devices (FAD) for enhancement of fishery resource is an age-old practice. FADs provide shelter to fish and serve as spawning, feeding and nursery ground for various fish species. The basic objective of providing FADs at the inshore waters is to enhance the biological productivity of the coastal waters and thereby to increase the fishery resources of the area. Different types of materials such as floating and anchored bamboo rafts with hanging lines, anchored buoys made of wood, polyester and iron, empty oil drums and tyres filled with Styrofoam materials have been in use on FADs. The pearl oyster farm of C.M.F.R.I. at Mandapam in the inshore waters of Gulf of Mannar covers an area of 1000 m^2. The farm is found to harbour a number of fishes and thus it is acting as an excellent fish-aggregating device particularly for the reef-associated fishes. The pearl oyster farm is made of a rectangular construction with casuarina poles with 2000 oyster cages suspended from it. Different types of the fouling animal and plant communities on the pearl oyster cages and farm structures have provided food to the fishes and offered shelter for them. The presence of fries and fingerlings attracts large predatory fishes to this area. Naked eye observation of the farm area showed the presence of various species of fishes. Fishes belonging to 21 families were observed and documented. The interesting observation was the occurrence of the fingerlings of the cultivable fishes particularly mullets and milkfish. The farm and the farm area can thus easily serve as a seed collection site for aquaculture purposes. The pearl oyster farm site attracts a large number of fishermen from Mandapam, because of the fish availability there. A number of fish traps/set nets are being used to fish around this site. This had indicated that pearl oyster farms in the inshore areas would improve the productivity of coastal waters and thus enhance the fishery resources, which in turn will increase the income of the fishermen to some extent.

293. **Boby Ignatius., I. Jagadis and A.C.C. Victor** 2003. Technique for half phearl production from tropical abalone *Haliotis varia* (Linn.). *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 103-104.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : CMFRI at its Regional Centre laboratory at Mandapam developed a technique for half pearl production in abalones. The technique basically involves selection of healthy abalones free from borers and physical injury and maintaining them in the laboratory with seaweed *Ulva* species as feed. Such maintained healthy abalones were taken from the tank and air dried for 10 minutes prior to fixing of required sized nucleus. Once the foot of

the abalones were retrieved, drilling was done on the inner side of the shell by pushing the mantle to the maximum possible extent, using an electrically operated hand drill (3 mm drill bit). Extreme care was taken while drilling to avoid any sort of physical injury to the animal and drilled abalones were returned to recovery tank containing filtered well-aerated seawater. Sufficient time was given to the abalones to recover from the drilling shock and also to get rid of the drill dust.

294. **Boergesen, F.** 1937. Contributions to a south Indian marine algal flora. I. *J. Ind. Bot. Soc.*, 16(1&2): 1-57.

Address : The Botanical museum of the University, Copenhagen.

Abstract : The following account of the marine algae of South India is based mainly on collections made some years ago by Professor M.O. Parthasarathy Iyengar of Madras, who most kindly placed at my disposal all his collections of seaweeds with the exception of the Chlorophyceae which he proposes to work out himself. The collection consisted of a small number of dried specimens, consisting, as a rule, of only a single or sometimes a few specimens of each species, and a very large number of specimens preserved in 6% sea-water formalin. Since the material was kept in this solution for many years, sometimes even about as long as 20 years, the algae were not always in their best condition. In the beginning of 1928, I also made a small collection of algae at Karvar in Bombay Presidency and at Tuticorin in South India during a short visit. Some species from these localities also are included in this account.

295. **Boergesen, F.** 1937. Contributions to a south Indian marine algal flora. II. *J. Ind. Bot. Soc.*, 16(6): 311-357.

Address : The Botanical museum of the University, Copenhagen.

Abstract : This second contribution to a South Indian Marine Algal Flora deals with a series of species found when I continued my examination of Professor Iyengar's comprehensive collection of Algae from South India. In the first part, I have dealt with the brown and red algae only, and the same is the case in this part also, as Professor Iyengar intends to work out the other groups himself. In order to compare several of the Indian specimens with those found in J. Agardh's famous herbarium, several visits to Lund in Sweden were necessary, and I am very much indebted to Dr. Hulten, Keeper of the Herbarium of the Botanical Museum in Lund, for permitting me to work there. I am also very grateful to Professor H. Kylin for valuable suggestions regarding critical species. I wish to thank him most sincerely for his kind hospitality during my repeated visits to Lund. For the final determination of several difficult species I went to London in the spring- of 1936 in order to study the different species found in the rich herbaria of the Royal Botanic Gardens, Kew, and of the British Museum (Natural History). I cannot thank the officials of these institutions sufficiently enough for all their kindness and help during my visits to their herbaria and libraries.

296. **Boergesen, F.** 1937. Contributions to a south Indian marine algal flora. III. *J. Ind. Bot. Soc.*, 17(4): 205-240.

Address : The Botanical museum of the University, Copenhagen.

Abstract : In this the third and last part of these contributions are enumerated the remaining species of Professor Iyengar's collections which I have been able to determine. Owing to the lack of sufficient material, there being often only a single specimen of each species, the determinations have often been difficult and somewhat uncertain, especially in the case of critical and polymorphic forms of which a large number of specimens are necessary in order to give an account of the variations. I wish to thank Professor Iyengar once more most heartily for his kindness in entrusting me with the work of determining his collection, as it is always very interesting to be able to work on the flora of a more or less unknown area. Professor Iyengar has taken very great interest in my algological researches in South-India. He met me at Karvar and later on during my stay at Tuticorin very kindly arranged for boats and a good working place also there. But for his kind help, I am afraid the result would have been very meagre.

297. **Bose, M.** 1999. On the landing of porpoise *Neophocaena phocaenoides* at Rameswaram, Tamil Nadu. *Mar. Fish. Infor. Serv. T & E Ser.,* 163: 15.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric messurements (cm) of the Porpoise are given and discussed.

298. **Bose, M and A. Gandhi** 1999. The stranding of sea cow, *Dugong dugon* (Muller) at Mandapam, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E Ser.,* 163: 14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The male seacow, *Dugong dugon* (Muller) was stranded in dead condition near Ayyanarkoil shore at Mandapam. The animal weighed around 80 kg. The skin of the upper head portion and the caudal peduncle was peeled off probably due to attack from the fishes. Since the animal was found in semi-decomposed condition, it was buried without delay.

299. **Bose, M and A. Palanichamy** 2003. Landing of *Neophocaena phocaenoides* at Rameswaram. *Mar. Fish. Infor. Serv. T & E Ser.*, 176: 13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract: Finless black porpoise was landed at Verkode off Rameswaram region. This female porpoise was measuring about 113 cm in total length. This porpoise was caught by Gill net. The morphometric characters are discussed in this report.

300. **Bostock, T.** 1991. Post-harvest activities in Kanyakumari, India show promise. *Bay of Bengal News.*, 41: 11-14.

Abstract : An examination is made of the problem of post-harvest fish losses and effects on the small-scale fishing community. Reference is made to the findings of the Bay of Bengal Programme. Post-harvest project involved several small scale fishing communities in the Kanyakumari District of Tamil Nadu. Three particular areas were examined, describing simple technologies to cut post-harvest losses and also to raise the income of the fisherfolk. Fish baskets for itinerant women vendors were tried. Drying anchovies and the use of ice for fish storage are given.

301. **Bourne, G.C.** 1906. Report on *Joursseaumia*, new genus of eumillibranches commensal with the corals *Heterocyathus* and *Heterosammia* collected by Professor Headman, at Ceylon in 1902. *Rep. Govt. Ceylon pearl Oyster Fish. Gulf of Mannar,* 5: 243-226.

302. **Bruce, A.J.** 1981. Notes on Some Indo-Pacific Pontoninae, XXXVII Additional Information on *Dasella herdmaniae* (Lebour) (Decapoda, Natantia). *Crustaceana,* 40(1): 50-56.

Address : Heron Island Research Station, Gladstone, Queensland, 4680, Australia.

Abstract : The occurrence of *D. herdmaniae* (Lebour), the only species of its genus, has been recorded in the scientific literature on only a single occasion, when the original specimens from Tuticorin, Gulf of Manaar, Madras Province, India, were described by M.V. Lebour (1939). A single further example of this species has been obtained at the southern end of the Great Barrier Reef, indicating a considerable extension in the known range of this species and also providing some further information upon its morphology. The specimen is deposited in the collections of the Australian Museum. Its morphology is described here.

303. **Burton, E.S.** 1903. List of marine algae collected by Professor Herdman at Ceylon in 1902 with a note on the fructification of Halimeda. *Rep. Govt. Ceylon pearl oyster fish. Gulf of Mannar,* 1:163-168.

304. **Burton, M.** 1930. Additions to the sponge fauna of Gulf of Mannar. *Ann. Mag. Nat. Hist*., 5: 665-676.

305. **Burton, M.** 1937. Supplement to the fauna of Krusadai Island in the Gulf of Mannar- Porifera. *Bull. Madras Govt. Mus. N. S. Nat. Hist. Sect*.,1(2)ptr.4: 1-58.

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306. **Calman, W.T.** 1904. Report on the Cumacea collected by the Prof. Herdman, at Ceylon, in 1902. *Rep. Ceylon Pearl oysters Fish. Gulf of Mannar,* 2: 159-180.

307. **Carpenter, G.H.** 1906. Report on the marine Hemiptera (Halobates) collected by Professor Herdman at Ceylon, in 1902. *Rep. Govt. Ceylon pearl oyster fish Gulf of Mannar, 5:* 151-156 (Suppl. Rept). The Royal Society, London.

308. **Carter, H.J.** 1880. Report on specimens dredged up from the Gulf of Mannar and presented to the Liverpool free museum by capt. W.H.Cawne Warren. *Ann. Mag. Nat. Hist.,* 5: 437-457.

309. **Carter, H.J.** 1881. Supplementary report on specimens dredged up from the Gulf of Mannar, together with others from the sea in the vicinity of the Basse Rocks and from Bass's stants respectively, presented to the Liverpool Free Museum by Capt. W.H.Carone wanen. *Ann. Mag. Nat. Hist.,* (5)7: 361.385.

310. **Chacko, P.I.** 1942. A note on rearing the larvae of the milk fish (*Chanos chanos*) *Curr. Sci.,* 11: 108.

Address : Krusadai Biological Station, Krusadai Island, Gulf of Mannar, India.

Abstract : A study of the plankton present in the water of the Milk-Fish Farm was started from August, 1941. On 11th August 1941, 3 larvae found in the plankton, all of the same size (16mm), were successfully brought alive to the laboratory for rearing. One of the larvae was killed for immediate study. The chief characteristics of the larva was described in this note.

311. **Chacko, P.I.** 1942. An unusual incidence of mortality of marine fauna. *Curr. Sci.,* 11: 404.

Address : Krusadai Biological Station, Krusadai Island, Gulf of Mannar, India.

Abstract : An unusual phenomenon of mortality of marine fauna occurred in the tide-pool on the southern (Ceylon) side of Krusadai Island on 17th May 1942. A list of the animals washed ashore along the shore of the tide-pool, which is about 12 furlongs in length from the sandy point to the bushy point of the Krusadai Island. The salinity of the seawater of this tide pool ranged from 35.59 to 35.91 ppt and the surface temperature from 30.1 to 30.5°C.

312. **Chacko, P.I.** 1943. A note on the nesting habits of the Olive ridley turtle, *Lepidochelys olivaceae* at Krusadai Island. *Curr. Sci.,* 12: 60-61.

Address : Krusadai Biological Station, Krusadai Island, Gulf of Mannar, India.

Abstract : Three species of turtles, namely, the Green Turtle *Chelonia mydas* (Linne.), the Olive Logger-head Turtle *Lepidoghelys olivacea* (Eschscholtz) and the Hawksbill Turtle *Eretmochelys imbricata* (Linne.) occur in the sea around Krusadai Island.

313. **Chacko, P.I.** 1944. Occurrence of a variety of the skates, *Urogymnus asperrimus* around Krusadai Island, Gulf of Mannar. *Curr. Sci.,* 13: 81.

Address : Krusadai Biological Station, Krusadai Island, Gulf of Mannar, India.

314. **Chacko, P.I.** 1944. On the bionomics of the big jawed jumper, *Lactarius lactarius* (Cuv.&Val.).*Curr.Sci.,*13: 108.

Address : Fisheries Bureau, Madras, India.

Abstract : The Big-jawed Jumper, *Lactarius* (Cuv. & Val.) is a shoaling fish contributing to an important fishery in the Gulf of Mannar and Palk Bay, from the month of January. The peak occurs in September and October.

315. **Chacko, P.I.** 1944. On the bionomics of the Leiognathidae. *Curr. Sci.,* 13: 214.

Address : Fisheries Section, Department of Industries and Commerce, Madras, India.

Abstract : Species of *Leiognathus* and *Gazza*, popularly known as the silver-bellies contribute to one of the important fisheries in the shallow sea around Pamban and Rameswaram. 1,170 specimens ranging in size from 4-16 cm were examined in the laboratory of Krusadai Biological station and the composition of the different species constituting are given.

316. **Chacko, P.I.** 1945. On the food and alimentary canal of the milk fish *Chanos chanos* (Forskal).

317. **Chacko, P.I.** 1945. Plankton investigations at the Krusadai Biological station. *Symposium on Plankton research, Indian Ecological Society. Madras centre, December 1945.* pp.1-4.

318. **Chacko, P.I.** 1949. Food and feeding habits of the fishes of the Gulf of Mannar. *Proc. Indian Acad. Sci.,* 29B: 83-97.

319. **Chacko, P.I**. 1950. Marine plankton from water, around the Krusadai. Island *Proc. Ind. Aca. Sci.,* 31B: 162-174.

320. **Chacko, P.I and S. Thiagarajan** 1952. On the development and parental care in the Potaminid crab, *Paratelphura* (Barytelphusa) *Jaequemonlee* (Rathburn). *J. Bom. Nat. Hist. Soc.,* 51(1): 289-291.

321. **Chacko, P.I., H.P. Valson and C. Malu Pillai** 1954. Meteorology and hydrography of the Kundhukal point in the Gulf of Mannar. *Centr. Mar. Fish. Biol. Stn., Krusadai Island,*1: 1-20.

322. **Chacko, P.I., S. Mahadevan and R. Ganesan** 1955. A guide to the field study of the fauna and flora of Krusadai Island, Gulf of Mannar. *Contr. Mar. Biol. St. Krusadai Island,* 3: 1-16.

Address : Marine Biological Station, Krusadai Island.

Abstract : The Krusadai Island lies off the Rameswaram Island in the Gulf of Mannar in Lat. 9°-14' N and Long. 79°-13' E. It is one of the coral Islands running approximately east and west parallel to the shore and on the south side of the Mandapam Peninsula. The southern shore and on the eastern part of the northern shore are entirely sandy and the western part of the northern shore is very muddy and rich with mangroves. Hence the eastern and western ends of the Island are known as Sandy point and Bushy point respectively. The Island is small being roughly two miles long and quarter mile in width.

323. **Chacko, P.I and S. Mahadevan** 1956. Swarming of *Trichodesmium erythraeum* Ehrenberg in waters around Krusadai Island, Gulf of Mannar. *Fish. Stn. Rep and Year book April 1955 - March 1956.* pp. 139-144.

324. **Chacko, P.I.** 1956. Annual report of the Marine Biological Station, Tuticorin, April 1954- March 1955 (section on plankton). *Fish. Sci. Rep. And Year book, April 1954- March 1955,* pp. 37-56.

325. **Chacko, P.I.** 1956. Annual report of the Marine Biological Station, Tuticorin, for 1955-56. (section on plankton). *Fish. Sci. Rep. And Year book, April 1955- March 1956,* pp. 11-15.

326. **Chacko, P.I and C. Malu Pillai** 1957. Importance of hydrobiological investigations in the Gulf of Mannar in relation to its fisheries. *Ind. Com. J.,* 12: 194-197.

327. **Chacko, P.I and S. George** 1958. An appraisal of the Sea fisheries resources of the Kanyakumari Dist. *Madras Fish. Market Rep.,* 3: 1-11.

328. **Chacko, P.I and A.D. Issac Rajendran** 1959. Maritime meteorology and hydrography of Tuticorin Bay, Gulf of Mannar, 1950-54. *Mad. Fish. Dept. Fish. Stn. Rep. Year Book,* 1954. 55: 175-193.

329. **Chacko, P.I.** 1959. Annual report of the Marine Biological Station, Krusadai Island, Gulf of Mannar for 1955-56. (section on plankton). *Fish. Sci. Rep. And Year book, April 1955- March 1956,* pp. 7-10.

330. **Chacko, P.I., S. Davidson Thomas and C. Malu Pillai** 1962. Scombroid fisheries of Madras State, India. *Proc. Symp. Scombroid fishes,* MBAI 3&4: 1006-1008.

331. **Chacko, P.I.** 1963. Meteorology, hydrology and planktonology of the sea around Krusadai Island, Gulf of Mannar in 1961-62. *Proc. Indian Sci. Cong., 50th Sess.* III: 504.

332. **Chacko, P.I and P.S. Sambandamurthy** 1963. Conditions of existence on the ten pearl banks in the Gulf of Mannar off Tuticorin in 1961-62. *Proc. Indian Sci. Cong., 50 th Sess.* III: 504.

333. **Chacko, P.I and N.R. Nair** 1963. Meteorology, hydrography, planktonology and fisheries of the sea off Cape Comorin in 1961-62. *Proc. Indian Sci. Cong., 50th Sess.* III : 515.

334. **Chacko, P.I and N.R. Nair** 1963. Size and sex composition of the Lobster *Panulirus dosypus* (Latreille) along Kanyakumari District coast in 1960 -62. *Proc. Indian Sci. Cong., 50 th Sess.* IV : 502.

335. **Chacko, P.I.** 1967. Marine fisheries of Madras State. *Seafood Exporter*, 2(1): 63-65.

336. **Chacko, P.I.** 1968. The pearl fisheries of Madras state. *Proc. Symp. on Mollusca* MBAI, 3: 868-872.

337. **Chacko, P.I and A. Rahim** 1968. Survey of fishing ground in the Palk-Bay and Northern sector of the Gulf of Mannar off Rameswaram, Pamban and Mandapam. *Madras J. Fish.,* 4: 47-55.

Address : Krusadai Biological Station, Krusadai Island, Gulf of Mannar, India.

Abstract : With the introduction of mechanized fishing boats by the Madras State Fisheries Department, a Survey Station was located in Rameswaram to survey the fishing grounds in the Palk Bay and northern sector of the Gulf of Mannar to demonstrate to the fishermen the method of exploitation of these new areas, a total area of 1,250 square miles, extending from Valinokkam Point to Dhanushkodi in the Gulf of Mannar side.

338. **Chacko, P.I and P.S. Sambandamurthy.** 1969. Condition of existence in twenty pearl banks in the Gulf of Mannar off Tuticorin during 1962-63. *Madras J. Fish.,* 5: 94-99.

339. **Chakraborty, S.K.** 1988. Population dynamics and management studies of *Otolithus cuvieri* (Trewavas) off Bombay waters. *CMFRI Spec. Publ.,* 40: 36-37.

Address : Central Marine Fisheries Research Institute, Bombay Research Centre, Bombay - 400 001, India.

Abstract : Studies on the age, growth and population management of *Otolithus cuvieri* based on the data collected from 1979-80 to 1984-85 off Bombay waters are reported.

340. **Chalayondeja, K and A. Saraya** 1982. Review of Brackishwater aquaculture development in Tamil Nadu. *BOBP/WP/18.*

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : In this article, the brackish water aquaculture farms in the various coastal regions of the Gulf of Mannar is discussed.

341. **Chandramohan, P., B.U. Nayak and V.S. Raju** 1990. Longshore-transport model for south Indian and Sri Lankan coasts. *J.Wat. Port, Coastal and Ocean Engg*., 116(4): 408-424.

Address : National Institute of Oceanography, Dona Paula, Goa - 403004, India.

Abstract : Longshore-sediment transport rates for the south Indian coast from Allur to Cochin and for Sri Lanka are estimated from ship-reported wave data (1968-86). Annual gross sediment transport rate is high (1.5 to 2.0 × 106 m^3) along the coasts of north Tamil Nadu and south Kerala and is less (0.5 to 1.0 × 106m^3) along the south Tamil Nadu and Sri Lankan coasts. The annual net transport is southerly along the west coast of India and predominantly northerly along the east coast except near Durgarajupatnam in Andhra Pradesh. Coasts near Tharangampadi, Karaikal, Nagore, Tuticorin, Virapandianpatinam, and Manakkodam in India and Kuchchaveli, Betticola, Pottuvil, Chilaw, and Negombo in Sri Lanka appear to be nodal drift points, with an equal volume of transport in either direction annually.

342. **Chandramohan, P., B.K. Jena and V. Sanil Kumar** 2001. Littoral drift sources and sinks along the Indian coast. *Curr. Sci.,* 81(3): 292-297.

Address : National Institute of Oceanography, Dona Paula, Goa 403 004 India; E-mail: sanil@darya.nio.org

Abstract : Numerous theoretical and field studies have been carried out to quantify the volume and direction of littoral sediment transport along the Indian coast. Nevertheless, very little effort has been made to identify the sources for the littoral transport, which feed to the nearshore transport mechanism and on sinks, wherein the continuous movement of the littoral sediment breaks and deposits over a considerable period of time. Rivers are the major source for the littoral drift and the annual discharge of sediments to sea along the Indian coast is about 1.2 x 10^{12} kg. The construction of inland dams, irrigation barrages, have considerably reduced the sediment load

brought to the sea. Due to the fall in the influx of sediments and concentration of wave energy, many coastal segments experience erosion. In order to identify the extent of the significance of the major sinks for the sediment deposition along the Indian coast, a study was undertaken to evaluate the long-term sediment deposition in Gulf of Kachch, Gulf of Khambhat, Gulf of Mannar, Palk Bay and Sandheads. The study shows an average yearly deposition of sediments to a thickness of 0.025 m at Gulf of Kachchh, 0.03 m at Gulf of Khambhat, 0.01 m at Gulf of Mannar, 0.006 m at Palk Bay and 0.003 m at Sandheads. The depositional features identified in the present study have been noticed as occurrences of spits, shoals and the progradation of coastline.

343. **Chandrasekaran, P., V. Ananth, G. Subramanian, S. Guruviah and K.I. Vasu** 1990. Corrosion behaviour of heat-treated steel in marine environment. *Bull. Electrochem.*, 6(6): 584-585.

Address : Corrossion Testing Centre, CECRI Unit, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : This study deals with the effect of heat treatment of steel with 0.17% C at three different temperatures selected through metallographic analysis viz. untreated, 873, 1073 and 1223K on the corrosion behaviour in aggressive tropical marine environment. Accelerated salt spray test has also been conducted to compare the actual field data. The corrosion rates are in tune with the meteorological data collected. The heat treatment process is graded according to the performance in combating corrosion. Results are discussed in the light of micro structure levels of pollutants and other meteorological data.

344. **Chandraseker, N and A. Cherian** 2003. Heavy mineral sand retention in and around coral reef platform, Van Island, Gulf of Mannar. *Nat. Sem. Reef Ecosystem Remediation,* 24th-26th Sep'03, SDMRI,Tuticorin, India. p.80.

Address : Marine Geochemistry Research Lab, SPIC Research Centre, V.O. Chidambaram College, Tuticorin-628 008, India. E-mail: ncsmarine@yahoo.co.in

Abstract : A concise review of selected investigations into coral lithohydrodynamics, recently carried out by the Marine Geochemistry Research Lab of V.O.C. College, is presented. The study encompasses various research approaches, including nature of sediment, coral morphology, sediment transport under waves and currents are discussed. Coral reefs are three dimensional features that reduce wave heights in their lee. Changes in wave energy along the shore resulting from smaller reefs are primarily due to attenuation or dissipation of wave energy as it passes over the reef structure. Coral reefs that enhances heavy mineral sand retention and are allowing sand to pass on the beach, seaward and over the top at times. The retention is more in the leeward side of the reef. The total heavy mineral concentration is recorded to the tune of 6.25 to 30%. The distribution of heavy mineral is very high at high tide and dipping towards reef platform. Major disparity in the composition of heavy minerals are pragmatic around island reflecting both a geographic trend of upsurge in heavy mineral composition from north to south and a decreasing tendency away from coral reef. Overall results suggests that coral reef structures can act as a trap for heavy mineral storage in a particular location.

345. **Chandrasekhara Rao, A and P. Kaladharan** 2003. Improvement of yield and quality of agar from *Gracilaria edulis* (Gmelin) Silva. *Seaweed Res. Utiln.*, 25(1&2): 131-138.

Address : Central Marine Fisheries Research Institute, Cochin- 682 018, India.

Abstract : Optimum levels of alkali acid and thermal manipulations during extraction of agar were determined to increase the yield and quality of agar from red Seaweed *Gracilaria edulis* (Gmelin) Silva. Pre-soaking of dry weeds in water for 2 h increased the yield by 11.44 %, but did not improve the gel strength. Pre-soaking for 12 h increased gel strength and melting temperature considerably, but not the yield. Pre-soaking of dry weeds in 1.0N NaOH resulted in gel strength of135 g.cm^{-2}. Pre-soaking of dried weeds with 0.5N and l.0N HCL even at higher temperature showed improvement neither in yield nor in the quality of agar and also resulted in hydrolysis of agar. Pretreatment at 2.0-3.0 N NaOH at 80°C for 1 hour to pre-soaked *G. edulis* for 11 h in water proved to be the most ideal and optimum extraction procedure to obtain higher yield (14.16 %), maximum gel strength (291g.cm^{-2}), lowest sulphate (0.732%) and highest melting point (99°C) of agar.

346. **Chandrika, V and C.S.Gopinadha Pillai** 1962. Bacterial flora on corals, sponges and reef sediments of Manoli Island in Gulf of Mannar. *Associatin of Microbiologists of India 32nd Annual Conference, Madurai.* p. 174.

347. **Chari, S.T and M. Mukundan Unny** 1947. The food value of two common molluscs found near Pamban and the chemical composition of their shells. *Curr. Sci.,* 16: 294.

Address : Fisheries Section, Department of Industries and Commerce, West Hills, Madras, India.

Abstract : Two varieties of molluscs, Turban shells (*Turbo margaritaceus*) and wedge shells (*Donax cuneatus*) occur on the shores of the Madras Presidency and their flesh are commonly eaten by fisherfolk when other seafish are not available. Data on the food value of these edible molluscs are given here.

348. **Chari, S.T** 1966. Chemical composition and food value of chank and pearl oysters. *Madras J. Fish.,* 2: 84-85.

349. **Chari, S.T and N. Sabapathy** 1966, Vitamin 'A', copper and iron in the East coast marine fishes available at Tuticorin. *Madras J. Fish.,* 2: 91-92.

350. **Chauhan, V.D and F. Thivy** 1965. *Sargassum merrifieldi* J. Agl new to the shores of India. *Phykos*, 4(2): 69-70.

351. **Chellam, A and K. Alagarswami** 1978. Blooms of *Trichodesmium thiebautii* and their effect on experimental pearl culture at Veppalodai. *Indian J. Fish.*, 25(1&2): 237-239.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Blooms of the blue-green alga, *T. thiebautii* , were observed at the pearl culture farm off Veppalodai in the Gulf of Mannar in March-April and Sept. 1973. Although the alga occurred in high concentration, it did not cause any unusual mortality of pearl oysters in the open-sea farm. However, a few hundred experimental oysters kept in bloom-laden water in the laboratory died due to the death and decay of the algal filaments. It is pointed out that in a widespread bloom situation, as in the present instance, work on pearl culture is hampered, as it is not possible to draw clear, bloom-free water for "seeding" operations.

352. **Chellam, A.** 1978. Growth of pearl oyster *Pinctada fucata* in the pearl culture farm at Veppalodai. *Indian J. Fish.,* 25(1&2): 77-83.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Growth of pearl oyster, *P. funcata*, under conditions of raft culture at Veppalodai, Gulf of Mannar, has been studied during the period March 1973-September 1974, with reference to growth of the dorsoventral dimension, hinge line, thickness and weight. The first 2 dimensions showed positive growth up to a cerain period followed by growth recession. Thickness increased uniformly throughout the period of study in the younger size groups (30-45 mm) but showed stagnation in the older size groups (45-60 mm) during certain times of the year. Weight increased steadily but showed retardation, except in younger groups (30-40 mm), in a few months. The progress of growth was better in younger size groups than in the older groups. The growth of pearl oysters in the shallow area is considered moderate.

353. **Chellam, A.** 1983. Study on the stomach contents of pearl oyster *Pinctada fucata* (Gould) with reference to the inclusion of bivalve eggs and larvae. *Proc. Symp. on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: Molluscan culture,* Marine Biol.l Assoc. India, Cochin, India, pp. 604-607.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Experiments were conducted to elucidate the role of bivalve larvae in the feeding of pearl oysters. Trochophore larvae of *P. fucata* obtained in rearing experiments were fed to starved oysters. These were readily ingested by the pearl oysters. The larvae were passed out in the faecal matter alive and these, when reared, developed into straight-hinge stage.

354. **Chellam, A., T.S. Velayudhan, S. Dharmaraj, A.C.C. Victor and A.D. Gandhi** 1983. A note on the predation on pearl oyster *Pinctada fucata* (Gould) by some gastropods. *Indian J. Fish.,* 39(2): 337-339.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Considerable mortality of young pearl oyster, *Pinctada fucata* , was noticed on the oyster beds in Gulf of Mannar due to predation by gastropods, *Cymatium cingulatum* and *Murex virgineus* . Pearl oysters reared in the farm also suffered mortality, due to accidental transplantation of *C. cingulatum* while stocking.

355. **Chellam, A.** 1987. Biology of pearl oyster *Pinctada fucata* (Gould). *CMFRI Bulletin,* 39: 13-20.

Address : Central Marine Fisheries Research Inst., Cochin - 682 018, India.

Abstract : The findings are presented of a study conducted, investigating the biology of the pearl oyster (*Pinctada fucata*) under culture conditions. Age and growth, food and feeding, reproductive biology, maturity stages, sex ratio, sex reversal and effects of environmental parameters on the reproductive cycle are discussed.

356. **Chellam, A., T.S. Velayudhan and A.C.C. Victor** 1987. Pearl oyster farming. *CMFRI Bulletin,* 39: 72-77.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract: Rearing methods used in the culture of pearl oyster in India are discussed, describing also culture containers. Factors to be taken into account when selecting a site for pearl oyster farms are considered detailing environmental parameters affecting the pearl oysters during culture.

357. **Chellam, A., S. Dharmaraj and A.C.C. Victor** 1987. Experimental sea-ranching of pearl oyster in the Gulf of Mannar. *CMFRI Bulletin,* 39: 90-91.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A brief account is given of results obtained during an experimental sea-ranching program regarding the mass production of pearl oyster spat in the Gulf of Mannar. Fluctuations of the pearl oyster resource in natural beds are examined, considering also their conservation in natural beds.

358. **Chellam, A.** 1988. Growth and biometric relationship of pearl oyster *Pinctada fucata* (Gould). *Indian J. Fish.,* 35(1): 1-6.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The Indian pearl oyster, *Pinctada fucata* (Gould) produced in the hatchery and grown at the protected farm at Tuticorin Harbour, attains a dorsoventral length of 47.0, 64.0 and 75.0 mm at the end of 12^{th}, 24^{th} and 36th months and the corresponding averages in weight are 8.3, 31.6 and 45.4 g. The estimated Von Bertalanffy growth parameters are L- ∞ = 79.31 mm, K = 0.0757 per month and t_6 = 0.44 months. Relationships between total weight, shell weight, flesh weight and dry weight of flesh and length with depth were found by least square technique.

359. **Chellam, A., S. Dharmaraj, T.S. Velayudhan and P. Muthiah** 1988. Experimental molluscan seed transport. *Mar. Fish. Inf. Serv., T & E. Ser.,* 79: 26-28.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Trials were conducted during 1985-87 at Tuticorin to determine safe methods of molluscan seed transport, avoiding mortality. Some of the procedures found to be effective in handling *Pinctada fucata* and *Crassostrea madrasensis* seeds before, during and after subjecting them to long distance transport by road, sea or air are outlined.

360. **Chellam, A., S. Dharmaraj, T.S. Velayudhan and A.C.C. Victor** 1988. On some aspects of transportation of seed of pearl oyster *Pinctada fucata*. *CMFRI Bulletin,* 42(2): 288-294.

Address : Central Marine Fisheries Research Station, Cochin - 682 018, India.

Abstract : The object of mass production of pearl oyster seed in the hatchery at Tuticorin Research Centre of Central Marine Fisheries Research Institute (CMFRI) is to ensure adequate supply of seed needed by the culture indutry and also to meet the demands of the future requirement of different maritime states and other establishments. To ensure adequate supply of healthy seeds experiments were conducted to perfect the technique of transport of seed oysters. The paper highlights some significant results which will facilitate transport of pearl oyster seed over long distances.

361. **Chellam, A., A.C.C. Victor, S. Dharmaraj and T.S. Velayudhan** 2000. The Pearl Oysters. ***In***: *Marine Fisheries Research and Management, (eds.)* V.N. Pillai and N.G. Menon. pp. 536-545.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : An account of the pearl oyster resources with a brief note on biology, collection methods, seed production and conservation and management in the Indian subcontinent is dealt with in this paper. Both in the Gulf of Kutch and the Gulf of Mannar, the population does not show improvement. Conservation and management of this important resource in the light of the present R & D carried out by the CMFRI is discussed. Enhancement of the wild stock through the production of genetically improved seed in the hatchery and ranching them to selected beds and close monitoring of the physico-chemical and biological factors over a period of time is suggested. Farming of oysters on the natural beds can enhance the pearl quality and may form a breeding reserve.

362. **Chellam, A., A.C.C. Victor and I. Jagadis** 2003. An unusual pearl oyster fishery at Tuticorin. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 65-66.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The ban on the fishing by mechanised boats during the months 16th April 2002 to 31st May 2002 promulgated by the Tamil Nadu Government, prompted many of the fishermen having Tuticorin type motorized crafts, to resort to fishing with bottom-set gill nets, (locally called "Chinki valai" made of monofilament) in and around the pearl bank areas off Tuticorin. The gill net is set to sway in the area at least for 4-6 gills. When it sways due to the effects of swells and currents, it will entangle not only the bottom dwelling fishes and shellfishes but also the immovable shells both dead and live, coral pieces, sponges and gorgonids along its course. When the sea is rough owing to winds and currents, the area covered by the swaying net will be more and also the catches in the net. When the net is set in the vicinity of the pearl banks with the sand-coral-shell grits, most of the materials on the floor of the sea especially pearl oysters, dead corals, sea weeds, sponges and pinna shells with pearl oysters settled on them also get entangled in the net. During this season of the year 2002, the area of fishing was centred on some of the southern group of pearl banks, especially around peria (Tholayiram) paar and Kodamuthu paar. The fishermen of Tharuvaikulam (about 10-12 boats) and Tuticorin (about 8-10 boats) had been engaged in the bottom-set gill net fishing (locally "Chinki valai") during May-September and landed pearl oysters numbering from 200 to 5000 on each occasion when they fished at 10-15 fathom depth in the paar area. Likewise, during the year 1999-2000, a very dense settlement of pearl oysters was seen on the northern group of pearl banks, especially on and around the Vanthivu (Van island) Arupagam (six fathom) paar. As much as 6000 oysters per diving hour could be collected from the paar during October-December 1999. The length of the oysters ranged from 43.0 to 58.0 mm with an average of 50.0 mm and the weight from 12.0 to 27.0 gm with an average of 18.6 gm. A survey made in the same spot during March 2000 indicated that a total mortality of oysters had taken place and heaps of shells were seen spread on the rocky and the adjacent patches of the pearl banks. Mass mortality of pearl oysters on the northern group of pearl banks had been noted in the previous seasons also, indicating that these pearl banks (nearshore-northern) do not sustain the pearl oysters long enough to contribute to a pearl fishery.

363. **Chellam, A., A.C.C. Victor, I. Jagadis, Boby Ignatius and K. Ilangovan** 2003. On the Low Cost Transportation of the Pearl Oyster *Pinctada fucata* (Gould). *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. p. 70.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The seed of the Indian pearl oyster *Pinctada fucata* had been transported to different parts of our country adopting different methods. At present, the concept of having hatcheries at places of suitability and farming and pearl production at places conducive for this purpose had necessitated to study the method of transportation of mother oysters. The results of the experiments conducted to transport mother oysters at low cost with less risk is discussed in this abstract.

364. **Chellappa, D.E.** 1959. A note on the night fishing observations from a Kelong. *J. Mar. Biol. Ass. India*, 1(1): 93-94.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Night fishing observations were made from the Kelong during a short period only. More extensive work is required in order to elucidate the various aspects connected with the use of lights for night fishing.

365. **Chellappa, S., T.S. Balasubramanian and G. Arumugam** 2002. On the occurrence of sunfish along Tuticorin coast in Gulf of Mannar. *Mar. Fish. Infor. Serv. T&E Ser.*, 174: 10.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Ocean sunfishes of the family Molidae has three genera namely Ranzania, Masturus and Mola. The occurrence of some of the species like *Ranzania truncata, R. typus, R. laevis, Masturus axyuropterus, M. lancealatus* and *Mola mola* have been reported from Indian waters. On 12-06-2001 and 08-07-2001 two sunfishes *Mola mola* measuring 630 mm and 650 mm total length and weighing 11.5 kg and 12 kg respectively are reported.

366. **Chellappan, C.** 1980. Status report on fisheries extension in Tamil Nadu. *Seminar on fisheries extension, Status Reports and Background papers*: 31 pp.

367. **Chellaram, C., V. Deepak Samuel and J.K. Patterson Edward** 2003. Status of echinoderm fishery in the Gulf of Mannar, southeast coast of India. *SDMRI Res. Publ.*, 3: 173-176.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: coralchella@rediffmail.com

Abstract : In the Gulf of Mannar, Holothuroidea, Asteroidae and Echinoidea are among the five classes of echinoderms that are considered economically important. The class Holothuroidea includes 10 commercially important species of sea cucumbers and among them only 6 species have high export market demand. Besides, 6 species of Asteroidea and 4 species of Echinoidea are used as ornamentals and curios. The holothurians are collected through skin diving and as by-catch, whereas Asteroidea and Echinoidea are collected only as by-catch and there exists no exclusive fishery. The inclusion of holothurians in the list of protected animals under Indian Wildlife (Protection) Act, 1972 has left the holothurian fishery dependent fishing community in the wild. Alternate income generating schemes should be provided to safeguard the livelihoods of these people.

368. **Chellaram, C and J.K. Patterson Edward** 2003. Growth and survival of *Acropora formosa* transplanted on different substrates. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 34.

Address : Suganthi Devadason Marine Research Institute 44 Beach Road, Tuticorin-628 001, Tamilnadu, India.

Abstract : Coral reefs are valuable economic and recreational resources. However, urbanization and other human activities have accelerated the destruction of reefs and the branching corals are worst affected. In the present study, fragments of *A. formosa* of 3 to 11 cm were transplanted to different substrates like cement slabs and stones. The growth and survival of the fragments were observed. The overall survival of the fragments was 84.5%. The secondary basal disc formation was observed within 15 days of transplantation and maximum numbers of fragments (95%) were completely fused to the substrate within 4 weeks and the rest were overgrown on the wire, which was used to fix with the substrate. Among the different size group of fragments, 9-11 cm size fragments showed higher growth rate in both the substrates. Among the substrates, the cement slabs were found to be better than stones due to the higher growth rate of transplants. This simple technique can be used to restore the highly damaged coral species and thereby to increase the biomass in the degraded areas.

369. **Chellaram, C., K. G. Mary Elizabeth and Jamila Patterson** 2003. Insecticidal and herbicidal effects of gorgonid associated winged oyster, *Pteria chinensis* (Abstract only). *Natl. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 44.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Marine organisms represent a massive resource of bioactive substances, which pave way for the development of structurally and chemically active novel herbicidal and insecticidal compounds. A preliminary study was made in evaluating the bioactive properties of the tissue extracts of a gorgonid associated bivalve, *Pteria chinensis*, using different solvents such as Ethyl acetate, Acetone and Dichloromethane. The acetone extracts of *Pteria* was found to cause 100% mortality to *Sitophilus oryzae*, a dreadful pest of rice at a concentration of about 20mg/ml using glass petri dish bioassay; Extracts from the same solvent were also found to be effective in yellowing the duckweed, *Lemna minor* at a concentration of 50 µg/ml at day 7, indicating herbicidal property *in vitro.* However, the results were confirmed by spraying the evaporated acetone extracts to a potent weed, *Cynodan dactylan* at a concentration of 17.333 mg / 10 ml of water /day for three days and the herbicidal activity was evidenced by the decaying of the grasses. The preliminary screening for insecticidal and herbicidal activities becomes a corner stone for the future development of novel biologically active compounds that could replace the already existing chemical insecticides and herbicides.

370. **Chellaram, C., J.K. Patterson Edward, G. Mathews, Jamila Patterson, M. Venkatesh and D. Wilhelmsson** 2004. A field guide to stony corals (Scleractinia) of Tuticorin in Gulf of Mannar, southeast coast of India. *SDMRI Res. Publ.*, 4, 89 p.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin-628 001, Tamil Nadu, India.

Abstract : An attempt is made to document the available fauna. Total of 53 species belonging to 22 genera recorded by SCUBA diving in and around Tuticorin (Tamil Nadu, India) are discussed here. Investigation of the line as well as possibility of culturing corals to strengthen eco-development is undertaken. This field guide will be a valuable document for future researchers in the area.

371. **Chellaram, C., K. Mary Elizabeth Gnanambal and J.K. Patterson Edward** 2005. Isolation and screening of mucus-associated bacteria of the gastropod, *Drupa margariticola* for antagonistic activity. *J. Mar. BioI. Assoc. India*, 47(2): 154-159.

Address : Suganthi Devadason Marine Research Institute, 44, Beach Road, Tuticorin - 628 001. Tamiladu, India. E mail: coralchella@rediffmail.com

Abstract : The mucus-associated bacteria of the gastropod, *Drupa margariticola* were screened for their ability to inhibit the human and fish pathogens. Out of the two hundred and eighty five bacterial strains isolated, 23% (65) were found to be pigmented, 71% (202) were identified as Gram-negative. A higher percentage of nonpigmented (77%) and Gram-negative (71%) strains were observed in the present investigation. 16% (46) of the isolates was found to have antagonistic activity against both human and fish pathogens tested and 63% of the Gram-negative strains (29) were found to be antibiotic producers. Antagonistic activity was found to be exhibited by pigmented strains too. A higher degree of inhibition was conferred by 3 of the isolates (D_{15}, D_{130} and D_{237}) against both human and fish pathogens. These strains exhibited full or complete degree of inhibition against *Escherichia coli*

372. **Chennapayya, A.** 1927. Littoral fauna of the Krusadai Island in the Gulf of Mannar : Mollusca. *Bull. Madras. Govt. Mus. New, Sci. Nat. Hist.*, 1: 95-109.

373. **Chennubhotla, V.S.K., S. Kalimuthu, N. Kaliaperumal and J.R. Ramalingam** 1977. Studies on the growth variation alginic acid and mannitol content in *Padina gymnospora* (Kuetzing). *Seaweed Res.Utiln.*, 2 (1 & 2) : 91-94.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In the present account, variation in growth, and mannitol contents in *Padina gymnospora* observed over a period of 2 years (Jan'1975 to Dec'1976) are given.

374. **Chennubhotla, V.S.K., N. Kaliaperumal and S. Kalimuthu** 1978. Seasonal changes in growth, fruiting cycle and oospore output in *Turbinaria conoides* (J. Agardh) Kutzing. *Bot. Mar*., 21(1): 67-69.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Monthly samples of *T. conoides* were collected, from the Gulf of Mannar, to study its seasonal changes, fruiting cycle and oospore output. The growth cycle commenced in April. The fruiting cycle starts in October and ends in February during which time oospore output gradually increases to a peak in January with a sudden decline in February. From the studies it is concluded that *T. conoides* may be harvested for extraction of alginic acid during the peak growth season between Oct-Jan.

375. **Chennubhotla, V.S.K., N. Kaliaperumal and S. Kalimuthu** 1978. Culture of *Gracilaria edulis* in the inshore waters of Gulf of Mannar (Mandapam). *Indian J. Fish.*, 25(1&2): 228-229.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The possibilities and advantages of submerged floating culture of *G. edulis* in the inshore water of the Gulf of Mannar are discussed. Observations suggest that a pure strain of the alga could be harvested without contamination and much sedimentation.

376. **Chennubhotla, V.S.K., N. Kaliaperumal and S. Kalimuthu** 1981. Seaweed recipes and other practical uses of seaweeds. *Seafood Exp. J*., 13(10): 9-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Some seaweed recipes (Halwa, jam, agar jelly, food products requiring agar, seaweed salad, seaweed vegetables, seaweed curry, seaweed porridge) are outlined together with some other practical uses, (seaweed manure, seaweed compost, seaweed animal feeds and agar-agar and algin).

377. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu, M. Selvaraj, J.R. Ramalingam and M. Najmuddin** 1982. Seasonal changes in growth and alginic acid and mannitol contents in *Sargassum ilicifolium* (Tunner) J. Agardh and *S. myriocystum* J. Agardh. *Indian J. Mar. Sci.*, 11(2): 195-196.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Young plants of *Sargassum ilicifolium* and *S. myriocystum* appear in April and May and reach maximum size in September or October. Alginic acid yield varies with the seasonal growth behaviour of these alginophytes, with maximum yields in July or August. Alginic acid content varies from 22.3 to 30.8% in *S. myriocystum*. Mannitol content ranges from 2 to 5 and 1.3 to 5% in *S. ilicifolium* and *S. myriocystum* respectively. The suitable harvesting period to get the maximum yield of alginic acid appears to be between July and September.

378. **Chennubhotla, V.S.K., N. Kaliaperumal, J.R. Ramalingam and S. Kalimuthu** 1986. Growth, reproduction and spore output in *Gracilaria foliifera* (Forsskal) Boergesen and *Gracilariopsis sjoestedtii* (Kylin) Dawson around Mandapam. *Indian J. Fish.*, 33(1): 76-84.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Observations made for one year on the seasonal changes in growth, reproduction and spore output of *Gracilaria foliifera* and *Gracilariopsis sjoestedtii* are given. These red algae occurred only a few months during the year in the area of study. Maximum growth of *G. foliifera* was during April and of *G. sjoestedtii* was during September and January to March. Tetrasporophytes were more abundant than carposporophytes in *G. foliifera*, whereas in *G. sjoestedtii* carposporophytes occurred more. Maximum outputs of tetraspores and carpospores were recorded on the first day, and the period of peak shedding of spores coincided with the peak growth period of these seaweeds. There was, however, no definite rhythm of diurnal spore output.

379. **Chennubhotla, V.S.K., S. Kalimuthu and M. Selvaraj** 1986. Seaweed culture: Its feasibility and industrial utilisation. *Proc. Symp. Coastal Aquaculture*, 4: 1206-1209.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Culture of seaweeds is practiced since ages in countries such as Japan, China and Korea. Seaweed cultivation is an industry in Japan as a part-time avocation for land farmers and fishermen. The seaweeds cultured mainly in these countries are *Porphyra, Undaria, Laminaria, Enteromorpha* and *Monostroma.* In India seaweed culture is yet to develop on commercial lines. While the demand for these seaweeds is for food purposes in foreign countries, their demand in India is for the extraction of two phytochemicals namely agar-agar and algin. In recent years many factories manufacturing these chemicals have come up in India as a consequence of which the demand for the agarophytes and alginophytes has gone up. In order to maintain a continuous supply of this raw material to the industry, methods to augment the supplies through culture practices have to be developed. In recent years the Central Marine Fisheries Research Institute has been engaged in the cultivation of several economically important seaweeds such as *Sargassum wightii, Turbinaria* spp., *Gracilaria edulis, G. corticata* and *Gelidiella acerosa* which indicated great scope for cultivation. The production rate has been found to be 4.4 kg/m^2 in the case of *G. edulis* and 3 kg/m^2 in the case of *G. acerosa* in about 80 days for 0.30 kg and 1 kg of seed material introduced respectively. In the case of alginophytes the growth was not encouraging. These culture experiments were conducted by introducing small fragments of the seaweed into the twists of the coir ropes fabricated in the form of a 5 X 2 m net and tied to fixed poles in inshore waters. In the case of *G. acerosa*, the substratum along with the plant fragments was tied to the ropes. The agarophytes thus grown can be processed further for extraction of agar-agar. The extraction could be done by a simple cottage industry method not involving any costly equipment. In the case of *Gelidiella* agar, freezing and thawing are required to remove the insoluble chemicals. A total of 90 tonnes of *G. edulis* can be obtained from 3 harvests in a year from a hectare area.

380. **Chennubhotla, V.S.K., J.R. Ramalingam and M. Najmuddin** 1986. Socioeconomic standards of fishermen of Marakayarpatnam and Vedalai villages in Tamil Nadu and the role of coastal Aquaculture in raising their standards. *Proc. Symp. Coastal Aquaculture*, 4: 1476.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The villages of Marakayarpatnam and Vedalai are located on the southeast coast of India in Ramanathapuram District of Tamil Nadu. The main livelihood of the fishermen in these villages is fishing (chank fishery, gillnet, shore-seine and cast net operations) and collection of economically important seaweeds from the neighbouring Islands. There are no cultivable lands in Marakayarpatnam but in Vedalai coconuts, plantains, flowering plants and ragi are cultivated in 395 acres. The population of the former is nearly 500 and of the latter around 2000. At Marakayarpatnam and Vedalai potable water is drawn from unprotected well situated about 1 km away from the villages.

381. **Chennubhotla, V.S.K., S. Kalimuthu, M. Najmuddin, R. Panigrahy and M. Selvaraj** 1986. Changes in growth and phycocolloid content of *Gelidiella acerosa* and *Gelidiella edulis. Seaweed Res.Utiln.*, 9(1&2):45-48.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Results obtained on seasonal growth, yield and physical properties of agar in *Gelidiella acerosa* and *Gracilaria edulis* for a period of one year are presented. Vegetation of these two species occurred throughout the year with two peak growth periods. In *G. acerosa* the agar content varied from 26.1 to 50.8 % and gel strength from 147 to 325 g/cm^2. In *G. edulis* the yield of agar ranged from 26.5 to 45.0 % and gel strength from 69 to 139 g/cm^2. Seasonal variations observed in growth and yield, gel strength, setting and melting temperature of agar were not conspicuous in both these red algae.

382. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu** 1987. Economically important seaweeds. *CMFRI Bulletin,* 41: 3-19.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The plants in the sea other than seagrasses-what we call seaweeds-belong to the simplest group of plants: the marine algae. With few exceptions, these plants are so simple that they have no distinguishable roots, stems or leaves. The algae vary in size from microscopic single-celled forms (eg. diatoms) to the giant macrophytes of temperate waters *(Macrocystis, Nereocystis,* etc).

383. **Chennubhotla, V.S.K., N. Kaliaperumal and S. Kalimuthu** 1987. Common seaweed products. *CMFRI Bulletin,* 41: 26-30.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The seaweeds are the only source for agar and algin. They are also used as food material, livestock feed and fertilizer in many parts of the world. The various products obtained from Indian seaweeds and their uses are dealt with here.

384. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu, J.R. Ramalingam, M. Selvaraj and M. Najmuddin** 1987. Seaweed Culture. *CMFRI Bulletin,* 41: 60-74.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Seaweed culture has perforce to be adopted should the supply of raw material to Industries be uninterrupted, like in the case of the Japanese and Korean *Porphyra* industries, the Chinese *Laminaria* industry and the Philippines *Eucheuma* Industry which are now in the main based on cultured raw material. The culture is at present almost entirely confined to the Orient, reaching its peak of sophistication in Japan and China. The necessity of marine algal cultivation in India and the principles and problems involved therein were discussed by Thivy (1964), Krishnamurthy (1967) and Chennubhotla (1976).

385. **Chennubhotla, V.S.K., N. Kaliaperumal and S. Kalimuthu** 1987. Post harvest technology. *CMFRI Bulletin,* 41: 74-77.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Species of *Sargassum* and *Turbinaria,* which are used for algin extraction are either dried on the beach sand or treated with formalin in wet condition and then dried on the beach sand. The percentage of moisture and purity decide the cost of seaweed at the time of sale. Cleared dry seaweeds are weighed, packed in gunny bags and despatched to industries.

386. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu and P.V.R. Nair** 1987. Biology of the economically important Indian seaweeds: A review. *Seaweed Res. Utiln.,* 10(1&2): 21-32.

387. **Chennubhotla, V.S.K.** 1988. Status of seaweed culture in India. *Report on the Training course on Seaweed Farming, Manila, Philippines,* 2-21, May, 1988. pp. 91-98.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Following is a brief account of techniques used in India regarding the culture of *Gracilaria acerosa, G. edulis* and other red algae; details are given as to the seaweed culture experiments conducted at the Central Marine Fisheries Research Institute at Mandapam. The culture of spores, the effects of environmental factors on seaweed culture and surveys of seaweed resources are covered. An examination is also made of the economics of seaweed culture.

388. **Chennubhotla, V.S.K., N. Kaliaperumal and M.S. Rajagopalan** 1988. Seaweed culture in India - an appraisal. *CMFRI Spec. Publ.,* 40: 57-58.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Attempts have been made in India to develop suitable seaweed farming techniques by some institutes, notably the CMFRI at its Mandapam Regional Centre and CSMCRI at its field centre, Mandapam. Experimental culture of economically important seaweeds such as *Gracilaria edulis, Gelidiella acerosa* and other species was undertaken since 1972 at Mandapam. In these experiments production rates ranging from 3 to 8 times the initial wet weight were obtained. The techniques of seaweed culture, the favourable seasons, optimum duration of culture period and the influence of environmental parameters are discussed in this account with notes on economics

of seaweed culture. General information on the seaweed coastal resources, their potential for exploitation and culture are also highlighted.

389. **Chennubhotla, V.S.K., M. Najmuddin, J.R. Ramalingam and N. Kaliaperumal** 1988. Biochemical composition of some marine algae from Mandapam coast. *CMFRI Spec. Publ.*, 40: 65.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies were made on biochemical composition of 33 marine algae comprising 16 green, 7 brown and 10 red algae commonly occurring along Mandapam coast. The algae were analysed for protein, carbohydrate and lipid. In general, the protein content was found high in green algae, the values ranging from 6.8% to 25.8%. The carbohydrate content was found to be high (75%) in red algae, followed by brown algae (24.9%) and green algae (11.6%). The lipid content ranged from 4.0 to 8.0% in green algae, 0.5 to 4% in brown algae and 0.5 to 6.0% in red algae. The present investigation indicates that selected species could be utilized as an alternate source of protein and carbohydrate for the formulation of fish feed in fish culture or for the manipulation of other animal and human feed.

390. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu, J.R. Ramalingam, S. Krishna Pillai, K.Subbaramaiah, K. Rama Rao and P.V. Subba Rao** 1989. Seaweed resources of Tamilnadu coast: Kattapadu - Tiruchendur. *Mar. Fish. Infor. Serv. T & E. Ser.*, 96: 10-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The percentage compostion of Green, Brown and Red algae collected by SCUBA diving is discussed.

391. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu, J.R. Ramalingam, K. Subbaramaiah, K. Rama Rao and P.V. Subba Rao** 1990. Seaweed resources of the Tuticorin-Tiruchendur coast, Tamil Nadu, India. *J. Mar. Biol. Assoc. India*, 32(1&2): 146-149.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The southern coast of Tamil Nadu (Mandapam to Kanyakumari) support luxuriant growth of economic seaweeds. The entire indigenous phycocolloid industry of the country gets the raw material from this region and during the last two decades, due to indiscriminate harvesting, there has been over-exploitation of the resource. The present paper deals with survey conducted in the first sector from Tuticorin to Tiruchendur during December 1986-March 1987. In this study 58 species of marine algae were recorded of which 7 belong to Chlorophyta, 12 to Phaeophyta and 39 to Rhodophyta besides 3 species of seagrasses namely *Cymodocea serrulata*, *Halophila ovalis* and *H. ovata* within 650 sq. km area surveyed. The total standing crop of the seaweeds was estimated at 9,100 tonnes (wt.). The estimates for the dominant species are *Dictyota maxima* 530 t, *Sargassum tenerrium* 640 t, *D. bartayresiana* 860 t, *Selieria robusta* 2,090 t and *Hypnea valentiae* 2,430 t. The seaweed potential for commercial exploitation has been briefly discussed.

392. **Chennubhotla, V.S.K., N. Kaliaperumal, S. Kalimuthu and J.R. Ramalingam** 1991. Commercially important seaweeds of India, their occurrence, chemical products and uses. *Mar. Fish. Infor. Serv. T & E. Ser.*, 107: 11-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The chemical constituents in terms of mineral comoposition in seaweeds (in mg per 100 gm of dry weed) are given.

393. **Chennubhotla, V.S.K., N. Kaliaperumal, Reeta Jayasankar, S. Kalimuthu, J.R. Ramalingam, K. Muniyandi and M. Selvaraj** 2000. Seaweeds, ***In***: *Marine Fisheries Research and Management*, (eds.) V.N. Pillai and N.G. Menon, CMFRI, Kochi. pp. 21-37.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Research works on various aspects of seaweeds have been carried out since last five decades. They include resources survey, studies on distribution, taxonomy, ecology, biology, phycocolloids, biochemicals, culture and utilization of marine algae growing in Tamil Nadu, Kerala, Lakshadweep and Andaman-Nicobar Islands. Information was also gathered since 1978 on the quantity of seaweeds commercially exploited from the natural seaweed beds occurring in Tamil Nadu coast. The results obtained on these aspects are reviewed in this paper. The prospects of seaweed research, industry and utilization in India are also briefly described.

394. **Cherian, A[1]., Chandrasekar, N[2]., G. Victor Rajamanickam[2]** 2004. Light minerals of beach sediments from Southern Tamilnadu, southeast coast of India. *Oceanologia*, 46(2): 233-252.

Address : [1]Department of Coastal Mining, Centre for Marine Science/Technology, M.S. University, Nagercoil - 629 502, Tamilnadu, India; [2]Department of Disaster Management, School of Civil Engineering, SASTRA Deemed University, Thanjavur - 613 403, Tamilnadu, India.

Abstract : A brief investigation of light minerals along the beaches between Valinokkam and Tuticorin has been carried out for the first time along the Southern Tamilnadu coast in order to discover the provenance of the sediments. The study spotlights a wide variation in light mineralogy along the three zones of the investigated area (Valinokkam, Vaippar and Tuticorin). A higher percentage of quartz is reported from the Valinokkam (48.34 to 68.63%) and Tuticorin zones (55.66 to 73.05%) than from the Vaippar zone (40.24 to 60.77%). The trend with regard to the maturity index is similar, with appreciably higher values in Valinokkam (1.15 to 1.89) and Tuticorin (1.61 to 1.94) than Vaippar (0.79 to 1.39). Morphological analysis of quartz grains shows a higher order of sphericity and roundness values in Valinokkam and Tuticorin as compared to Vaippar. Moreover, the surface texture of quartz grains observed with the aid of scanning electron microscope (SEM) photographs reveals the presence of different depositional environments and the multiple origin of beach sediments in the study area. From the present study of the light mineralogy of beach sediments, it is inferred that the source of the sediments is a mixed type: igneous and metamorphic crystalline rocks, together with palaeosediments.

395. **Chhapgar, B.F.** 2003. History of marine sciences (except Ichthyology) in India. *J. Bombay Nat. Hist. Soc.*, 100(2&3): 521-532.

Address : Bombay Natural History Society, Hornbill House, S.B. Singh Road, Mumbai 400 023, Maharashtra India.

Abstract : The history of marine science is, in fact the history and achievements of several institutions and organisations, mainly governmental but also a few learned societies and many individual scientists contributions. As Calcutta was the earlier capital of British India, pioneering studies naturally started there and flourished. Parallel to the natural history studies and animal and plant collections of the Bombay Natural History Society, leading to the establishment of the Prince of Wales Museum in Bombay, the Indian Museum itself the offspring of the Royal Asiatic Society of Bengal was the progenitor of the Zoological Society of India. Its sister institution, near Calcutta, is the Botanical Survey of India. The Marine Survey of India, most well known for the deep-sea investigations by R.I.M.S.S. Investigator, was one of the first to pursue marine sciences, and can be considered the Father of the National Institute of Oceanography, Goa India and the Department of Ocean Development which had its own ship O.R.V. Sagar Kanya and had annual forays to Antarctica. Bombay has the popular Taraporevala Aquarium with its connected Taraporevala Marine Biological Station. It is also the Headquarters of the Fishery Survey of India and the Central Institute of Fisheries Education, a Deemed University. The erstwhile Madras Presidency was fortunate in having some of the richest coral reefs in the Gulf of Mannar, and the Bulletins of the Madras Government Museum, especially the series covering Krusadai Island, the predecessors of the present day Bulletins of the Marine Biological Association of India. Among the princely states, Travancore, Cochin and Baroda had enlightened maharajas who sponsored and encouraged prime studies in marine biology. The head offices of the Central Marine Fisheries Research Institute and the Central Institute of Fisheries Technology at Ernakulam, Kerala, India, and their universities have been consistently doing yeoman research in marine biology and oceanography.

396. **Chhaya, N.D., K.C. Parmar, C.N. Khatri and P.C. Malli** 1988. Utilization of trash fish in increasing milk yield and milk quality in cattle. *CMFRI Spec. Publ.*, 40: 72.

Address : Fisheries Aquatic Science Research Institute, Okha, Gujarat, India.

Abstract : The margin between cost of milk production and its selling price is very thin and is getting thinner due to cumulative increase in cattle feed prices on one side and limitations on marketing price of milk on the other. Possible utilisation of trash fish converted to liquid silage as part of cattle feed to increase yield of milk and fat content is discussed in the paper. The development of silage and field trials on milk cattle were carried out by GFASRI, Okha.

397. **Chidambaram, K and M.M. Unny** 1944. Note on the swarming of planktonic algae, *Trichodesmium erythraeum* in the Pamban area and its effect on the fauna. *Curr. Sci.*, 13: 263.

Address : Krusadai Biological Station, Gulf of Mannar, India.

Abstract : An unusual phenomenon of mortality of marine fauna was noticed on the southern coast of Pamban

in Oct'42. Beside confirming the cause reffered to by Mr. Chacko for the mortality, our recent observations showed that the mortality is also due to the putrefaction and pollution caused by the dead algae.

398. **Chidambaram, K and M.M. Unny** 1947. Certain observations on the development of the sacred chank, *Xancus pyrum* (Linn.) *Proc. Zool. Soc. Lond*., 117: 528-532.

399. **Chidambaram, K and M.M. Unny** 1947. Note on the value of seaweeds as manure. *Madras Agri.J.,* July 1947.

400. **Chidambaram, K and M.M. Unny** 1947. Preliminary study on the Chank marketing experiments at Tuticorin. *Proc. Indian Sci. Congr., 38th session*: 1951, pt. III: 221.

401. **Chidambaram, K., A.D. Issac Rajendran and A.T. Valsan** 1951. Certain observations on the hydrography and biology of the pearl bank, Tholayiram Paar, off Tuticorin in the Gulf of Mannar in April 1949. *J. Madras Univ.,* 21B: 48-74.

402. **Chidambaram, K and G.K. Kuriyan** 1952. Fluctuation of diatoms and copepods in the plankton off Krusadi sea with their inter-relationship and relation to hydrographical conditions. *Proc. 39th Sess. Indian Sci. Cong.,* p. 338.

403. **Chidambaram, K and G.K. Kuriyan** 1952. Notes on the grey mullets (*Mugil* sp.) of Krusadai Island, Gulf of Mannar. *J. Bombay Nat. Hist. Soc.,* 50: 515-519.

Address : Marine Biological Station, Krusadai Island, Pamban, India.

Abstract : Grey Mullets (*Mugil* spp.) constitute an important group of fishes hugging the shores of Krusadai and nearby islands in the Gulf of Mannar. The mullet fishery extends throughout the year. The fish is caught in comparatively shallow water at flood tide, with cast and drag nets.

404. **Chidambaram, K and G.K. Kuriyan** 1952. The fluctuation of the blue green algae *Trichodesmium erythraeum* Ehrenb in the plankton off Krusadai Island. Gulf of Mannar. *Proc. 39th Sess. Indian. Sci. Cong.,* 338.

405. **Chidambaram, K.** 1988. Management and conservation of marine fisheries resources.*CMFRI Spec.Publ.*,40: 92.

Address : Matsyasagar Consult. Serv. Pvt. Ltd., Madras, India.

Abstract : The marine fisheries resources of India including the EEZ of about 2 million sq. km are of considerable magnitude. They consist of demersal fishes, shoaling pelagic fishes, large pelagic fishes, crustaceans, cephalopods, sedentary molluscs, seaweeds, etc. In view of the different nature of fisheries at different levels and in coastal, off-shore, deep sea and high sea areas, the varying intensities of fishing at different seasons their behaviour, characteristics and the stocks, they call for different approaches for management. Conservation of the fisheries and the methods to be adopted will also naturally be different. The approach and strategy for each of these fisheries will have to be worked out carefully, taking into consideration the biological, economic, social and political problems, proving each type of fishery.

406. **Chidambaram, K.** 1990. Biofouling and corrosion in the coastal waters of Mandapam and Tuticorin. *Proc. Specialists meeting on Marine Biodeterioration with reference to power plant cooling systems* held at IGCAR, kalpakkam on 26-28 April, 1989. (eds) K.V.K. Nair and V.P. Venugopalan. pp. 90-91.

Address : Central Electro Chemical Research Institute, Karaikudi - 623 006, Tamilnadu, India.

Abstract : CECRI has collected data on the different types of fouling species in the coastal waters of Mandapam (India) as well as Tuticorin. In Tuticorin, 42 fouling species have been recorded and barnacles, molluscs and tunicates form the major groups. The fouling load was high for Ti, Al and 304 stainless steel in comparison with other metals like brass and copper. In the case of waters at Mandapam, 70 species of organisms were recorded and identified and apart from barnacles and tunicates, algae were also the dominating foulers. The corrosion rate of steel, stainless steel, aluminium and zinc were measured for a period of 1 year and it was found that corrosion was of the order of 25 to 30 mpd in the case of steel. Fouling on cathodically protected steel was severe.

407. **Chidambaram, K.** 1991. Management and conservation of marine fishery resources. *CMFRI Bulletin,* 44(3): 594-603.

Address : Matsyasagar Consultancy Services Pvt Ltd., Madras, India.

Abstract : The marine fisheries resources of India including the EEZ of about 2 million sq. km are of considerable magnitude. It is estimated that the Economic Zone may support about 4.5 million tonnes. They consist of demersal fishes, shoaling pelagic fishes, large pelagic fishes, crustaceans, cephalopods, sedentary molluscs, seaweeds, etc. At present, the landings are confined mostly to inshore bell up to 50 metres in depth. Prawn resources are Intensively fished. Pelagic fisheries like mackerel and sardine are highly fluctuating in this bell, due possibly to the limitalions in operations and to migrating and breeding influences. Bombayducks are intensively fished. There is no fishing effort for cephalopods, tuna and tuna-like fishes worth mentioning, though their potential is rich. Shell fisheries like oyslers, mussels, clams, etc, cannot now be considered as organised fisheries, though there is subsistence fishing in selected regions. Pearl oyster fishery is highly fluctuating. In view of the different nature of fisheries at different levels and in coastal, off-shore, deep sea and high sea areas, the varying intensities of fishing at different seasons, their behaviour, characteristics and the stocks, they call for different approaches for management. Conservation of the fisheries and the methods to be adopted will also naturally be different. The approach and strategy for each of these fisheries will have to be worked out carefully, taking into consideration the biological, economic, social and political problems, providing each type of fishery. Some of these aspects are highlighted in the paper.

408. **Chithra, G., C. Thampi Jeyaraj and D.S. Raj** 2003. Studies on hydrology and fish species diversity of Thamiraparani River in Kanyakumari District. *Nat. Environ. Pollut. Technol.,* 2(3): 323-326.

Address : Department of Zoology, Scott Christian College, Nagercoil-629 003, Tamilnadu, India.

Abstract : The perennial river Thamiraparani (Kanyakumari, Tamil Nadu) is loaded with discharge of effluents from industries (rubber factories), agricultural wash and domestic sewage along its course. Hydrological studies conducted at the four selected stations, revealed a gradual deterioration of water quality from station-I to IV. Fish species diversity studies undertaken at these stations confirmed the above finding. The Shannon-Weiner index (H) value falling to 2.1 at station-IV showed that deterioration of water quality was nearing moderate pollution. Hence, strict measures have to be taken to prevent further deterioration as the people of this tiny district solely depend on Thamiraparani river for their total water requirements.

409. **Chittibabu, P., S.K. Dube, P.C. Sinha, A.D. Rao and T.S. Murty** 2002. Numerical simulation of extreme sea levels for the Tamil Nadu (India) and Sri Lankan Coasts. *Marine Geodesy*., 25(3): 235-244.

Address : Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi, Hauz Khas, New Delhi-110016, India.

Abstract : Numerical modeling of extreme sea levels associated with tropical cyclones in the Indian seas has been confined to the northern part of the Bay of Bengal (north of Tamil Nadu). However, limited attempts have been made for modeling of surges along the Tamil Nadu and Sri Lankan coasts. Although, very rarely, cyclones form south of 10°N, there are some instances of severe cyclonic storms hitting these areas and causing widespread destruction to life and property. Keeping this in view, a suitable location-specific, high-resolution, numerical model has been developed for the prediction of storm surges in these regions with a grid resolution of 3 km. Using the model, numerical experiments are performed to simulate the storm surge associated with the 1964 Rameswaram cyclone, the 1978 Batticaloa cyclone, the 1992 Tuticorin cyclone, the 1993 Karaikal cyclone, and the 1994 Madras cyclone. During the years 1964, 1978, and 1992, the cyclones struck both Sri Lanka and Tamil Nadu coasts. While in 1993 and 1994, the cyclones struck only the Tamil Nadu coast. It is found that the computed sea surface elevations are in close agreement with the available observations/estimates.

410. **Chopra, B.** 1927. The littoral fauna of Krusadai Island in the Gulf of Mannar, Crustaceana - Bopyrid Isopods. *Bull. Madras Govt. Mus., N.S., Nat. Hist. Soc.,* 1(1): 119-123.

411. **Citarasu, T., G. Immanuel and M. Peter Marian** 1999. Effects of feeding Artemia enriched with stresstol and cod liver oil on growth and stress resistance in the India white shrimp *Penaeus indicus* post larvae. *Asian Fish. Sci*., 12: 65-79.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

412. **Citarasu, T., R. Raja Jeya Sekar, M.M. Babu and M. Peter Marian** 2002. Developing Artemia enriched herbal diet for producing quality larvae in *Penaeus monodon*. *Asian Fish. Sci*., 15 : 21-32.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari, Tamil Nadu, India.

413. **CMFRI** 1977. Report on the survey of the Islands of Gulf of Mannar for the setting up of a Marine National Park, 33 pp.

414. **CMFRI** 1978. Synopsis of marine prawn fishery of India for the first quarter of 1978. *Mar. Fish. Infor. Serv. T & E. Ser.,* 1: 3-10.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In this article, prawn landings by commercial shrimp trawlers in relation to the total prawn catch during January to March, 1978 are discussed.

415. **CMFRI** 1978. All India Marine Fisheries census. Frame survey 1973-77. *Mar. Fish. Infor. Serv. T & E. Ser.,* 3 : 2-8.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The census on Marine fishing Villages, Fishermen population and Fishing crafts during 1961-62 and 1973-77 are discussed in this chapter.

416. **CMFRI** 1978. Synopsis of marine prawn fishery of India for the second Quarter of 1978. *Mar. Fish. Infor. Serv. T & E. Ser.,* 4: 1-9.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The prawn landings in different maritime states from April to June, 1978 are discussed in this report.

417. **CMFRI** 1978. The vanishing turtle. *CMFRI- News Letter,* 7: 5-6.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Of the four commonly exploited turtles of the east coast of India the most severely hunted are the *Lepidochelys olivacea* and *Chelonia mydas*. It is estimated that 3,000 to 4,000 green turtles are captured annually from the Gulf of Mannar. A large number of eggs are also removed from nesting grounds and sold in markets all along the coast. Eggs have been collected for incubation in hatcheries, and unauthorized egg collection has been made illegal since 1977. A brief description of the hatchery operation is given.

418. **CMFRI** 1978. Culture of other marine organisms. *CMFRI Spec. Publ.*, 2: 21-22.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The Institute is also studying the possibilities of culture of other marine organisms such as sponges, holothurians, marine turtles and perches. The sponge, *Spongia officianalis* var. *ceylonensis* has a wide distribution in the shallow waters of the Gulf of Mannar, Palk Bay and the Arabian Sea. It grows to 30 cm in diameter. Culture experiments on this species have indicated great prospects of its large-scale culture.

419. **CMFRI** 1979. Marine fish production in India during July to September 1978. *Mar. Fish. Infor. Serv. T & E. Ser.,* 5 : 1-9.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This report deals with the marine fish catch of various maritime states of India from July to September, 1978.

420. **CMFRI** 1979. Synopsis of Marine prawn fishery of India for the third Quarter of 1978. *Mar. Fish. Infor. Serv. T & E. Ser.,* 7: 1-10.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The statewise penaeid and non-penaeid prawn landings and their percentage for the third quarter of 1977 and 1978 are discussed.

421. **CMFRI** 1979. The Indian mackeral in 1978. *Mar. Fish. Infor. Serv. T & E. Ser.,* 8: 1-11.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The catch of Mackeral fish per net in different year classes in important years at sellected centers of observation during June to December period are discussed.

422. **CMFRI** 1979. Trends in total marine fish production in India 1978. *Mar. Fish. Infor. Serv. T & E Ser.,* 9: 7-22.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The statewise marine fish landings in India (in tonnes) during the year 1977 and 1978 are discussed.

423. **CMFRI** 1979. Synopsis of marine prawn fishery of India 1978. *Mar. Fish. Infor. Serv. T & E. Ser.,* 10: 1-17.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The statewise penaeid and non-penaeid prawn catch from October to December, 1978 are discussed.

424. **CMFRI** 1980. Synopsis of marine prawn fishery of India 1979. *Mar. Fish. Infor. Serv. T & E. Ser.,* 25: 1-13.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The statewise prawn landings and their percentage contribution during 1978 and 1979 are discussed.

425. **CMFRI** 1981. All India census of marine fishermen, Craft and Gear. 1980. *Mar. Fish. Infor. Serv. T & E. Ser.***,** 30: 2-32.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The statewise figures of marine fishing villages, fishermen population and marine fishing crafts and gears are discussed.

426. **CMFRI** 1982. Synopsis of Marine Prawn Fishery of India 1980. *Mar. Fish. Infor. Serv. T & E. Ser.,* 35: 1-14.
Address : Crustacean Fisheries Resource Team, Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The statewise penaeid and non-penaeid prawn landings and their percentage for 1979-80 are discussed in this article.

427. **CMFRI** 1982. Trends in marine fish production in India - 1981. *Mar. Fish. Infor. Serv. T & E. Ser.,* 41: 1-33.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The statewise total marine fish landings in India in the year 1980-81 (in tons) are discussed in this article.

428. **CMFRI** 1982. Synopsis of marine prawn fishery of India 1981. *Mar. Fish. Infor. Serv. T & E. Ser.,* 43: 8-23.
Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.
Abstract : The statewise penaeid and non-penaeid prawn landings and their percentage for 1980-91 are discussed in this article.

429. **CMFRI** 1982. New light on the migration of the Indian white prawn, *Penaeus indicus*. *Mar. Fish. Infor. Serv. T & E. Ser.,* 45: 1-9.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.
Abstract : The summary of data on mark capture experiments on prawns from phases I to III are discussed.

430. **CMFRI** 1982. Proven Technology: Technology of Cultured pearl production and Technology for hatchery production of pearl oyster. *Mar. Fish. Infor. Serv. T & E. Ser.,* 45: 22-24.
Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamil Nadu, India.
Abstract : This study reveals an aspect of surgery for implantation of shell-bead nucleus in the pearl oyster.

431. **CMFRI** 1983. Trends in marine fish production in India 1982-83. *Mar. Fish. Infor. Serv. T & E. Ser.,* 52: 1-21.
Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.
Abstract : The statewise breakup of the landings of pelagic and demersal group of speices during 1982-83 in tons are discussed.

432. **CMFRI** 1983. Technology of cultured seaweed production. *Mar. Fish. Infor. Serv. T & E. Ser.,* 54: 19-21.
Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.
Abstract : This study reveals various culture techniques for *Gracillaria edulis* at different time intervals in Mandapam area.

433. **CMFRI** 1986. Marine Fish production in India during 1983-84 and 1984-85. *Mar. Fish. Infor. Serv. T & E. Ser.*, **67: 1-79**.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The total estimated catch of exploited marine fishery resources during the year 1983-84 and 1984-85 along the coast of India including the union territories of Andamans and Lakshadweep was 1.58 million tons as compared to 1.42 million tons in 1982-83 showing an increase of about 12%.

434. **CMFRI** 1989. Marine fish production in India 1985-86. *Mar. Fish. Infor. Serv. T & E. Ser.,* 91: 1-32.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The estimated pelagic landings in India during 1985-86 and 1984-85 in tons are compared.

435. **CMFRI** 1990. Lucrative fishery for oil sardine around Mandapam. *Mar. Fish. Infor. Serv. T & E. Ser.,* 104: 9 pp.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The average catch of oil sardine in and around Mandapam and the size of the oil sardine landed are discussed.

436. **CMFRI** 1991. Pearl oyster farming and Pearl culture. *8th Training manual on Pearl oyster farming and Pearl culture training Course.* (RAS/90/002).

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Pearls have been known to mankind since the beginning of civilization. They are highly esteemed as gems for their beauty and splendour. These structures are secreted by the mantle (*i.e.,* the skin) of pearl oysters in response to irritations caused by external or internal stimuli such as sand grains, mollusc, eggs, parasites, detritus, and other foreign particles. Many attempts have been made to culture pearls in freshwater mussels. In the 13th century, the Chinese fixed small Buddha figures inside freshwater mussels, which became covered with a pearly layer. After considerable perseverance and study on the mode of pearl formation, success was achieved early in this century in Japan on the production of spherical cultured pearls. The Japanese grafted a piece of mantle with a small bead in a pearl oyster and reared the oyster in protected coastal waters with favourable environmental conditions.

437. **CMFRI** 1991. Report on the international training course on pearl oyster farming and pearl culture organised by FAO/UNDP Regional sea farming development and demonstration project (NACA) and conducted by CMFRI at the shellfish research laboratory of the Tuticorin R.C. of CMFRI, Tuticorin, February 1-28, 1991. *Mar. Fish. Infor. Serv. T & E. Ser.,* 112: 1-9.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : The NACA members and even France candidates were trained in the international training course on pearl oyster farming and pearl culture at Tuticorin. In this training, a total of 26 participants from ten countries participated. The training course was of four weeks duration with practicals on pearl oyster hatchery, nuclei implantation process, tissue grafting and raft construction and fabrication were taught.

438. **CMFRI** 2003. Coral Reef heritage of India. *The Hindu* 18th *November* 2003.

Address: Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract: The Indian coral reefs are world famous but least explored, studied and indiscriminately damaged by human exploitation mainly for the cement industry (calcium carbide), road and building material in certain areas like the Gulf of Mannar and the Gulf of Kutch. The other two regions, the Andaman and Nicobar Islands and the Lakshadweep, because of their far-flung location from the mainland, are comparatively less affected by human depredations. Coral reefs are in peril not only in this country but also in the oceans around the globe due to human interference, natural calamities, disease, etc. It is sad to note while even small island countries have taken adequate steps to protect and contain the damage to corals, mainly from human interference, India has paid practically no attention to the alarming deterioration of coral reefs. It is, however, understandable that this pathetic condition of the reefs and neglect is merely due to ignorance of the authorities concerned and lack of political will and action on such vital scientific issues.

439. **CMFRI** 2003. Breakthrough achieved in pearl production through tissue culture. *CMFRI News Letter*. 99: 1.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Central Marine Fisheries Research Institute has developed the technology for *in-vitro* pearl production in the Indian pearl oyster, *Pinctada fucata* and in the abalone, *Haliotis varia* through tissue culture method.

440. **CMFRI** 2003. Cephalopod stocks under exploitation pressure. *CMFRI News Letter*, 99: 2.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Investigation carried out under the institute project on the resource characteristic of cephalopods from six centers along the west coast and five centers along the east coast of India conducted during 1997 to 2002, indicated some of the stocks are under heavy exploitation. The Indian squid *Loligo duvauceli* stocks at Visakapatinam, Kakinada, Mumbai, Mangalore and Calicut are under heavy exploitation pressure. Similarly, the cattlefish, *Sepia aculeata*, at stock in Rameshwaram and *S. pharaonis* stock in Vizhinjam are also being exploited above the optimum level, whereas *S. pharaonis* stock in Cochin and *S. aculeata* stock in Visahapatnam are under exploited. In general, octopuses are lightly exploited along both the coasts.

441. **CMFRI** 2004. Development of management strategies for sustainable fishery of sardines (*Sardinella* spp.). *CMFRI Ann. Rep.* (2003-2004) PEL/CAP/1. pp. 19-21.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The ring seines operation off Rameswaram realised the highest C/E of 4.2t, followed by pair trawl (3 t), purseseines at Cochin (2.7t), at Karwar (0.8 t) and Mangalore-Malpe (0.7t), ring seine at Cochin (0.7 t) and Calicut (1.4 t), and the shore seine at Tuticorin (0.7 t). In other gears the C/E was less than 100 kg.

442. **CMFRI** 2004. Development of strategies for rational exploitation of seerfishes. *CMFRI Ann. Rep.*, (2003-2004) PEL/CAP/3. p. 22.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : All India seerfish catch was estimated at 0.55 lakh t during 2003 as against 0.52 lakh t in the previous year. The landings declined at Chennai (-21%) and Veraval (-12%) while it increased at Cochin (8%), Tuticorin (19%), Visakhapatnam (70%) and Mangalore-Malpe (97%). Gillnet, trawl and hook and line were the major gears contributing 50%, 35% and 9% respectively and purse seine and indigenous gears contributed the remainder. Four species contributed to the fishery, the major species was king seer *Scomberomorus commerson* (78.5%) followed by the spotted seer *S. guttatus* (20.5%). The other two species, the wahoo *Acanthocybium solandri* and the streaked seer *S. lineolatus* together contributed about 1%.

443. **CMFRI** 2004. Development of strategies for sustainable exploitation of tunas, tuna live-baits and billfishes. *CMFRI Ann. Rep.*, (2003-2004) PEL/CAP/4. p. 23**.**

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Annual average tuna production (1998-2003) by Indian fleet from our EEZ is about 47,000 t of coastal and 10,000 t of oceanic tunas. Thus, presently only 23% of the annual potential yield of coastal tuna is harvested while with regard to oceanic tuna it is mere 6%. The coastal and neritic tunas (*E. affinis, Auxis* spp. *and Thunnus tonggol*) contributed 85% of the total tuna landings (0.56 lakh t), the rest constituted by oceanic species such as yellow fin *Thunnus albacares* (juveniles) and skipjack *Katsuwonus pelamis.* Among billfishes, sailfish *(Istiophorus platypterus)* dominated. Drift gill net is the major gear employed in the fishery all along the Indian coast, while purse seines and hooks and lines also contributed significantly along the southwest coast.

444. **CMFRI** 2004. Development of management strategies and options for sustainable harvest of mackerels. *CMFRI Ann. Rep.* (2003-2004) PEL/CAP/5. p. 24**.**

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The estimated mackerel landing during 2003 was 1.12 1akh t which showed a marginal increase by 18% compared to 2002. One of the objectives of the project was to investigate the effectiveness of different types of gears for the exploitation of mackerel resource. Gill net, purse seine, trawl net and ring seine were the major gears employed for the exploitation of mackerel along the Indian coasts. The contribution of gill net to the mackerel catch was 74% at Vizhinjam, 29.4% at Cochin, 0.3% at Mangalore, 5.6% at Tuticorin, 96.2% at Mandapam, 27% at Chennai and 56.5% at Visakhapatnam. Purse seine contributed 71.8% and 25.2% respectively at Mangalore and Mumbai. Trawl net contributed 74.8% of mackerel catch at Mumbai, 27.9% at Mangalore,

35.5% at Calicut, 70.6% at Cochin, 94.4% at Tuticorin, 3.8% at Mandapam, 24% at Chennai and 43.5% at Visakhapatnam. Ring seine contributed 64.5% of the mackerel catch at Calicut.

445. **CMFRI** 2004. Taxonomy of marine pelagic finfishes. *CMFRI Ann. Rep.*, (2003-2004) PEL/BIOD/01. p. 27.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Detailed cataloguing and inventory of seventy two species of pelagic finfishes belonging to seven families and thirty nine genera were completed during the year. The genera covered under Clupeidae family were *Escualosa, Sardinella, Nematolosa, Anodontostoma, Pellona, Ilisha, Opisthopterus, Dussumieria* and *Hilsa* and under Engraulidae family, four genera *Encrasicholina, Stolephorus, Thryssa* and *Coilia.* Carangids belonging to seventeen genera namely, *Seriolina, Decapterus, Megalaspis, Selar, Alectis, Ulua, Uraspis, Atropus, Selaroides, Gnathanodon, Atule, Alepes, Caranx, Carangoides, Elagatis, Trachinotus* and *Scomberoides* were studied. The genera under Scombroids included *Auxis, Euthynnus, Thunnus, Scomberomorus* and *Rastrelliger.*

446. **CMFRI** 2004. Investigations on the resource characteristics and development of management strategies for lobsters and crabs. *CMFRI Ann. Rep.*, (2003-2004) CRU/CAP/01. pp. 35-36.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The total landing of lobsters by bottom-set gill net at Tuticorin was 6 t. *P. ornatus* dominated the catches (58 %) followed by *P. homarus.* At Chennai, trawlers landed about 33 t of lobsters. *T. orientalis* dominated the fishery. Regionwise analysis of the data showed that maximum landing of lobsters was from the northwest coast (45%) followed by the southwest (33%) and southeast (19 %) coasts. Catch was maximum during the fourth quarter (36 %) followed by the third quarter (33%) of the year.

447. **CMFRI** 2004. Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks. *CMFRI Ann. Rep.*, (2003-2004) CRU/CAP/01. pp. 35-36.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Along Southeast coast at Tuticorin and Rameswaram *P. semisulcatus* (size range 81-180 mm) was the dominant species of penaeid shrimp fishery. The penaeid shrimp landings at Kasimedu (Chennai) was 2048 t and the important species which constituted the fishery were *M. dobsoni, F. indicus, P. maxillipedo, M. stridulans* and *M. monoceros.*

448. **CMFRI** 2004. Brood stock development, selective breeding and restocking of marine shrimps. *CMFRI Ann. Rep.*, (2003-2004) CRU/CUL/01. p. 40.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During the period under report, 45 sets of experiments on spawning and larval rearing of *Penaeus semisulcatus* were carried out. A total of 30,06,790 nauplii were produced. Altogether 20,01,866 (2 million) PL were produced. The rate of survival from nauplius to postlarva ranged from 51.87% to 89.7% with an average survival of 66.6%. All the larvae (except 10,000 used in nutrition experiments) produced in these experiments were sea ranched in the Gulf of Mannar.

449. **CMFRI** 2004. Breeding and seed production of lobster and crabs. *CMFRI Ann. Rep.*, (2003-2004) CRU/CUL/02. pp. 40-42.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Maturation and breeding of the commercially important slipper lobster *Thenus orientalis* and *Scyllarus rugosus* were achieved at Kovalam Field Laboratory, Chennai. The phyllosoma larvae were reared to settlement for the first time in India. The technology comprises brood stock constitution and management, induced maturation, larval culture, feed development and harvest of postlarvae. Broodstock of the slipper lobster *T. orientalis* was constituted from wild collection of juveniles and sub-adults from a gill net fishery for the lobsters near Kovalam, Chennai.

450. **CMFRI** 2004. Organic farming of *Penaeus semisulcatus. CMFRI Ann.Rep.*, (2003-2004) CRU/CUL/03.pp. 42.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Standards for organic agriculture farming have been developed in different parts of the world by various International Organisations. However, standards for organic fish farming were developed by Natureland, Germany. The standards for hatchery production of organic shrimp seeds and farming of *Penaeus semisulcatus*

are being developed as follows. Broodstock from wild or from organic culture farm. Maturation and breeding by natural means without using any chemicals or hormones. Hatchery production of seeds using naturally produced live feeds (no inorganic fertilizers, chemicals, antibiotics) low density stocking and efficient water management. The effluent quality shall be similar to the inlet water. Formulations of grow out feed using natural low-protein ingredients from a predominantly vegetable source. Creation of natural feeding areas in the pond (seaweed, sea grass, mangroves). The standards which are to be approved by a National/International agency. Farming operations are yet to be carried out.

451. **CMFRI** 2004. Fishery and biological characteristics of exploited cephalopod resources. *CMFRI Ann. Rep.*, (2003-2004) MOL/CAP/01. pp. 43-46.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Investigations were made from five centres along the west coast of India *viz*., Mumbai (New ferry Wharf), Mangalore (Mangalore & Malpe), Calicut (Puthiyappa), Cochin (Cochin, Vypeen, Munambam, Neendakara & Sakthikulangara) and Vizhinjam, and five centres along the east coast, Tuticorin, Mandapam (Mandapam, Pamban & Rameswaram), Chennai, Kakinada and Visakhapatnam. Trawl units undertaking daily and multiday voyages contributed more than 90% of the cephalopod catch. At Vizhinjam, hooks & lines operated from mechanized and non-mechanized crafts and boat seines accounted for entire landings. The landings along the west coast accounted for the bulk of the production. The all India production of cephalopods is estimated as 1,27,000 tonnes which is 22% more than the previous year. The 22% increase in national cephalopod production was mainly due to steep increase in catch and catch rates at Mumbai, Mangalore-Malpe, Mandapam-Rameshwaram and Vizhinjam. The catch and catch rates decreased at all other centres, especially in Kerala, Tamil Nadu and Andhra Pradesh. Maximum increase (113%) was observed in Mangalore- Malpe and this could be on account of the sizeable magnitude of spawning congregations of squids observed in the area during the previous year.

452. **CMFRI** 2004. Assessment of bivalve and gastropod resources. *CMFRI Ann. Rep.*, (2003-2004) MOL/CAP/02. pp. 46-48.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In Mandapam, 1,44,862 numbers of chank *(Xancus pyrum* Vat. *ocuta* and *obtusa)* were landed from trawlers at Rameswaram (75%) and Mandapam (25%). The size ranged from 90-255 mm. The catch per unit effort of the chanks at Mandapam was 0.91 nos. and at Rameswaram it was 1.47 nos. 216333 nos. ornamental gastropods, *Hemifusus pugilinus* were landed at Rameswaram. The size range in the fishery was 49 to 152 mm.

453. **CMFRI** 2004. Technological feasibility studies and upgradation of Molluscan Mariculture. *CMFRI Ann. Rep.*, (2003-2004) MF/CUL/01. pp. 48-51.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A total of 169 oyster strings with hatchery produced spat set on shells were transferred for nursery rearing. 4398 young oysters of size 37.4 mm in 169 strings after nursery rearing were broadcast in the Karapad creek. From the farmed oysters 26 kg of oyster meat were harvested. 1000 numbers of clam seeds of *Paphia malabarica* were reared from March 03 to November 03 in three different substrata i.e. sand, clayey sand and coral-sand and the survival rate observed ranged from 1.9 to 28.2% with minimum in coral sand and maximum in clay bottom.

454. **CMFRI** 2004. Selective breeding of Pearl oyster *Pinctada fucata. CMFRI Ann. Rep.*, (2003-2004) MF/CUL/02. pp. 51-52.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Various growth parameters (DVM, APM & Cavity) were selected and tested for heretability in successive generations at Mandapam. Spats were divided into different groups based on their growth performance in hatchery and tested whether the same growth pattern was continued in the farm conditions also. Results showed that the growth difference in hatchery phase was not reflected in the farm rearing trials.

455. **CMFRI** 2004. Technological upgradation of molluscan seed production. *CMFRI Ann. Rep.*, (2003-2004) MF/CUL/03. pp. 52-53.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Pearl oyster, *Pinctada fucata,* out of 8.1 million larvae produced from 5 spawning 20 lakhs of

spat settled and 3.15 lakhs spat (size 2 - 7) were transferred to the farm for further rearing. The Sacred chank, *Xancus pyrum, t*otally 79 baby chanks released from egg capsules were reared. The baby chanks registered monthly growth rate of 4.59 mm in length, 2.15 mm and 1.89 g in weight. The two year old baby chanks had low growth rate of 0.43 in length, 0.25 mm width and 0.97 gm in weight / month. Baby chanks fed with different feeds in captivity for 60 days, showed that those fed with earthworm had appreciable growth than those fed with clam or fish.

456. **CMFRI** 2004. Marine pearl production through tissue culture.*CMFRI Ann.Rep.*,(2003-2004) MF/CUL/04. p.54.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Shell beads used in earlier organ cultures of mantle tissue of both pearl oyster and abalone were analyzed through the Scanning Electron Microscope (SEM) for the coating, if any, on the beads. The chemical crystals deposited on the beads were also analyzed by Energy Dispersive X-Ray Micro-analyzer (EDS). The analysis revealed the formation of organic matrix, nacreous layer and deposition of crystals. These results were obtained simultaneously in both pearl oyster and abalone and were exactly similar to earlier studies in Japan on shell regeneration and restructure. The formation of nacreous layer *in-vitro* culture was considered to be a stepping-stone for *in-vitro* pearl production. Further work on organ culture of mantle tissue of pearl oyster and abalone is being carried out to ascertain whether the pearl growth is continued for longer duration in *in-vitro* condition. The effect of calcium on cell proliferation and secretion of nacre was studied. The concentration of 100, 200, 300 and 400 ìl/ml were tested along with a control with medium alone. Numerous cells were proliferated from the explant tissue in both cases and hence no significant difference could be noticed.

457. **CMFRI** 2004. Biodiversity of marine molluscs. *CMFRI Ann. Rep.,* (2003-2004) MOL/BIOD/01. pp. 54-55.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Collections of cephalopods, bivalves and gastropods were done from the landing centers as well as from the coastal areas, inter-tidal areas and estuaries. Checklist of recorded marine molluscs from Indian waters is prepared. So far a total of 521 species of Gastropods under 238 families and 298 genera; 248 species of Bivalves under 85 families and 115 genera; 13 species of Polyplacophores under 8 families; 11 species of Scaphopoda under 7 families; 9 species of aplacophores under 6 families; and 201 species of cephalopods under 26 families are included in the checklist. A total of 84 different species of gastropods belonging to 26 families and 32 genera were tentatively identified from the samples collected from the trawl landing centers of Mandapam, Kollam and Cochin. 36 species of bivalves belonging to 12 different families were collected and identified.

458. **CMFRI** 2004. Monitoring the environmental characteristics of the inshore waters in relation to fisheries. *CMFRI Ann. Rep.,* (2003-2004) FEM/01. p. 56.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Regular monitoring of the environmental parameters were continued from the inshore waters of west and east coasts of India by making fortnightly/monthly collections with the available facilities from Cochin, Calicut, Mangalore, Karwar, Bombay, Veraval, Minicoy, Tuticorin, Mandapam, Chennai and Visakhapatnam Centres with reference to water temperature, salinity, dissolved oxygen, nitrate, nitrite, phosphate and silicate. Besides, primary and secondary production of the inshore waters upto 30m depth zone were also attempted from selected Centers.

459. **CMFRI** 2004. Monitoring environmental contaminants from coastal waters with reference to bioaccumulation and biomagnification in fishes. *CMFRI Ann. Rep.,* (2003-2004) FEM/02. p. 57.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Mean Cd concentrations in sediment samples from the industrialized areas of Vishakhapatnam, Cochin, Chennai, Veraval, Karwar, Mumbai and Tuticorin were above the Effect Range Low (ERL) concentration of 1.2 ppm prescribed by NOAA for Cadmium. Mean oncentrations in sediment samples from industrialized areas of Veraval and Mumbai were above the ERL concentration of 34 ppm. Mean Cd concentrations (ppm dry weight) in bivalves from Karwar Vishakhapatnam and in finfishes from Vishakhapatnam were above the WHO safe limits of 9 ppm. Mean Pb concentrations (ppm by weight) in bivalves from Tuticorin and finfishes from Cochin were above the WHO safe limits of 9 ppm.

460. **CMFRI** 2004. Culture of seaweeds. *CMFRI Ann. Rep.,* (2003-2004) FEM/03. p. 58.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Data on the quantity of seaweeds exploited from the natural beds were collected from 11 seaweed landing centers in Tamil Nadu. Total landings were 2,749 tonnes (dry weight) compared to 2821 tonnes (dry weight) during 2003 constituting 1,618 tonnes of *Sargassum* spp, 148 tonnes of *Turbinaria* spp., 701 tonnes of *Gelidiella acerosa*, 258 tonnes of *Gracilaria edulis* and 24 tonnes of *G. crassa*. Experimental culture of the agar yielding red seaweed *Gracilaria edulis* was carried out in the onshore condition in 1 ton capacity fiberglass tanks with running seawater and aeration system. The seed material was pretreated for 12 hours with Magnesium sulphate, Ferrous sulphate and Calcium nitrate separately at the concentration of 10, 20, 30 and 40 mg/l. The plants treated with 40 mg/l concentrations of Ferrous sulphate showed maximum increase in biomass of 26% after 42 days culture period.

461. **CMFRI** 2004. Development of strategies for sea turtle and sea cucumber conservation. *CMFRI Ann. Rep.*, (2003-2004) FEM/04. p. 59.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Four lakhs auriculariae produced on Jan 2003 showed 0.5 % settlement in 16 days. The survival and metamorphosis of the larvae were greatly affected by the ciliate infestation and high turbidity of the intake water due to the breakage of seawater filter system. By the end of April, 46% of the initially settled juveniles survived, 8.3% at the end of June, 8% at the end of July and 7.6% at the end of August. The juveniles measuring >20mm showed a growth rate of 0.1695 *mm*/day in length and 0.0542g/day in weight towards the end of July and 0.052mm / day in length and 0.0308g/day in weight by the end of August. 7.6% of the initially settled juveniles (145 numbers) having an average length of 40mm and weighing 3.35g were released at a depth of 6m at the sea grass beds of Tuticorin Port area on 3.9.03.

462. **CMFRI** 2004. Mariculture of live feed organisms. *CMFRI Ann. Rep.*, (2003-2004) FEM/05. pp. 59-60.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies revealed that the algal species influenced the morphological plasticity in size in the ultra minute *Brachionus rotundiformis*. At Chennai, regular zooplankton samples were collected and isolation and culture of chaetognaths *(Sagitta spp.)* and ctenophores *(Pleurobrachia sp.)* were attempted as these form important prey items for lobster larvae.

463. **CMFRI** 2004. Development of cost effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions. *CMFRI Ann. Rep.* (2003-2004) PNP/NUT/01. pp. 62-63.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of two experiments revealed the sets of protein requirement to be 350 g. kg^{-1} diet for juveniles weighing > 2 g and 400 g. kg^{-1} diet for post larvae of *Penaeus semisulcatus.* With a view to identifying suitable substitutes for partial or complete replacement of fish meal in shrimp diets, a process for fermentation of a mixture of oilcakes and wheat flour along with soybean meal was developed. The amino acid profile of the diets incorporated with *B. coagulans* fermented ingredient at different levels showed considerable increase in glutamic acid, aspartic acid and serine. An increase in lysine and decrease in methionine levels were observed as compared to the control.

464. **CMFRI** 2004. Development of cost-effective low stress methods for live transport of fish and crustaceans. *CMFRI Ann. Rep.* (2003-2004) PNP/PHY/01. p. 65.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Experiments were conducted to identify a suitable anaesthetic/sedative to be used for transportation of marine ornamental damselfish. Oxygen consumption, output of CO_2, NH_3 and *p*H changes in the water during transportation of the fish at different intervals have been studied to evolve a suitable packing strategy for safe transport. Clove oil at a dose rate of 45ppm is found to be ideal anaesthetic/sedative for the initial packing. Incorporation of 1ppm clove oil in the packing water facilitated maintenance of sedative effect during transport.

465. **CMFRI** 2004. Marketing and price structure of marine fisheries in India. *CMFRI Ann. Rep.* (2003-2004) SEE/PMS/01. p. 68.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Analysis of price spread and monthly price fluctuations of different species of fishes at landing centre, wholesale and retail levels were done for the year 2003 for all maritime states at all India level.

466. **CMFRI** 2004. Evaluation of transfer of technology programmes in marine fisheries. *CMFRI Ann. Rep.* (2003-2004) SEE/TOT/01. pp. 69-70.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Out of the 15 Transfer of technology programmes identified in Tamil Nadu, Kerala, Karnataka, Andhra, Maharashtra and Orissa, 10 were implemented by State/ Central government organisations and 5 by NGOs. All the identified TOT programmes met the set goals and objectives. Majority (70 to 85 %) stated that the programmes are techno- socioeconomically acceptable and consistent at farm level. Under the artificial reef programme, 15 % experienced social problems. Average annual income increased from 30 % under value addition in Tamil Nadu to 120 % in shrimp farming in Andhra Pradesh. Average indebtedness among beneficiaries reduced 10 to 20 % in all the programmes.

467. **CMFRI** 2004. Indigenous knowledge systems and community based resource management in marine fisheries. *CMFRI Ann. Rep.* (2003-2004) SEE/ITK/01. pp. 70-71.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The study was taken up in Kerala, Karnataka, Tamilnadu and Andhra Pradesh. The survey work was accomplished after translating the schedules into Malayalam, Kannada, Tamil and Telugu. The recording of ITKs are completed. Based on a preliminary analysis, the ITKs were classified into five categories *viz*; I) Craft and gear making/maintenance, 2) Harvesting, 3) Post harvest, 4) Medicinal values and 5) Beliefs and customs. Some of the significant findings on ITK's are: Craft and gear making, Maintenance of craft and gear, and harvesting.

468. **CMFRI** 2004. Commercial production of cultured pearls adopting onshore culture technology. *CMFRI Ann. Rep.* (2003-2004) ICAR Revolving Fund. p. 81.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Currently a stock of 1,39,280 numbers of pearl oysters of different sizes are under rearing in the pearl farm. An amount of Rs.90,000/- was realized through the training charges for the two batches of training conducted. A total of Rs.8, 89,686/- has been realized through sale of cultured pearls. A total of Rs. 11,31,772/- has been realized through sale of oysters/ nucleated oysters. A stock of 31 nos. (A), 1,047 (B) and 7,368 (C grade) commercial grade pearls valued at Rs.5, 61,014/- is currently available under the project. Pearl farmers of Mundalmunai Pearl culture society with the financial support from M.S. Swaminathan Research Foundation and technical guidance given by CMFRI, started pearl farming and harvested pearls from their pearl farms in Gulf of Mannar from June 5th 2003.

469. **CMFRI** 2004. Production of agar from the seaweeds of Gulf of Mannar and Palk Bay. *CMFRI Ann. Rep.* (2003-2004) ICAR Revolving Fund. pp. 82-83.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During April to October, 2003, a total of 664 kg of food grade agar was produced from the red seaweed *Gracilaria edulis* in sheet, bit and powder forms. An income of Rs.l, 24,329/- was generated by sale of 594 kg agar.

470. **CMFRI** 2004. Studies on marine mammals of Indian EEZ and the contiguous seas. *CMFRI Ann. Rep.* (2003-2004) DOD Fund. p. 83.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During the period 2003-2004, project personnel participated in the Research Cruises (218, 219, 220, 221 & 222) on board FORV Sagar Sampada. Collected data on the sightings of *Stenella* sp, *Sousa chinensis*, *Tursiops* spp, *Globicephala* spp and *Delphinus delphis.* The number of marine mammal sightings on board FORV *Sagar Sampada* varied from 6 to 20 sightings. The Project personnel (Dr. P. Jayasankar and Anoop A. Krishnan) participated in Pilot Expedition to Southern Ocean onboard ORV *Sagar Kanya* during Jan.-March 2004. Collected data on the sightings from Lat. 24°59' Long. 52°32' to Lat. 45°00' Long 57°30'. A total of 21 whales and dolphins sighted in the study area and sei whale *Balaenoptera borealis*, minke whale *B. acutorostrata* and blue whale *B. musculus* were confirmed through photo identification.

471. **CMFRI** 2004. Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers. *CMFRI Ann. Rep.* (2003-2004) ICAR AP Cess Fund. p. 85.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : RAPD fingerprints of *Amphiprion sebae, A. chrysogaster, A. percula* and *A. sandaracinos* were developed using primers OrA 08, OrA 10, OFF 02 and OFF 03 with a view to studying their genetic relationships. Cluster analysis has shown that *Amphiprion chrysogaster* and *A. sandaracinos* are more closely related. *A. sebae* is relatively closer to this grouping while *A. percula* forms a distinct outgroup.

472. **CMFRI** 2004. Breeding and culture of pearl oysters and production of pearls. *CMFRI Ann. Rep.* (2003-2004) NATP/PSR. pp. 89-91.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies were made on uptake by the pearl oysters of allochthonous metals into nacre in higher quantity so as to decisively influence the colour of the nacre. The safe level of chromogenic metals dosage suitable for administration was broadly estimated following LC_{50} methodology.

473. **CMFRI** 2004. Natural Resources Management- Coral Reef Ecosystem. *CMFRI Ann. Rep.* (2003-2004) NATP. p. 92.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Shore line morphology of the islands was delineated using different satellite imageries. The shoreline alignment has been observed to have changed due to illicit coral mining. Illicit mining has built the long shore bar towards North West. This study provides, for the first time, a comparison of multidata sensors for coral reef habitat mapping in Gulf of Mannar. The mixed algae - coral- sand spectra in different proportions and at different spatial resolutions have provided the relative importance of classification on coral reef habitat. From the intensive study, it is concluded that the proportions of the different classes within the studied reef are very important. According to image interpretation, Van Island underwent a loss in live and dead coral more than 90% whereas Koswar Island has a loss of 50% live coral cover.

474. **CMFRI** 2005. Development of management strategies for sustainable fishery of sardines (*Sardinella* spp.). *CMFRI Ann. Rep.* (2004-2005) PEL/CAP/1. pp. 19-20.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The stock of oil sardine and lesser sardines remained under-exploited due to continued availability and low consumer demand, except at places like Calicut & Mangalore where a lucrative dry fish trade flourished to meet the demands of fish meal plants in Tamil Nadu and Andhra Pradesh. No visible impact on the fishery and biological characteristics of sardines was noticed after the tsunami.

475. **CMFRI** 2005. Development of strategies for sustainable exploitation of Tunas, Tuna live-baits and billfishes. *CMFRI Ann. Rep.* (2004-2005) PEL/CAP/4. pp. 22-23.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The total tuna landings along the mainland coast during 2004 were 45,684 t showing a decrease of 12.7% compared to 2003. Southwest region contributed 48.8% followed by southeast (29.6%), northwest (21.1%) and northeast (0.5%). Major gears employed in the fishery were drift gillnet, hooks and line and purse seine.

476. **CMFRI** 2005. Development of management strategies and options for sustainable harvest of mackerels. *CMFRI Ann. Rep.* (2004-2005) PEL/CAP/5. p. 23.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The estimated landing of Indian mackerel during 2004 was 1.43 lakh t, which showed an increase by 26% compared to the year 2003. A major objective of the project was to investigate the effectiveness of different types of gears for the exploitation of mackerel resource. Gill net, purse seine, trawl net and ring seine were the major gears employed for the exploitation of mackerel along the Indian coasts. The contribution of gillnet to the mackerel catch was 0.2% at Mangalore-Malpe, 0.2% at Calicut, 0.4% at Kochi, 13.1% at Tuticorin, 95.8% at Mandapam, 7.2% at Chennai and 4.1 % at Visakhapatnam. Purse seine contributed 55.7% at Mumbai, 80.7% at Mangalore-Malpe and 26.1 % at Kochi. The contribution of trawl net to the total mackerel catch was 44.3% at Mumbai, 19.1% at Mangalore-Malpe, 38.8% at Calicut, 43.1% at Kochi, 86.9% at Tuticorin, 4.2% at Mandapam, 2.4% at Chennai and 32.8% at Visakhapatnam. The multiday trawlers landed 62.3% of the mackerel at

Visakhapatnam. Bagnet contributed 90.4% of the mackerel catch at Chennai. Ring seine contributed 60.9% and 30.4% of the mackerel catch at Calicut and Kochi, respectively.

477. **CMFRI** 2005. Management of carangid resources of Indian EEZ. *CMFRI Ann. Rep.* (2004-2005) PEL/CAP/8. p. 25.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Several species sustain the fishery of carangids. *Decapterus russelli* was the dominant species in trawl landings at Veraval (88.1%), Mangalore, Kochi (75%), and Visakhapatnam as also in purse seine (50%) and ring seine (65%) at Kochi. *Megalaspis cordyla* was the dominant species in gillnet landings at Veraval (76.6%), Kochi (31 %) and Visakhapatnam and in purse seine and gillnet landings at Mangalore. At Tuticorin *Caranx ignobilis* was the dominant species in paruvalai (23%) and hooks & line (60.7%). C. *carangus* was dominant (32.9%) in podivalai and *Decapterus* spp., (25.4%) and *S. leptolepis* (10.6%) were the dominant species in trawl.

478. **CMFRI** 2005. Taxonomy of marine pelagic finfishes. *CMFRI Ann. Rep.* (2004-2005) PEL/BIOD/01. p. 26.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Pelagic finfishes belonging to Clupeidae, Engraulidae, Chirocentridae, Megalopidae, Scombridae, Istiophoridae, Carangidae and Trichiuridae families were collected from different gears operating at Visakhapatnam, Tuticorin, Cochin, Calicut, Mangalore and Malpe.

479. **CMFRI** 2005. Investigations on the resource characteristics of the exploited stocks of Elasmobranchs. *CMFRI Ann. Rep.* (2004-2005) DEM/CAP/01. pp. 27-28.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Off Mandapam, the total production of rays was 1713. 4 t brought by trawlers (85%) and gill net (15%). *H. bleekeri* (38%) and *H. uarnak* (36%) were the dominant species in gill net and trawl, respectively. Off Chennai, trawlers accounted for 73% of the total elasmobranch catch of 673 t. Rays, the major group landed was dominated by *Dasyatis* spp (73%).

480. **CMFRI** 2005. Monitoring the resource characteristics of groupers and catfishes. *CMFRI Ann. Rep.* (2004-2005) DEM/CAP/02. pp. 28-29.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Centrewise, Tuticorin brought maximum catch of groupers (1,011 t) caught by trawlers (384 t) and hooks and line (627 t). *Epinephelus malabaricus* contributed to the bulk of the grouper catch off Tuticorin in hooks and line followed by *E. undulosus, E. longispinis, E. tauvina, E. areolatus* and *Cephalopholis sonnerati.* In trawl off Tuticorin, *E. undulosus* was the major species landed. At Tuticorin, *E. tauvina* and *E. malabaricus* weighing more than 10 kg had a price range of Rs. 90 - 300/Kg due to export demand.

481. **CMFRI** 2005. Characteristics of exploited stocks of threadfin breams and silverbellies. *CMFRI Ann. Rep.* (2004-2005) DEM/CAP/03. pp. 29-30.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Off Mandapam, the fishery was contributed by 8 species from Palk Bay dominated by *L. brevirostris* and by 10 species of Gulf of Mannar dominated by *L. dussumieri*.

482. **CMFRI** 2005. Marine finfish culture. *CMFRI Ann. Rep.* (2004-2005) DEM/CUL/01. p. 34.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Grouper *Epinephelus merra* spawned in captivity at Mandapam. Mass culture of rotifers *Brachionus rotundiformis, Moina macrura* and *Artemia salina* were developed in the hatchery.

483. **CMFRI** 2005. Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks. *CMFRI Ann. Rep.* (2004-2005) CRU/CAP/01. pp. 35-37.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The estimated All-India penaeid shrimp catch for the year 2004 was 1.76 lakh t which formed 48% of the crustacean landings of the country and 72% of the catch was caught along the west coast. Important

maritime states, which contributed to the penaeid shrimp fishery, were Maharashtra (32%), Kerala (17%), Gujarat (16%), Andhra Pradesh (10%) and Tamil Nadu (8.5%). Mechanised boats operating otter trawl landed about 90% of the catch.

484. **CMFRI** 2005. Investigations on the resource characteristics and development of management strategies for lobsters and crabs. *CMFRI Ann. Rep.* (2004-2005) CRU/CAP/03. pp. 38-40.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : At Mandapam, 200 t of crabs were landed by trawl nets and 30 t by bottom-set gill-nets with an average CPUE of 7 and 8 kg, respectively. The fishery was supported exclusively by *Portunus pelagicus*. 30 t lobsters were landed by trawl nets at Chennai and 3 t by gill-nets along Kovalam-Pudupattinam stretch. *Thenaeus orientalis* dominated both the landings (93% and 63%, respectively) followed by *Panulirus homarus.* 552 t of crabs were landed at Kasimedu, at a catch rate of 1.3 kg/h, with *P. sanguinolentus* dominating (54%) the catches.

485. **CMFRI** 2005. Broodstock development, selective breeding and restocking of marine shrimps. *CMFRI Ann. Rep.* (2004-2005) CRU/CUL/01. pp. 40-41.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Breeding and larval rearing experiments using the green tiger shrimp *Penaeus semisulcatus* were carried out at Mandapam. 6.2 million nauplii from 82 spawners were obtained. 2.4 million postlarvae produced at an average survival rate of 47.8% were released in Gulf of Mannar.

486. **CMFRI** 2005. Breeding and seed production of lobsters and crabs. *CMFRI Ann. Rep.* (2004-2005) CRU/CUL/02. pp. 41-42.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In Mandapam, 16 sets of experiments on breeding and seed production of *Portunus pelagicus* were carried out. 26 million zoea were produced and 25.7 million released into Gulf of Mannar. 4,630 crablets were produced.

487. **CMFRI** 2005. Organic farming of *Penaeus semisulcatus. CMFRI Ann. Rep.* (2004-2005) CRU/CUL/03. p. 42.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Three preliminary experiments were carried out following organic protocols for the seed production of *Penaeus semisulcatus*, larval rearing and live feed culture. Whereas spawning of wild caught prawns could be achieved without much problem, larval rearing posed serious problems due to delay or lack of development of diatoms in the culture tanks. Experiments were conducted with concentrates/extracts of organic manures for mass culture of live feed. Lack of feed/nutrition and consequent weakening of the larvae rendered them vulnerable to the attack of pathogens and opportunistic predators.

488. **CMFRI** 2005. Fishery and biological characteristics of exploited Cephalopod resources. *CMFRI Ann. Rep.* (2004-2005) MOL/CAP/01. pp. 43-45.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The all India production of cephalopods during 2004 was estimated as 1.13 lakh t which is 3.85 % less than the previous year and the landings along the west coast accounted for 82 % of the total production. Observations on the landings and biological characteristics of cephalopods from Veraval, Mumbai (New Ferry Warf), Mangalore (Mangalore, Malpe), Cochin (Munambam, Kochi, Vypin, Neendakara, and Sakthikulangara) and Vizhinjam on the west coast of India and Tuticorin, Mandapam (Mandapam, Pamban, and Rameswaram), Chennai and Visakhapatnam on the east coast were made. Trawlers contributed more than 90% of the cephalopod catch. *S. pharaonis* was landed at Vizhinjam in hook and lines operated from mechanized and non mechanized crafts and boat seines.

489. **CMFRI** 2005. Assessment of bivalve and gastropod resources. *CMFRI Ann. Rep.* (2004-2005) MOL/CAP/02. pp. 46-48.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In Tuticorin, a total of 95,970 chanks (Jaadhi variety) were landed at two landing centres viz; Kayalpattnam and Tharuvaikulam. The depth of fishing area was 20-25 m. Higher MSD (Maximum Shell Depth) 53-138 mm with a CPUE of 23 Kg was recorded in Kayalpattnam. The Gear used was 'podivalai' (bottom set

gill net with mesh size of 85 mm). In Mandapam region total number of chanks landed was the highest at Rameswaram (133,649 nos) compared to Mandapam (57,525 nos). The overall length, ranged from 80-240 mm with an MSD (Maximum Shell Depth) of 40-130mm. The length-weight relationship of *X. pyrum* var. *acuta* (Jaadhi variety) is derived as Y = 3.48 X - 209.63, whereas for var. *pyrum* is Y = 3.8181 X -219.02.

490. **CMFRI** 2005. Stock assessment techniques in marine fish and shellfish resources and management, *CMFRI, Ann. Rep.* (2004-2005) FRA / ASSESS / 02. pp. 16-17.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The project aims to review the existing methodology in stock assessment, develop methods suitable to the tropical multi-species and multi-gear systems and development of software for fish stock assessment.

491. **CMFRI** 2005. Marine pearl production through Tissue culture. *CMFRI Ann. Rep.* (2004-2005) MOL/CUL/04. p. 52.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Organ cultures were continued with mantle tissue of pearl oyster and abalone. Nacre coating was found to continue several months in *in-vitro.* Successful coating in all the beads were tested. Intermediate feeding was arranged for cultures in order to accelerate nacre growth. Cell yield was found to increase towards higher concentration of calcium. Injection of free cells in live pearl oyster was also attempted. Results would be known after harvest. Organ cultures were organized using mantle tissue of windowpane oyster.

492. **CMFRI** 2005. Biodiversity of Marine Molluscs. *CMFRI Ann. Rep.* (2004-2005) MOL/BIOD/01. pp. 52-53.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Lists of molluscs recorded from Indian waters were documented group wise and species wise for the preparation of checklists. The checklist so far contains a total of 540 species of Gastropods from 240 families and 302 genera; 318 species of Bivalves from 90 families and 123 genera; 13 species of Polyplacophores from 8 families; 11 species of Scaphopoda from 7 families; 9 species of Aplacophores from 6 families and 201 species of Cephalopods from 26 families.

493. **CMFRI** 2005. Technological feasibility studies and up-gradation of molluscan mariculture. *CMFRI Ann. Rep.* (2004-2005) MF/CUL/01. pp. 48-50.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In Tuticorin, 428 nos of pearl oysters (*P. fucata*) were nucleated with 4mm bead nuclei. Clam (*P. malabarica*) culture experiments were carried out to find out the ideal stocking density of seed clams while doing re-laying. *P. malabarica* seeds of 3.3 mm were reared in densities of 200, 300 and 400/m^2 in the hatchery. Maximum growth rate of 2.4 mm/month was observed in the seeds reared in 400/m^2. In Mandapam, various types of spat settlers like lime coated coconut halves, tiles, corrugated asbestos sheet and bunch of nylon threads were placed in the oyster beds of Athankarai estuary to study the pattern of spat settlement. But the Tsunami resulted in loss of settlers.

494. **CMFRI** 2005. Selective breeding of pearl oyster *Pinctada fucata* (Gould). *CMFRI Ann. Rep.* (2004-2005) MF/CUL/02. pp. 50-51.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Twenty nine spat and five adult pearl oysters transported from Gujarat to Thankassery Bay and Tuticorin survived only for four months, while *P. fucata* adult and spat from Tuticorin survived well in Gujarat. The pearl oyster spat transplanted from Tuticorin to Thankassery Bay for selective breeding studies showed good growth. Nucleus of 8-10 mm was used in 23 oysters of 65- 75mm in DVM range of which only three survived during convalescence. Those oysters were transplanted to Thankassery farm but died due to unexpected blooming of toxic algae in the farm area.

495. **CMFRI** 2005. Technological up-gradation of Molluscan seed production. *CMFRI Ann. Rep.* (2004-2005) MF/CUL/03. pp. 51-52.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : At Tuticorin, spat production of pearl oyster, edible oyster and clams was continued. Five thousand one hundred pearl oysters spat (1 to 1.5 mm) were supplied to Chennai Research Centre and four hundred numbers to Vizhinjam and Kollam. Adult edible oysters were maintained as broodstock, which gave 12 spawnings. Settlement percentage ranged from 0.014 to 2.02 %. Out of 255 strings made with the spat set on shells in the hatchery, 150 were transferred to the farm and the rest were being maintained in the hatchery. New batch of *P. malabarica* collected from Kollam did not give any spawning but the seed produced from a spawning in December '03 attained an average size of 13.8 mm. 17th generation of *S. inermis* maintained at Tuticorin hatchery laid eggs but did not attain maturity. An egg cluster of *S. pharaonis* maintained in the hatchery released 144 hatchlings, which were reared upto 21 days. Feeding experiments for *S. pharaonis* juveniles showed that those fed with 20% of feed (mysid) at the ratio of its body weight gave a growth rate of 4.6 mm ML with a weight of 2.1 g/month. In the salinity tolerance experiment, the juveniles reared in 35 ppt had shown good growth rate of 9.5 mm ML with 1.1 g than those reared in 25 and 30 ppt. In Mandapam, 35 nos. of *Xancus pyrum* were reared in the hatchery. Growth and feeding experiments for baby chanks are being continued.

496. **CMFRI** 2005. Marine pearl production through Tissue culture. *CMFRI Ann. Rep.* (2004-2005) MOL/CUL/04. p. 52.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Organ cultures were continued with mantle tissue of pearl oyster and abalone. Nacre coating was found to continue several months *in-vitro.* Successful coating was seen in all the beads tested. Intermediate feeding was arranged to cultures in order to accelerate nacre growth. Cell yield was found to increase towards higher concentration of calcium. Injection of free cells in live pearl oyster was also attempted. Results would be known after harvest. Organ cultures were organized using mantle tissue of windowpane oyster.

497. **CMFRI** 2005. Monitoring the environmental characteristics of the inshore waters in relation to fisheries. *CMFRI Ann. Rep.* (2004-2005) FEM/01. pp. 54-55.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The water temperature of the inshore waters ranged from 26.7 to 32.5°C in the west coast and it was 26.0 to 32.4°C in the east coast. Values of salinity ranged from 10.5 ppt to 36.0 ppt in the west while it was 27.7 to 38.0 ppt in the east. The dissolved oxygen content ranged from 1.8 to 5.2 ml/l in the west and it was 1.16 to 6.5 ml/l in the east. Values of nitrite ranged from 0.18 to 2.14µg at/l in the west while it was 0.02 to 1.4 µg at /l in the east. The nitrate values ranged from 0.66 to 5.37 µg at/l in the west while it was 0.09 to 1.3 µg at /l in the east. The phosphate values ranged from 0.04 to 5.20 µg at /l in the west while it was 0.09 to 1.3 µg at /l in the east. The values of silicate ranged from 1.8 to 60 µg at /l in the west and it was 0.02 to 6.64 µg at /l in the east. The gross primary production ranged from 28.0 to 715 mgC/m^3/day in the west and it was 24 to 1,162 mgC/m^3/day in the east. The biomass of zooplankton recorded high values of 40.3 ml / 100m^3 of water in the west and it was 8.0 ml /100m^3 of water in the east coast.

498. **CMFRI** 2005. Monitoring environmental contaminants from coastal waters with reference to bioaccumulation and biomagnification in fishes. *CMFRI Ann. Rep.* (2004-2005) FEM/02. pp. 55-56.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Concentrations of Pb in seawater samples from industrialized areas of Chennai and Veraval were relatively high. Mean lead concentrations in sediment samples from the industrialized areas of Veraval and Mumbai were above the ERL concentration of 47 ppm. Mean Pb concentrations in fish samples from Tuticorin, Veraval and Cochin were relatively high.

499. **CMFRI** 2005. Culture of seaweeds. *CMFRI Ann. Rep.* (2004-2005) FEM/03. pp. 56-57.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Total landings of seaweeds in Tamil Nadu were 1,668 t (dry weight) compared to 2,749 t (dry weight) during 2004 constituting 995 t of *Sargassum* spp, 34 t of *Turbinaria* spp, 170 t of *Gelidiella acerosa,* 58 t of *Hypnea* spp, 76 t of *Gracilaria edulis,* 35 t of *G. crassa* and 300 t of *Gracilaria* spp. Pilot scale field cultivation of carrageenan yielding red seaweed *Kappaphycus alvarezii* carried out in the nearshore area of Palk Bay and

Gulf of Mannar showed maximum increase in yield of 4.3 fold after 30-32 days in Palk Bay and 5.7 fold after 22-34 days in Gulf of Mannar. A total quantity of 12.5 t (wet wt) of crop was harvested during July 2004 to March 2005.

500. **CMFRI** 2005. Development of strategies for sea turtle and sea cucumber conservation. *CMFRI Ann. Rep.* (2004-2005) FEM/04. p. 57.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During April-July 2004, seven experiments on induced spawning trials were conducted in *Holothuria scabra* and on only one occasion four males spawned. In view of the spent gonadal stage of the existing broodstock, 19 fresh brood stock specimens were collected from Kalavasal area, Tuticorin. With the fresh brood stock of *H. scabra*, spawning trials attempted during Oct-Dee 2004 raising the salinity level. The larvae of *H. scabra*, reared at a density of 1.65 lakhs per 500 litres of 35 ppt sea water, on 10^{th} day became the doliolaria, on 15^{th} day metamorphosed to pentactula and on 25^{th} day became 1 mm size juveniles and survival rate of 8% was obtained. Sea ranched 1200 young ones of *H. scabra* of the mean size 25 mm in the sea grass bed at Tuticorin, in March 2005.

501. **CMFRI** 2005. Mariculture of Live feed organisms. *CMFRI Ann. Rep.* (2004-2005) FEM/05. pp. 57-58.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Cultures of micro algae were sold to different hatcheries for Rs.31,920 and Rs. 64,900 from Tuticorin and Kochi, respectively and the amount was deposited to ATIC of the Institute.

502. **CMFRI** 2005. GIS based Atlas on potential mariculture sites along the Indian coast. *CMFRI Ann. Rep.* (2004-2005) FEM/07. p. 59.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Initiated development of first stage maps of potential mariculture sites of the designated areas by eliminating the places subjected to industrial pollution, mangrove vegetation, port and fishing harbors, tourism and pilgrim centers, shrimp hatcheries etc. In second phase of the work collection of coordinates and attributes was done from the short-listed sites.

503. **CMFRI** 2005. Development of cost effective and eco-friendly feeds for cultivable marine crustaceans and finfish by Biotechnological interventions. *CMFRI Ann. Rep.* (2004-2005) PNP/NUT/01. pp. 61-62.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The minimum fish meal requirement in compounded diets of post larval *Penaeus semisulcatus* has been determined as 10% based on two experiments. In a comparative trial with four compounded feeds, a feed containing a mixture of protein sources of marine and plant origin (fish meal 35% Acetes meal 7.5%, prawn head meal 7.5%, groundnut cake 25%) produced the best growth response of 0.53g per day with a gross conversion efficiency of 91.77% in *Portunus pelagicus*.

504. **CMFRI** 2005. Development of cost effective low stress methods for live transport of fish and crustaceans. *CMFRI Ann. Rep.* (2004-2005) PNP/PHY/01. pp. 66-67.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The microbial changes in the water in control and under sedation with 40 ppm clove oil for damselfish for live transport (mean weight g) was studied. It was observed to be 5×10^3 (CFU) for 0h, 15×10^3 (CFU) for 1h for control and only 6×10^3 CFU after one hour under sedation.

505. **CMFRI** 2005. Price behaviour and marketing system of marine fisheries in India. *CMFRI Ann. Rep.* (2004-2005) SEE/PMS/01. p. 68.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : On the basis of the price structure, economic evaluation of marine fish landings for 2004 has been done. The value of the fish at first sales was estimated at Rs 13,019 crore and at last sales Rs 22,353 crore. Crustaceans alone contributed Rs 5,768 crore at first sales and Rs 10,295 crore at last sales forming about 40% of gross revenue. Average percentage share of fishermen in the consumers rupee ranged from 40% for oil sardines to 77 % for penaeid prawns and rock cods.

506. **CMFRI** 2005. Economics of marine fishing operations. *CMFRI Ann. Rep.* (2004-2005) SEE/ECO/01. p. 69.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In Tuticorin, the operating ratio of motorized crafts with gillnets (multiday) was worked out to 0.55 against 0.65 for a motorized craft with bottom-set gill net. It is seen that, higher the operating ratio, lower is the economic surplus.

507. **CMFRI** 2005. Indigenous knowledge systems and community based resource management in marine fishes. *CMFRI Ann. Rep.* (2004-2005) SEE/ITK/01. pp. 69-70.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Analysed the perception of fisherfolk in Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. More than 80 % opined that ITKs are to be preserved and applied with suitable modifications.

508. **CMFRI** 2005. Marine fisheries census 2005. *CMFRI Ann. Rep.* (2004-2005) *Min. Agri.* pp. 74-75.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Census was aimed at collection of essential information on the number of fishing villages, landing centres, fishermen population, active fishermen, fishing crafts and gears including the infrastructure facilities for planning developmental programmes in different maritime states of India. The census was also focused on getting information on characteristics of the fisherfolk including their community, educational and occupational status, membership in co-operative societies etc., besides their holdings of crafts and gears.

509. **CMFRI** 2005. Studies on marine mammals of Indian EEZ and the contiguous seas. *CMFRI Ann. Rep.* (2004-2005) DOD. pp. 79-81.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During 2004-2005, 215 days were spent on board FORV *Sagar Sampada* and made 146 sightings of mammals from Bay of Bengal and Arabian Sea (Cruise numbers 223-232). Two species of whales *viz.*, *Balaenoptera borealis* and *Physeter macrocephalus* and 5 species of dolphins *viz.*, *Stenella longirostris, Stenella coeruleoalba, Sousa chinensis, Delphinus delphis* and *Pseudorca crassidens* were positively identified on many occasions. Apart from this many unidentified dolphins and whales have also been recorded during cruises.

510. **CMFRI** 2005. Evaluation of genetic heterogeneity in marine ornamental fishes using Molecular Genetic markers. *CMFRI Ann. Rep.* (2004-2005) ICAR A.P. CESS. pp. 83-84.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Microsatellites are excellent markers for studying genetic heterogeneity and parental inheritance in cultured fish. Experiments on cross-species amplification of microsatellite loci in clown fish were carried out; inheritance from parents to progeny was studied.

511. **CMFRI** 2005. Breeding and culture of Pearl oysters and production of pearls. *CMFRI Ann. Rep.* (2004-2005) NATP/PSR. pp. 88-89.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Comparative studies of growth and biometric relationships of pearl oyster *Pinctada fucata* (Gould) transplanted from the Tuticorin Bay in the Gulf of Mannar along the Indian southeast coast to Kollam Bay in the Arabian Sea, south west coast of India were made.

512. **CMFRI and CSMCRI** 1989. A report on the seaweed resources off the Tuticorin-Tiruchendur coast, Tamilnadu, India. Sector I. 24 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India; Central Salt and Marine Chemicals Research Institute, Mandapam - 623 520, India.

Abstract : In addition to the conventional shallow waters of upto 4 to 6 m depth, the seaweeds are known to thrive on big rocks, boulders, chank and mussel beds located in the deeper waters. To find out these resources a joint survey by CMFRI and CSMCRI was planned. The present report deals with survey (Phase I) of the area between Tuticorin and Tiruchendur. Other contiguous areas will also be covered for knowing the resource potential.

513. **CMFRI and CSMCRI** 1990. A report on the seaweed resources of Tamilnadu coast, India. II. sector. Alantalai – Manapad and Vembar-Nallathanni Tivu. 30 pp.

Address : Central Marine Fisheries Research Institute, Cochin- 682 018, India; Central Salt and Marine Chemicals Research Institute, Mandapam - 623 520, Tamilnadu, India.

514. **CMFRI and CSMCRI** 1991. A report on the seaweed resources off Tamilnadu coast, India. sector IV. Kilakkarai, Rameswaram Island (Dhanushkodi). 25 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India; Central Salt and Marine Chemicals Research Institute, Mandapam - 623 520, Tamilnadu, India.

515. **Collett, O.** 1900. Pearl oysters and pearl fisheries. *J. Ceylon Archh. R. Asiat. Soc.*, 16(51): 165-198.

516. **Coppen, J.J.W.** 1990. Production of agar from seaweed with special reference to India. *Gracilaria production and utilization in the Bay of Bengal. Seminar papers: Session II small-scale Agarophyte processing* BOBP, pp. 45-47.

Address : Overseas Development Natural Resources Institute Chatham, Kent ME4 4TB. UK.

Abstract : Agar production in India is about 75 tonnes annually, and takes place mostly in Tamil Nadu. Species from the genera *Gelitlium, Gelidiella* and *Gracilaria* are utilized for agar production. Two grades of agar are manufactured in India: food grade and IP grade (Indian Pharmacopoeia standards). The common processing is as follows: acid treatment, hot water extraction, freeze-thaw cycle, bleaching and sun-drying. Plant capacity ranges from 2 to 60 kg agar per day.

517. **Coppen, J.J.W.** 1991. Agar and Alginate production from seaweed in India. BOBP/WP/69. 27 pp.

Address : Bay of Bengal Programme, Madras, India.

Abstract : This paper surveys the Indian seaweed industry and its principal products, agar and sodium alginate. Technical and economic aspects of seaweed collection and processing, and the markets for the products, are examined. Trials undertaken by BOBP to cultivate *Gracilaria* seaweed and to employ it as a source of raw material for village scale agar production are briefly described. The work presented is based on information collected during visits made in 1988 and 1989 to harvesting centres along the south-eastern coastline of Tamilnadu, Kerala, Andhra Pradesh and Gujarat. The seaweed industries are not well documented and the report relies heavily on first-hand information gained through visits and discussions with the seaweed collectors, agents and processors.

518. **CSMCRI.** 1978. *A report on survey of marine algal resources of Tamilnadu. 1971-76,* CSMCRI, Bhavnagar. 137 pp.

519. **CSMCRI, CMFRI and SF** 1978. *Report of the survey of marine algal resources of Tamil Nadu. Report. CSMCRI, CMFRI & State Fisheries,* pp. 1-37.

520. **Curray, J.R.** 1984. Sri Lanka: Is it a mid-plate platelet?. *J. Natl. Aquat. Resour. Agency Srilanka*, 31: 30-51.

Address : Scripps Institute of Oceanography, University of California at San Diego, La Jolla, CA 92093, USA.

Abstract : Two observations suggest the possibility that Sri Lanka is acting as a small-mid-plate platelet moving very slowly within and relative to the larger Indian plate. First, sediments of the Bengal Deep-Sea Fan off the SSE continental margin are folded and uplifted in a manner similar to the deformation from front of accretionary prisms where thick sediment columns are passing into subduction zones. And second, subsidence rates in the area of presumed spreading or continuing stretching of continental crust, the Cauvery, Palk Strait and Gulf of Mannar Basin, have not decreased during the Cenozoic as would be predicted by an aborted rift or aulacogen model, but instead appear to have accelerated during the Neogene. Information available on other phenomena which re predicted by the model is at the present time inadequate for evaluation.

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521. **Daniel, A.** 1953. *Conchoderma indicum* n.sp. a Pedunculate cirripede from Krusadai Island. *J. Zool. Soc. India*, 5(2): 235-238.

Address : Zoological Research Laboratory, Madras University, India.

Abstract : Since the establishment of the genus *Conchoderma* by Olfers in 1814, <4 number of species have been described of which only two *Conchoderma virgatum* (Spengler) and *Conchoderma auritum* (Linne) are considered to be valid by Annandale (1909). Of these two, *Conchoderma auritum* (Linne) occurring on whales has not been recorded from the Indian Ocean region, while *Conchoderma virgatum* occurring commonly on turtles, seasnakes etc., was recorded from the Madras coast by Annandale as early as 1909. In 1909, Annandale also recorded a variety of this species, *viz.*, *Conchoderma virgatum* var. *hunteri* (Owen, 1830). In 1953, the present author has recorded another variety of this species *Conchoderma virgatum* var *Olfersii* (Leach, 1818) from Madras along with the typical form and the form *hunteri.*

522. **Daniel, A and B.P. Halder** 1974. Holothuroidea of the Indian Ocean with remarks on their distribution. *J. Mar. Biol. Assoc. India*, 16(2): 412-436.

Address : Zoological Survey of India, Calcutta, India.

Abstract : In the Indian Ocean more than 160 species of holothuroid echinoderms have been recorded, of which 150 species are available in the collection of the Zoological Survey of India. These include about 75 species from the deep sea and another 70 species from shallow offshore and littoral regions. The remaining species occur exclusively on reef flats of coral Islands *i.e.*, Andamans, Nicobars, Krusadi and adjacent Islands in the Gulf of Mannar, Pirotan Island and adjacent coral beds in the Gulf of Kutch and Laccadive-Minicoy-Maldive groups of Islands; these species contribute to the '*Beche-de-mer'* or 'trepang' industry. The geographical and bathymetrical distribution pattern of the valid species of Holothuroidea of the Indian Ocean are also presented. An attempt has been made to explain the distribution chiefly in relation to oceanic currents and bottom topography.

523. **Daniel, C.J.** 1949. Foraminifera of Krusadi Island. *M.Sc. Dissertation*, University of Madras, Chennai.

524. **Daniel, C.J.** 1949. Encrusting foraminifera of Krusadai Island. *J. Mad. Univ.*, 18: 23-37.

525. **Daniel Sudhandra Dev and A.L. Muthuraman** 1988. Observations on the bio-fouling in pearl oyster farm of Krusadai Island, Gulf of Mannar. *CMFRI Bulletin*, 42(2): 306-310.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Emphasis was laid mainly to identify the dominant groups of biofoulers on pearl oysters and cages in commercial farming during the year 1985-86. The rate of biofouling observed in Krusadai farm was less compared to the observations made at Tuticorin. Comparatively more of fouling was observed during the southwest monsoon and northeast monsoon periods. During the southwest monsoon, barnacles contributed more and during the northeast monsoon silt deposition was found to increase the quantum of fouling. Barnacles, bryozoans, molluscan spat, tunicates, decapods, crustaceans and sea weeds were found on pearl oysters and cages througout the year in varying quantities. Boring by sponges and spionids were practically nil.

526. **Daniel Sudhandra Dev and A.L. Muthuraman** 1988. On the large scale predation by the gastropod (*Cymatium cingulatum)* on pearl oysters. *CMFRI Bulletin*, 42(2): 311-313.

Address : Tamil Nadu Pearls Limited, Mandapam 623 519, Tamilnadu, India.

Abstract : The predatory gastropod *Cymatium cingulacum* was found to occur in large numbers in the pearl oyster farm at Krusadai from February to July, 1986. They feed mainly on spat and young oysters below the size 40 mm in DVM and thereby causing large scale mortalities of pearl oyster stock. This menace was eradicated by periodical checking and hand picking manually. In all 50,901 oysters were found dead in the 4,010 cages inspected and 934 predators were collected and destroyed. The gastropods ranged between 21 and 88 mm in length.

527. **Daniel Sudhandra Dev and S. Durairaj** 1993. On commercial aspects of cultured pearl production from pearl oyster *Pinctatada fucata* (Gould) in India. *Seafood Export J.*, 25(8): 25-38.

528. **Das, P., P.C. Mahanta and D. Kapoor** 1988. Marine fish genetic resource conservation. *CMFRI Spec. Publ.*, 40: 24.

Address : National Bureau of Fish Genetic Resources, B-209 Mehdauri Colony, Allahabad 211 004, India.

Abstract : Overfishing, unscientific commercial exploitation, and destruction of habitats caused by nature and also induced by man have been, of late, causing serious threat in the marine fish germ plasm resources. The present status of knowledge about resource conservation is outlined with respect to the present Indian strategy for the research on the subject. This broadly includes a thorough survey of fish fauna, cataloguing of genotypes, study of genetic variability, scanning of polymorphic characters, development of practicable methodologies for conservation of exploited and endangered species and implementation of the same through concerned agencies.

529. **David Kingston, S., C. Rajagopalasamy and G. Jegatheesan** 1988. A comparative study on the quality characteristics of masmin and mechanically smoke cured tuna. *CMFRI Spec. Publ.*, 40: 73.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : 'Masmin' a smoke cured product prepared from tuna in traditional smoking kilns is considered a delicacy by the people of southern States. It is shown by certain researches that some chemicals particularly the Phenolic components present in the smoke is carcinogenic in nature which is tremendously hazardous to human beings when consumed beyond a certain limit. So it is essential to have a knowledge on the total phenols present in masmin. In the present study the total phenolic content as well as other biochemical constituents of masmin were studied. Further, the results were compared with the mechanically smoke cured product.

530. **David Kingston, S., C.B.T. Rajagopalasamy and G. Sugumar** 1990. A comparative study on the quality characteristics of traditional masmin and mechanical kiln prepared masmin. *Fish. Technol.*, 27(1): 45-47.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : The quality characteristics of traditional masmin and masmin prepared in a mechanical kiln were compared. The quality of the mechanical kiln prepared product was superior.

531. **David Kingston, S and D. Manikandavelu** 1994. Coral reefs and their management. *Seafood Export J.*, 25(15): 5-7.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : This article classifies different coral reefs on the basis of their morphology. Highlights importance of such a system and need for their management.

532. **David Kingston, S and C.B.T. Rajagopalasamy** 1994. Sea bass - A promising candidate species for culture. *Seafood Export J.*, 25(19): 23-26.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : Sea bass (*Lates calcarifer*) is considered an excellent table fish and promising candidate species for the future. Though the fish usually occurs in marine environment, it can get accustomed to any salinity level, even to fresh water. This paper highlights its culture methods - pond and cage culture.

533. **David Kingston, S and V.K. Venkataramani** 1994. Biochemical composition of yellow stripe scad, *Selaroides leptolepis* as a function of maturity stage and length. *Fish. Technol.*, 31(2): 159-162.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : The biochemical composition of *Selaroides leptolepis* was studied in different maturity stages as well as in different length groups. The juveniles contained more protein (76.92%) than males (73.92%) and females (69.24%). With the advancement of maturity, a decrease in moisture as well as protein was noticed whereas a positive relationship was noticed with fats. Spent animals showed distinct variations. Protein and fat followed an inverse relationship.

534. **David Kingston, S and D. Manikandavelu** 1995. Remote sensing and its applications in fisheries. *Seafood Export J.*, 26(2): 29-31.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : The remote sensing technique has vast potential in scanning the marine resources. If this is used it is possible to augment the production through culture and capture fisheries. It can help in identifying potential fishing zone and locating fishing grounds. Besides the conservation of marine resources, coastal area development,

monitoring of ocean systems, regulation of degrading mangrove forests, avoidance of overexploitation of coral reefs, *etc*., can also be done using this technique.

535. **David Kingston, S., V.K. Venkataramani and K. Venkataramanujam** 1999. Food habits and feeding intensity of finless scad *Atule mate* (Teleostei) off Gulf of Mannar, southeast coast of India.*Indian J. Mar. Sci.*, 28(3): 307-311.

Address : Fisheries College and Research Institute, Tuticorin - 628008, Tamilnadu, India.

Abstract : *Atule mate* exhibits two types of feeding patterns, the juveniles feeding mainly on crustaceans and the adults exclusively on fishes. Low intensity of feeding was observed in juveniles, males and females. Juveniles had high diet breadth (2.86) when compared to the males (1.86) and females (2.10). The overlap studies showed clustering of high overlaps in the younger and older length groups. The dendrogram of the diet at various length groups showed two principal clusters, one at 91-150 mm (TL) length group and another at 151-280 mm (TL) length group. As per the cluster analysis two types of food patterns are evident in this species.

536. **David Kingston, S and V. Ramadhas** 2006. Coral reef fishery resources of India and their conservation. *Fishing Chimes,* 26(3): 55-56.

Address : Fisheries College and Research Institute, Parakkai, Kanyakumari, Tamilnadu, India.

Abstract : A coral reef can be defined as, "a ridge or mound of limestone, the upper surface of which lies near the level of the sea, and is predominantly composed of Calcium carbonate secreted by coral organisms".

537. **Deepak Samuel, V. and J.K. Patterson Edward** 2002. Destructive fishing in Reef and Mangrove areas of Tuticorin coastal waters. *SDMRI Res. Publ.*, 2: 98-103.

Address : Suganthi Devadason Marine Research Institute, 44, Beach Road, Tuticorin 628 001, Tamilnadu, India; E-mail: deepp_ocean@yahoo.com

Abstract : The coral mining and denuding of mangroves along Tuticorin coastal waters reduced the breeding grounds of shell and finfishes substantially. Adding to these losses, the illegal fishing and lapse on the part of government in implementing strict regulations also increased the destruction rate. The use of harmful nets such as Karai valai, Roller madi, and Sippi valaia and dynamite fishing in coral and mangrove areas of Tuticorin coast, Tamil Nadu, India were assessed and their impacts are described with the list of species targeted.

538. **Deepak Samuel, V., R. Ramkumar and Jamila Patterson** 2003. FADs and their effectiveness in cephalopod fishery. *Nat. Sem. Reef Ecosystem Remediation,* 24th-26th Sep'03, SDMRI, Tuticorin, India. p. 55.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : For time immemorial, fishermen have designed and discovered natural Fish Aggregating Devices (FADs) for the capture of finfishes and cephalopods. The innovative discovery of these devices have resulted in "region wise" differences in FADs for cephalopod fishery based on the depth of operation, breeding ground and season. The cephalopods are attracted towards these structures and the females start spawning on them. Males follow the females and ultimately, they are caught by jigs, Originally, FADs were made out of plants but now, broken nets, dead gorgonia and broken PVC pipes are also used. The catch, effectiveness and feasibility of FADs from plant origin and artificial substrata are discussed.

539. **Deer, P.K.** 1970. Development of fishing harbors in India. *Seafood Export J.*, 2(6): 15-25.

540. **Dendy, A.** 1887. The Sponge-fauna of Madras. A Report on a Collection of Sponges obtained in the neighbourhood of Madras by Edgar Thurston, Esq. *Ann.& Mag. Nat. Hist.*, S.5. 20: 153-169.

Address : Assistant in the Zoological Department of the British Museum, England.

Abstract : The specimens upon the study of which this paper is based' were collected in the neighbourhood of Madras by Edgar Thurston, Esq., Superintendent of the Government Central Museum, and forwarded by him to my colleague, Prof. F. J. Bell, to whom I am indebted for the opportunity of examining and describing them. The collection is of exceptional interest, owing to the fact that it is the first, which has been obtained from this particular locality. Indeed, our knowledge of the sponge-fauna of the entire Indian Ocean is extremely deficient. This deficiency is almost certainly due to want of investigation rather than to any actual scarcity of sponges. The best-known locality for sponges in the Indian Ocean is undoubtedly Ceylon. Out of the ten determinable species from Madras, four have already been recorded from the neighbourhood of Ceylon.

541. **Dendy, A.** 1889. Report on a second collection of sponges from the Gulf of Mannar. *Ann. Mag. Nat. Hist.*,S.6. 3: 73-99.

Address : Demonstrator and Assistant Lecturer in Biology, University of Melbourne.

Abstract : A little more than a year ago I published in this journal an account of a collection of sponges made by Mr. Edgar Thurston, Superintendent of the Government Central Museum at Madras, off the shores of the Island of Rameswaram in the Gulf of Mannar. Shortly before leaving England I received from Mr. Thurston a second collection, obtained in the neighbourhood of the Tuticorin Pearl Banks. This collection was of even greater interest than the first, and its value was greatly enhanced by the fact that Mr. Thurston had carefully preserved portions of nearly all the species in spirit, and had also kept a record of the colours of the sponges in the living state. Unfortunately my report on this collection has been greatly delayed by pressure of other work and even now I feel that I have been unable to do full justice to the material at my disposal. The collection comprises twenty-four determinable species of which fourteen are new to science and two are represented by new varieties.

542. **Dendy, A.** 1898. On *Pontobolos,* a remarkable marine organism from the Gulf of Mannar. *J. Linn. Soc.* (Zool), 26: 443-452.

543. **Dendy, A.** 1905. Report on the Sponges Collected by Professor Herdman at ceylon in 1902. *Rep. Govt. Ceylon panel Oyster Fish. Gulf of Mannar,* 3(57): 246.

544. **Desai, B.N.** 1967. Seaweed resources and extraction of alginate and agar. *Proc. Seminar Sea, Salt and plants. CSMCRI, Bhavnagar,* 1965: 343-351.

545. **Deshmukh, S and G. Venkataramani** 1995. The Gulf of Mannar marine Biosphere Reserve. ***In***: *Protecting Endangered National Park, RGICS Project No.7,* RajivGandhi Institute for contemporary studies, New Delhi. pp. 4-5.

546. **Deshmukh, V.D.** 1988. Stock assessment and management of the coastal mud shrimp *Solenocera crassicornis* (Milne Edwards) in the trawling grounds off Veraval. *CMFRI Spec. Publ.,* 40: 29.

Address : Central Marine Fisheries Research Institute, Bombay, India.

Abstract : *Solenocera crassicornis* formed 44.86% of the penaeid prawn landings at Veraval during 1983-86. Annual stock and standing stock for the species are 2,023.2 tonnes and 264.2 tonnes and the exploitation rate is 0.56. From the yield per recruit analysis, MSY under present conditions of fishing is 1,123.7 tonnes which is close to the present annual production. The catches of *S. crassicornis* are maximum during intense recruitment period of March-April. Hence 65-80% catch in these months consists of undersized prawns. If larger cod end mesh size of 35mm is used for the trawl during the recruitment period, the yield can be increased by 58.3% of the present production or doubled if used during entire trawling period.

547. **Devadoss, D.D.P., N.V. Choodamani, R. Venkataraman, S. Thyagarajan, S. Mahadevan and A.D. Issac Rajendran** 1958. Observations on the "Pearl Fishery off Tuticorin 1957" in the Gulf of Mannar. *Proc. Indian Sci. Congr. 45th Sess.*: 373-374.

548. **Devadoss, P., M.D.K. Kuthalingam and R. Thiagarajan** 1988. Present status and future prospects of elasmobranch fishery in India. *CMFRI Spec. Publ.,* 40: 29-30.

Address : Central Marine Fisheries Research Institute, Research Centre, Madras - 600 105, Tamilnadu, India.

Abstract : An increasing trend in the elasmobranch fishery from 35.6 thousand tonnes during sixties of 53.9 thousand tonnes during seventies and 59.6 thousand tonnes during the current decade (up to 1985) was observed. This increase is mainly due to the large scale mechanisation of the fishery during the seventies. An extensive and illustrated field key is given for sharks, skates and rays; the production trends are discussed with special reference to the major shark-fishing centres. The optimum level of effort to get the MSY for sharks and rays using the Schaeffer model at selected centres has been worked out and presented.

549. **Devanesan, D.W and S. Varadarajan** 1939. On *Coeloplana* sp. discovered by Prof.W.M.Tattersal at Krusadai Island, Marine Biological Station, Gulf of Mannar. *Curr. Sci.,* 8(4): 157-159.

Address : State Fisheries Department, Madras, India.

Abstract : The large number of species of *Coeloplana* recorded since 1880 made it impossible to settle the

identity of the species to which the Krusadai *Coeloplanae* belonged or to say defenitly if they constituted a species new to science within the short time at our disposal. For the present, therefore, we content ourselves with alluding to Krusadai *Coeloplanae* in this paper rather than to particular species.

550. **Devanesan, D.W and S. Varadarajan** 1940. The occurence of *Tornaria* larvae at Krusadai. *Curr. Sci.,*9:375-377.

Address : Department of Industries, Madras, India.

Abstract : *Krusadiensis* and *Chlamydothorax ceylonensis* occurred in the vicinity of Bushy point on the Ceylon side of the Island, while *Ptychodera minuta* and *Glandicepes hacksi* were collected from the Porites Bay and Watchman's Bay in the Northern shore of the Island facing Mandapam.

551. **Devanesan, D.W and P.I. Chacko** 1941. Balanoglossus as food of fishes. *Curr. Sci.,* 11(6): 242-243.

Address : Department of Industries, Madras, India.

Abstract : A systematic collection of fishes from both the "Balanoglossus area" and the watchman's Bay was arranged. Sri. S. Varadarajan recorded for the first time on 6th July 1940 and 1st August 1940 that the Whiting *Sillago sihama* and the squeaking perch *Therapon jarbua* had a specimen of Balanoglossus in their stomach contents.

552. **Devanesan, D.W and P.I. Chacko** 1941. Commensalism in sponges. *Curr. Sci.,* 10(8): 374.

Address : Department of Industries, Madras, India.

Abstract : Wellknown examples of commensalism in the animal kingdom are found between crabs and sea-anemones. The sea-anemone Adamsia lives in association with hermit crab. The crab Dorippe carries a sea-anemone on the top of a bivalve shell which is mounted on its back and held in position by its hind pair of legs.

553. **Devanesan, D.W and S. Varadarajan** 1942. On three new species of *Coeloplana* found at Krusadi Island, Marine Biological Station, Gulf of Mannar. *J. Madras Uni.,* 14: 181-188.

554. **Devanesan, D.W and P.I. Chacko** 1944. Cultivation of milkfish in Krusadai Island. *Proc. 31st Indian Sci. Cong.,* 3: 108.

555. **Devanesan, D.W and P.I. Chacko** 1944. On the fluctuations of a few typical items of planktonic organisms in the sea around Krusadai Island, Gulf of Mannar, for the Quinquennium, 1936-37 to 1940-41. *Proc. 31st Indian Sci. Cong.,* 3: 116-117.

556. **Devanesan, D.W and P.I. Chacko** 1944. On the bionomics of the sacred chank, *Xancus pyrum* (him) *Proc. nat. Inst. Sci. India,* 1B: 141-142.

557. **Devanesan, D.W and K. Chidambaram** 1956. Results obtained at the pearl oyster farm, Krusadai Island, Gulf of Mannar and their application to problems relating to pearl fisheries in the Gulf of Mannar., *Contr. Mar. Biol. Stn. Krusadai Island, Gulf of Mannar,* 4: 1-89.

558. **Devanesan, D.W and K. Chidambaram** 1956. Results obtained at the pearl oyster farm Krusadi Island, Gulf of Mannar and their application to the problems relating to pearl fisheries in the Gulf of Mannar - Part I. *Contr. Mar. Biol. Stn. Krusadi Island, Gulf of Mannar,* 5: 1-26.

559. **Devanesan, D.W and P.I. Chacko** 1958. Report on pearl culture experiments at the Marine Fisheries Biological Station Krusadai Island, Gulf of Mannar. *Contr. Mar. Biol. Stn. Krusadai Island, Gulf of Mannar,* 5: 1-26.

560. **Devaraj, M.** 1975. Osteology and relationships of the Spanish mackerels and seerfishes of the tribe *Scomberomorini*. *Indian J. Fish.,* 22(1&2): 1-67.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Scomberomorus is distinct from all other scombrid genera in twenty-nine osteological characteristics. In most of these characteristics Scomber, Rastrelliger, Acanthocybium, Gymnosarda, Allothunnus, Sarda, Auxis, Euthynnus, Katsuwonus and Thunnus agree one with another. Since Scomber is assumed to be the most primitive genus of Scombridae (excluding Gasterochisma), these characteristics are considered to be primitive ones retained in all scombrids but Scomberomorus, in which they are modified to suit its own line of specialization towards an

incomplete return to characters found in the Carangidae. Acanthocybium shares with Scomberomorus many features, seldom or rarely possessed by the other genera. Certain primitive percoid characteristics of Scomber are also retained in Scomberomorus and Acanthocybium. This evidence strongly suggests the closer affinities between Scomberomorus and Acanthocybium than the affinities of either with other scombrid genera, their common origin from or closer to the Scombrini, and the necessity to retain *Scomberomorini* as a tribe of the Scombridae. Sarda is remotely related to *Scomberomorini*. Acanthocybium is only superficially similar to the Xiphoidei. *Scomberomorus chinensis* appears intermediate between Acanthocybium and the other species of Scomberomorus as well as a primitive species of the genus from which two groups of seerfishes diverged, the cavalla group consisting of *S. commerson* and *S. cavalla*, and the guttatus group consisting of *S. guttatus, S. koreanus, S. lineolatus, S. maculatus* and *S. regalis*. Within the latter group, *S. guttatus* and *S. koreanus* are more closely related to each other. *S. lineolatus* possesses many characteristics intermediate between the two groups. The cavalla group is very closely related to Acanthocybium and the major difference lies in the vertebral count. Specialized characters of each species are pointed out.

561. **Devaraj, M.** 1976. *Capsala laevis* (Verill, 1874) on *Makaira tenuirostratus* with a discussion on host identity. *J. Mar. Biol. Assoc. India,* 18(2): 310-317.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The monogenetic trematod *Capsala laevis* (Verrill) is recorded from the marlin *Makaira tenuirostratus* (Deraniyagala). A detailed description of *C. laevis* along with notes on the identification of the host are dealt with here.

562. **Devaraj, M and P. Sam Bennet** 1976. Occurrence of *Xenobalanus globicipitis* (Steenstrup) on the finless black porpoise, *Neomeris phocoenoides* in Indian seas. *Indian J. Fish.,* 21(2): 579-581.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The previous record of *X. globicipitis* in the Indian Ocean is from the South African coast (Natal and Saldhana Bay). A specimen of *X. globicipitis*, 22.5 mm in length, was found attached to the fluke of *N. phocoenoides* caught off Karwar by R. V. Varuna, and this finding considerably extends the known range of distribution of this species.

563. **Devaraj, M., P. Nammalwar, and T. Thiagarajan** 1976. Record of the Sunfish *Masturus oxyuropterus* (Bleeker) from the Indian Coast. *J. Mar. Biol. Assoc. India,* 18(3): 664-666.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The sunfish *M. oxyuropterus* (Bleeker) is reported for the first time from the Indian Coast. The morphological features of the present specimen from the Gulf of Mannar and the distribution of this species are dealt with. The liver of the fish was found infested with seventy-two blastocysts of the cestode, *Molicola horridus* (Goodsir).

564. **Devaraj, M**. 1978. Morphological variations in *Caligus euthynnus* Kurian, 1961 with a discussion on its relationship with *C. coryphaenae* Stp. and Lutk. *J. Mar. Biol. Assoc. India*, 20 (1&2): 158-162.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *C. euthynnus* is redescribed based on four female specimens collected from the Gulf of Mannar. Variations in certain characters observed in the specimens have been recorded and the relationship of *C. euthynnus* with *C. coryphaenae* discussed.

565. **Devaraj, M.** 1981. Age and growth of three species of seerfishes *Scomberomorus commerson* , *S. guttatus* and *S. lineolatus*. *Indian J. Fish.,* 28(1&2): 104-127.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Length-frequency analysis indicates that the king seer (*S. commerson*) attains a size of 402 mm, 726 mm, 995 mm and 1,186 mm total length at 1, 2, 3, and 4 years of age, respectively, the streaked seer (*S. lineolatus*) reaches a size of 350 mm, 713 mm, 835 mm and 965 mm total length at 1, 2, 3 and 4 years, respectively, and the spotted seer (*S. guttatus* a size of 369 mm, 532 mm and 640 mm at 1, 2, and 3 years, respectively. Back-calculated lengths of fish at the time of ring formation on otoliths agree closely with the results of length-frequency analysis. All the three species develop two rings a year in their otoliths at a regular interval of six months. For all the three species, the exponent in the length-weight relationship is found to be close to 3.

566. **Devaraj, M.** 1983. Maturity, spawning and fecundity of the king seer, *Scomberomorus commerson* (Lacepede), in the seas around the India Peninsula. *Indian J. Fish.*, 30(2): 203-230.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Based on the modes of ova, 12 progressive stages are identified in the maturation of ovaries of king seer (*Scomberomorus commerson*). A line, 3 standard errors above the regression of Gonad Index on total length of fish in resting or immature stages, L (G.I. = -0.195 + 0.002046 L), is found useful in the separation of spawning fish from nonspawning fish. Estimation of maturity on the basis of the regression of maximum ova diameter (m.o.d.) on G.I. holds only up to a G.I. of 7.2, beyond which m.o.d. is in the range of 34 to 47 m.d. (1 m.d. = 0.0167 mm) irrespective of G.I. The three batches of ova in the spawn-ripe ovaries (stage L are spawned successively at an interval of a month or even less. The number of ova in the first, second and third batches are in the ratio of 1:1:0.27. Spawning grounds are located along strictly inshore and protected coves, as those close to Panaikulam on the Palk Bay and Pudumadam on the Gulf of Mannar. Males, females and indeterminates are in the ratio 52.3: 43.2: 4.5. Males are dominant up to a length of 1300 mm, and females, beyond this length. For most of the maturity stages, egg size-fish length relation exhibits negative correlation.

567. **Devaraj, M.** 1986. Maturity, spawning and fecundity of the streaked seer, *Scomberomorus lineolatus* (Cuvier and Valenciennes), in the Gulf of Mannar and Palk Bay. *Indian J. Fish.*, 33(3): 293-319.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The ovary of streaked seer passes through 12 finer maturity stages. Gonad index values separating the spawning from the nonspawning females range from 3 at the 441-480 mm length group to 5 at the 961-1000 mm group. The fish attain first maturity when about 700 mm total length when they are about 2 years old. Each year class is composed of one weak brood produced in the period January to early March, a dominant brood during mid-March to end of May and another weak brood in late June to late July. Spawning takes place in inshore waters up to a distance where the depth is about 25 m. There is no lunar periodicity in spawning. Males and females occur in the ratio of 40.5:59.5. The increase in fecundity per 10 mm body length is 65,998, whereas the fecundity per ton of spawning females is 570 million.

568. **Devaraj, M.** 1987. Maturity, spawning and fecundity of the spotted seer, *Scomberomorus guttatus*, in the Gulf of Mannar and Palk Bay. *Indian J. Fish.*, 34(1): 48-77.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The ovary of spotted seer passes through 10 finer maturity stages. First maturity is attained when the fish is about 400 mm in total length, i.e., when the age is about 20 months. Spawning extends from January to August, releasing a weak brood in January-February, a strong brood in March-July (peak in April-May) and another weak brood in August. Spawning takes place in areas between 20 m and 60 m depth in the northern Gulf of Mannar. The spent adults migrate to the central Gulf of Mannar coast by November-December. Spawning takes place around the full-moon period. Females far outnumber (60.2%) males (39.5%). Although the males are predominant in size groups between 361 mm and 481 mm, they are scarce or absent in size groups larger than 481 mm suggesting early senility and death.

569. **Devaraj, M and V. Ravichandran** 1988. Dynamics of Indian chank fisheries. *CMFRI Bulletin*, 42(1): 100-105.

Address : Central Institute of Fisheries Education, Versova, Bombay-400061.

Abstract : The demand for chanks from the bangle industry in West Bengal had persisted at about 2.5 million chanks per year from the early part of this century to the present. The present supplies which meet only about 40% of the demand come mainly from the Gulf of Mannar. The average annual stock in the Gulf of Mannar is 2.0 million adult chanks of which 44.83% are exploited. The initial stock size however varies from year to year and hence there exists different levels of optimum yields for different initial stock sizes than fisheries in Palk Bay and the Coramandal coasts yield annually an average of 49,000 chanks and 24,500 chanks respectively while in Kerala the average annual yield is 20,100 chanks. The average annual stock of chanks in the intertidal Gulf of Kutch is 25,000 of which only 30.6% is exploited but additional catch is possible only for the 60.8 mm diameter size chanks as the 81 mm diameter size groups are already well exploited. There is prospect for increasing the present supplies by introducing SCUBA diving in 20-30 m deep grounds in the Gulf of Mannar and by exploiting the Gulf of Kutch beyond the intertidal zone.

570. **Devaraj, M and Y. Sreekrishna** 1988. CIFE contribution to marine fisheries R & D (research and development).

CMFRI Spec. Publ., 40: 81-82.

Address : Central Institute of Fishery Education (ICAR), Versova, Bombay - 400 061, India.

Abstract : The Central Institute of Fisheries Education (CIFE) contributions to marine fisheries R & D are mainly in the areas of fish stock assessment, brackishwater farming, fishing and product diversification, fishery socioeconomics and technology transfer. In respect of brackishwater fisheries, R & D activities are concerned with prawn hatcheries, seed banks, low input culture, live feed culture, and fishery estates. Simple techniques for making laminated bombayduck, fish wafers and minced meat have been developed for the purpose of product diversification. High-opening bottom trawling has been experimentally proven to be more productive than the traditional bottom trawling, and is being popularised. Studies on profitability of mechanised fishing indicate some prospects for additional investment. Small private-owned brackishwater farms are more profitable than large government owned farms, indicating thereby the need to privatise the farm sector. The fisheries cooperative society at Versova is recommended to be a model for other fisheries societies in the country.

571. **Devaraj, M., V. Sundararaj and M.J. Prince Jeyaseelan** 1994. A report on rare and vulnerable ichthyofaunal elements from a South Indian estuarine mangrove ecosystem. *Proceedings of the National Seminar on Endangered fishes of India held at National Bureau of Fish Genetic Resources, Allahabad on 25-26 April, 1992.* (*eds.*) P.V. Dehadrai, P. Das and S.R. Verma. Muzaffarnagar, India Nature Conservators. pp. 261-269.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Intensive survey of ichthyofauna for over 4 years from a South Indian mangrove ecosystem revealed the occurrence of 197 typical brackishwater elements and a few freshwater species. Of these, 33 species were categorised as rare elements. They belong to the families Dasyatidae (1 sp.), Clupeidae (1 sp), Dorosomidae (1 sp), Ariidae (1 sp), Syngnathidae (1 sp), Scorpaenidae (3 spp), Serranidae (3 spp), Echeneidae (1 sp), Lutjanidae (3 spp), Lobotidae (1 sp), Pomadasyidae (1 sp), Sparidae (1 sp), Blennidae (1 sp), Callionymidae (1 sp), Gobiidae (4 spp), Periophthalmidae (1 sp), Taenioididae (1 sp), Trypauchenidae (1 sp), Acanthuridae (1 sp), Soleidae (2 spp) and Cynoglossidae (1 sp). Interestingly most of the rare species encountered were marine juveniles. Besides, one species belonging to the family Periophthalmidae (*Periophthalmus koelreuteri* (Pallas)) recorded just a decade ago is not available now in the South Indian mangroves. The reasons for the rare occurrence of certain selected species of ichthyofauna in the mangrove waterways are complex and diverse. A single factor or collective factors could be responsible for the rarity of individual species. Some of the factors discussed in the paper include the following: 1. Species richness in tropical regions makes certain species rare based on their poor genetic capability in the 'arena' of survival of the fittest. 2. Biotic control through predator-prey relationship and restricted feeding behaviour lead to rarity of certain species. 3. Zoogeography related factors such as restricted distribution, wider-distribution with preferential mass migration to certain selected localities and sporadic distribution to less conducive biotopes can also cause rarity of species in certain locations/open ecosystems. 4. Environmental variables in the dynamic brackishwater mangrove ecosystem and the capacity of individual species and size groups to tolerate/adjust to such fluctuating parameters lead to rarity of species. 5. Man made barriers and their adverse impact on the inherent behaviour and biological cycles of the species lead to rare occurrence of certain species. 6. Avoidance of certain small sized species to traditional gears and escaping mechanisms of certain other species by burrowing and hiding in the oyster reefs, prop roots of mangrove vegetation, algal mats etc. push certain species to 'rare' category besides biased sampling. 7. Unfavourable situations in breeding grounds of various species (including hydrobiological, climatological, biota related and anthropic factors) and the subsequent poor survival of the recruiting stock make the fish species rare in the natural systems. 8. Facultative utilization of mangrove waterways by certain marine juvenile fish species can cause rarity of species in the system. 9. Barriers and shelters (e.g., coral reefs) could make a nongregarious and nonparental care species sporadic in the mangrove ecosystem. 10. The demographic pressure, pollution by domestic wastes, indiscriminate over fishing, destructive fishing of undersized and felling of mangrove vegetation could affect the ecological stability and equilibrium of the fragile ecosystem and ultimately result in recruitment failure and rarity of species.

572. **Devaraj, M.** 1996. Coastal biodiversity - Conservation and sustainable management, pp.177-192. ***In***: *Marine biodiversity : Conservation and management.* (*eds*) N.G. Menon and C.S.G. Pillai, CMFRI. 205 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A management regime based on social acceptance, with the power of moral persuasion from within the group of participants, is the only way to manage widely dispersed resources which are shared by a multitude of small scale fishermen and various other users.

573. **Devaraj, M.** 1996. Seafarming and conservation of molluscan resources of India. *Phuket Mar. Biol. Cent. Spl. Publ.,* 16: 71-77.

574. **Devaraj, M.** 1997. A brief on the contribution of the Central Marine Fisheries Research Institute on research and knowledge of coral reefs of India. *Regional workshop on the conservation and sustainable management of coral reefs, Chennai,* 15-17. pp. C21-C25.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The coral reefs found in different parts of the coasts of the Indian mainland and Lakshadweep and Andaman Islands have always been a subject of Scientific interest and fascination. They include the sensitive fringing reef ecosystems in the Gulf of Mannar, Palk bay, Gulf of Kutch and the atolls of the Lakshadweep Islands and the continental Island reefs of Andaman and Nicobar, all covering an estimated area of about 1,217 sq. Km.

575. **Devaraj, M.** 1998. Food and feeding habits of the streaked seer, *Scomberomorus lineolatus* (Cuvier and Valenciennes), in the Gulf of Mannar and Palk Bay. *J. Mar. Biol. Assoc. India,* 40(1&2): 91-104.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Adult streaked seer feeds almost exclusively on smaller pelagics of which sardines are the most important, while the juveniles of < 200 mm length feed predominantly on the whitebaits and sometimes on the Sciaenids and Saurida. The total food spectrum is limited to only about five food items. This species is intermediate between the King Seer and the Spotted Seer in its predatory habits, but like the latter, does not chase baits fast enough to be caught in trolls. The stock of streaked seer however is much less than that of either of the other two species in the study areas. Feeding is active around 7 p.m. and between about 5 and 9 a.m. Competition between fish < 800 mm length and fish> 800 mm length was obvious in 1968-69 when there was a shortfall in forage abundance. Food intake and utilisation do not show definite evidence of the prevalence of spawning stress. The K-line shows that food intake maintains the streaked seer within the normal biokinetic range as the spotted seer and the king seer, but the T-line suggests low levels of metabolic expenditure per unit time and also conditions of stress.

576. **Devaraj, M.** 1998. Conservation and sustainable management of the marine living resources of Gulf of Mannar Marine Biosphere Reserve. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve,* MSSRF Publ. pp.23-31.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The last five decades of research and development in the fisheries harvest, post harvest and aquaculture sectors in India have transformed this industry from subsistence to a market oriented operation. Both capture and culture fisheries provide significant quantities of food, employment, recreation, trade and economic support to the community and to the nation. Indian marine fish production increased steadily through a change from natural to synthetic fibres in fishing gears, introduction of mechanised trawlers, purse-seiners and motorized fishing craft. The annual yield reached around 2.4 million tonnes by the eighties, but remained almost static through the nineties. About 90% of the yield is realised from the grounds in less than 50m depth. As a result, the shallow coastal belt is considerably stressed and there are clear symptoms of overexploitation of a few stocks of finfishes and shrimps. The sustainability of inshore fisheries seems threatened by increasing fishing pressure and the impacts of pollution from both municipal and industrial sources.

577. **Devaraj, M.** 2000. The need for a systems approach to the development of the coastal agroecosystems in the Gulf of Mannar area. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp.* pp.18-21.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The Gulf of Mannar is bordered by Ramanathapuram, Thoothukudi, Thirunelveli and Kanyakumari districts. Most of this coast is dry, and experiences only limited rainfall during the northeast monsoon. The mainstay of the population is comprised by marine fisherfolks, marginal farmers and landless labourers. Marine fish production has already reached its peak, and there is little scope for the expansion of capture fisheries. No large - scale agricultural farming is possible because of the limited irrigation potential. Agricultural operations essentially comprise seasonal millet and paddy cultivation and sheep rearing.

578. **Devaraj, M.** 2001. Integrated coastal mariculture, seafarming and stock proposal of a project concept for adoption in the Gulf of Mannar and the contiguous sea areas. ***In*** : *Perspectives in mariculture*. (*eds.*) N.G. Menon and P.P. Pillai, Cochin, India. The Marine Biological Association of India. pp. 273-292.

Address : Emeritus Scientist, Madras Research Centre, Central Marine Fisheries Research Institute, Chennai - 600 006, Tamilnadu, India.

Abstract : An integrated system of marine polyculture of shrimp with *Gracilaria*, pearl oyster and sea cucumber is proposed here through this project concept for adaption to help review the shrimp forms suffering from the problems of white spot disease and intense slush formation in the pond bottom on account of intensive monoculture practices. The project proposes introduction of floating, mobile, motorized sea farm platforms made of four artisanal boats each, which will function as a seafarming-cum-fish aggregating-cum-fishing device. Also included in the project is the construction of artificial reef complexes made of triangular concrete modules in order to create habitats for the colonisation of commercial fish stocks. The seafarming-cum-sea fishing platforms can function dependent on or independently of the artificial reef complexes. Conversion of the existing surplus boats in the Indian fishing fleets into such platforms seems to be the only means of rehabilitating the idling, unproductive boats and the fishermen. A multipurpose marine hatchery complex is included in the project to produce seeds of all the target candidate species for sea ranching in the artificial reef sites, for meeting the seed requirements of the project's onshore polyculture farm and of the seafarm, and supply for onfarm trials in the adopted farms.

579. **Devaraj, M.K., C. Rethinadhas and C.A. Ninan** 2002. The status of fishing vessels operatives training in India. *Fish. Chimes.,* 22(1): 130-134.

Address : Central Institute of Fisheries Nautical and Engineering Training, Fine Arts Avenue, Kochi-682 016 India.

Abstract : Organised fisheries training in India started in 1945 with two programmes, one on marine fisheries at Mandapam Camp, Tamil Nadu, India and the other on inland fisheries at Barrackpore, West Bengal, India. Later Fishermen's Training Centres were established in all maritime states. Central Institute of Fisheries Operatives was established in Kochi, Kerala, India in 1963 and later upgradated as 'Central Institute of Fisheries Nautical Engineering Training (CIFNET). CIFNET has been making valuable contributions in the training of manpower for larger fishing vessels. The State of affairs of training programmes at CIFNET is not very encouraging at present, as the decrease in number of vessels as a whole reduced the training berths for the CIFNET traninees for acquiring sea service. Fishermen Training Centres also face the problem of lack of training officers. In this situation it is suggested to have some initiative for co-ordination of training activities in the country under the banner of CIFNET.

580. **Dhanapal, K., K. Rathnakumar, G. Indra Jasmine and P. Jeyachandran** 1994. Processing chank meat (*Xancus pyrum*) into pickles. *Fish. Technol.,* 31(2): 188-190.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Methods have been worked out for the production of pickles from chank (*Xancus pyrum*) meat. The pickle was subjected to biochemical, bacteriological and organoleptic tests at different intervals of storage. The chank meat pickles packed in glass bottles and sealed air tight, remained in good condition for six months at ambient temperature.

581. **Dhandapani, P.** 1985. The effect of human activities in the Gulf of Mannar Biosphere Reserve and the needed remedial measures: A case study. *Proc. National symp. on Island ecosystem and sustainable Development, Port Blair,* pp.169-175.

582. **Dhanya, S., S. Rajagopal, S. Ajmal Khan and T. Balasubramanian** 2005. Embryonic development in alligator pipefish, *Syngnathoides biaculeatus* (bloch, 1785). *Curr. Sci.,* 88(1): 178-181.

Abstract : The alligator pipefish, *Syngnathoides biaculeatus* (Bloch, 1785) is a common inhabitant of seagrass beds along Palk Bay, southeast coast of India. This primitive pipefish broods the embryos along the undersurface of its trunk. Eleven embryonic stages were sequenced based on morphological differences. The newborn resembles adults in form except for a slightly cylindrical body, shorter snout and brown colour. The gestation period was 25 ± 5 days at a temperature range of 28-32 ^{o}C.

583. **Dharani, G., M. Ravindran, N. Saravanane and R. Venkatesan** 2004. Hydrography and plankton distribution in Gulf of Mannar, off Tuticorin. *Proceedings of the National Seminar on New Frontiers in Marine Bioscience*

Research, January 22-23, 2004. pp. 421-429.

Address : National Institute of Ocean Technology, Velachery-Tambaram Main Road, Pallikaranai, Chennai 601 302 India.

Abstract : Characteristic features of water mass off Tuticorin area, Tamil Nadu, India in the Gulf of Mannar region has been studied onboard FORV Sagar Sampada during march 2002. A hydrographic section/transect at Latitude 8^{o} 22' with 5 stations placed at an interval of 0.05 minutes from Longitude 78^{o} 15' to 78^{o} 36', has been surveyed for physico-chemical and plankton distribution. Profiles of CTD at stations in continental shelf region reveals that the entire water column was completely homogeneous, while station located in continental slope region and further off regions, showed characteristic features such as: (1) A thick mixed layer depth (MLD) up to 100 m; (2) existence of a sub surface high saline water from 100 to 125 m depth; and (3) presence of oxygen minimal layer at about 160 m depth. Plant nutrients such as nitrate, phosphate and silicate were relatively high at deep ocean water. Phosphate and nitrate varied sharply at the surface and were stable below the thermocline layer. However, silicate showed a gradual increase with depth. Phytoplankton distribution in continental shelf region was observed to be relatively high (2.67 x 10^5 cells/l) as compared to off shore station (7.9 x 10^3 cells/l). With respect to species composition, in continental shelf region, species such as *Chaetoceros borealis, Pleurosigma normani, Bacteruiastrum delicatulum* were dominant, while in off shore station the dominant species was *Lauderia annulata*.

584. **Dharmaraj, K and N. Balakrishnan Nair** 1983. Wood-boring organisms in relation to aquaculture along the coasts of India. *Proc. Symp. Coastal Aquaculture*, 2: 684-699.

Address : Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum, India.

Abstract : Timber is extensively used for the construction of a variety of aquaculture facilities and equipments all along our coasts and this activity is increasing rapidly. One of the serious impediments in the use of timber for sea and/or brackishwater structures is that it is subjected to severe damage, among others, by marine wood-boring organisms. 28 species of shipworms (Teredinidae), 4 species of piddocks (Pholadidae), 5 species and 1 variety of pill-bugs (Sphaeromatidae) and not less than 9 species of gribbles (Limnoriidae) constitute the marine wood-boring community in Indian waters. Their incidence, relative abundance, nature and degree of timber destruction and ecology in some aquafarms situated along the coasts of South India are examined and it was found that they are responsible for huge financial loss all along our seafront. The nature of attack on different types of wooden equipments used for mariculture like, floating rafts, submerged racks, stakes, piles, etc. showed variation so also the intensity of destruction at various localities. The occurrence and relative abundance of these pests along the coasts of India, their incidence and activity in different aquatic environments such as the open sea, coastal zones and bays, estuaries, backwaters and mangrove swamps, etc. are presented. Some suggestions for the control of them and the best period for installation of equipments in aqaufarms are also indicated.

585. **Dharmaraj, S.** 1983. Oxygen consumption in pearl oyster *Pinctada fucata* (Gould) and *Pinctada sugillata* (Reeve). *Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: Molluscan culture.* Marine Biological Assoc. of India, Cochin, India. 6: 627-632.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : The rate of oxygen consumption of pearl oysters *Pinctada fucata* and *P. sugillata* from different localities namely pearl culture farm, banks and near-shore waters of Tuticorin in the Gulf of Mannar has been studied. In *P. fucata,* oxygen consumption of *P. sugillata* from the pearl banks as well as from the near-shore waters showed a linear relation with size of oyster. The rate of oxygen consumption of *P. sugillata* from pearl banks (depth 12-21 m) was less when compared to that in the oysters of the near-shore waters (depth 0.5-1.5 m).

586. **Dharmaraj, S and A. Chellam.** 1983. Settlement and growth of barnacle and associated fouling organisms in pearl culture farm in the Gulf of Mannar. *Symp. on Coastal Aquaculture*, Cochin (India), 12-14, Jan'1980. Marine Biological Assoc. of India, Cochin, India. No. 6: 608-613.

Address: Central Marine Fisheries Research Institute, Tuticorin 682 001, Tamil Nadu, India.

Abstract: The settlement of fouling organisms on the pearl oysters, pearl oyster shells and wooden test panels was compared. The barnacle *Balanus amphitrite variegatus* was the major fouling organism observed and the polychaete *Polydora ciliata* and the sponge (*Cliona vastifica*) were the main boring organisms. The intensity of settlement at different depths and the periods of abundance of these organisms were studied. The successive settlement and fast growth of barnacles resulted in heavy loading on the oysters within a short period. The fouling load and the rate of growth of barnacles were higher on the shells than on live oysters. The settlement was more

at the top rows of the sandwich-type frame net.

587. **Dharmaraj, S., D. Kandasami and K. Alagarswami** 1987. Some aspects of physiology of pearl oyster. *CMFRI Bulletin,* 39: 21-28.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Details are given of experiments conducted investigating the physiological changes of pearl oyster (*Pinctada* species). Biochemical changes during reproduction, energy storage and utilization, oxygen consumption, salinity tolerance, rate of filtration and byssus formation are described.

588. **Dharmaraj, S., A. Chellam and T.S. Velayudhan** 1987. Biofouling, boring and predation of pearl oyster. *CMFRI Bulletin,* 39: 92-97.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : An examination is made of problems caused by fouling, boring and predation in pearl oyster farms. Organisms involved and control measures to be taken are discussed in detail.

589. **Dharmaraj, S and D. Kandasamy** 1988. Micro encapsulated diet as supplemental food for larvae and spat of the pearl oyster *Pinctada fucata*. *CMFRI Bulletin,* 42(2): 358-364.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The flagellate *Isochrysis galbana* was found to be the best natural food for the pearl oyster larvae. To supplement this artificial microencapsulated diet was prepared using edible oyster oil, fish oil and Soybean lecithin with a view of enhancing the growth of pearl oyster larvae and spat. Different concentrations of edible oyster oil diet fish oil diet and lecithin diet were tried by keeping a control wherein *I. galbana* was alone given as feed. The control with *I. galbana* gave good results. Among the artificial diets tested, the edible oyster oil diet showed better results on the growth of larvae and spat while the fish oil diet promoted weight gain in the spat. The suitability of microencapsulated diet for the larvae and spat is discussed in this paper.

590. **Dharmaraj, S and M.K. Sreenivasagam** 2002. Exploitation of windowpane oyster, *Placuna placenta* (Linn.) at Vellapatti area near Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.,* 174: 9.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Exploitation of molluscs, producing marine pearl was done for the collection of natural / cultured pearls only, whereas, the exploitation of windowpane oyster was mostly for their shells. The pearls obtained from windowpane oyster, *Placuna placenta* were mostly ivory or white in colour and small in size. The translucent shells are commercially and economically important in shell craft industry. Hence they are exploited in large quantities from the east and west coasts of India.

591. **Dharmaraj, S and C.P. Suja** 2003. Effect of depuration in cell proliferation from mantle tissue of the Indian pearl oyster *Pinctada fucata* (Gould).*1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp.28-29.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The effect of depuration on cell proliferation from the mantle tissue of the pearl oyster, *Pinctada fucata* was studied. The live pearl oysters, after thorough cleaning, were depurated in U.V. treated running seawater for 3-7 days. The mantle strip collected from the depurated oysters was processed and washed in 10 ml of antibiotic solution containing 1000 µg/ml streptomycin and 2000 IU/ml penicillin and in sterile seawater. Prior to washing, the strip was dipped in 35% alcohol for 15 seconds. The mantle piece was inoculated in TD flasks. Similarly mantle piece was prepared as above from the non- depurated oysters and inoculated. The cultures were incubated in CO_2 incubator at 28°C and pH at 7.3-7.6. Five replicates were organized in each treatment.

592. **Dharmaraj, S and C.P. Suja.** 2003. Role of antibiotics in cell proliferation from mantle tissue of the pearl oyster *Pinctada fucata* (Gould). *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 30-31.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : *In-vitro* explant cultures of mantle tissue of the pearl oyster, *Pinctada fucata* were organized. Standardisation of techniques was undertaken in *in-vitro* explant cultures. The role played by antibiotics in cell proliferation and in the control of contamination was studied. Live pearl oysters brought fresh from pearl culture farm were cleaned externally and wiped with 70% alcohol. The mantle strip collected from the oysters were processed by removing extra tissues and washed in sterile seawater (SSW) containing antibiotics. Prior to washing

in antibiotics, the mantle strip was immersed in 35% alcohol for 15 seconds. Different concentrations namely 250µg/ml streptomycin and 1000 IU/ml penicillin,1000µg/ml streptomycin and 4000 IU/ml penicillin and 4000µg/ml streptomycin and 8000 IU/ml penicillin were used to evaluate optimum dose for cell proliferation. The strips treated in the respective antibiotics were inoculated separately in TD flasks. The effective concentration of antibiotics was determined based on the number of cells liberated and occurrence of contamination. The percentage proliferation of cells was 25.5, 50.4 and 24.1 % in the respective concentrations in experiment I and 23.8, 45.8 and 30.5% in experiment II. The results indicated that the concentration 1000µg/ml streptomycin and 2000 IV/ml penicillin was the optimum dose for better cell proliferation (Fig. 1). However the frequency of contamination was more in this concentration and less in 4000µg/ml streptomycin and 8000 IU/ml penicillin.

593. **Dharmaraj, S and N. Sukumaran** 2003. Role of post-operative culture period on cultured pearl production in the Indian pearl oyster *Pinctada fucata* (Gould). *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. p. 57.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The study on the effect of post-operative culture period on pearl growth was carried out using 41-50, 51-60 and 61-70 mm size group of oysters. A uniform size of 4.24 mm nucleus was used in all the groups. The post-operative culture periods selected were 230,330,430 and 530 days. The survival of oysters decreased towards longer exposure from 66.7% to 38.1 % in 41-50 mm group of oysters, from 61.8 to 43.5% in 51-60 mm group of oysters. In the size group of 61-70 mm, the exposure period of 230 and 330 days was alone tested, since the aged oysters may not survive longer exposure. The survival rate between these two periods was 68.1 and 56.7%. The percentage pearl production in 41-50 mm group varied from 16.7 to 50.0%, the highest being in 330 days of post-operative culture and the least in 230 days of exposure. The percentage pearl production in 51-60 mm group was the highest 46.7% in 330 days of exposure and the least 40.7% in 530 days exposure. In the size group of 61-70 mm the highest 44.8% was in 330 days of exposure and the least was 19.1 % in 230 days of exposure. Statistical analysis revealed that there was no significant difference in pearl growth among the different post-operative culture periods in the size groups of 41-50 mm and 61-70 mm. In the size group of 51-60 mm significant difference was obtained in the growth of pearls harvested between 230 and 330 days ($P<0.026$); between 230 and 530 days of post-operative culture ($P<0.002$). In the size group of 61-70 mm the difference in pearl growth was significant ($P<0.015$) between 230 and 340 days of postoperative culture. Production of total number of pearls and gem quality pearls were more in oysters harvested between 330 and 430 days of exposure. An average of 380 days of exposure is more appropriate for better pearl production.

594. **Dharmaraj, S and N. Sukumaran** 2003. Effect of oyster size on cultured pearl production in the Indian pearl oyster *Pinctada fucata* (Gould). *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. p. 58.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The effect of oyster size on cultured pearl production was studied using the size groups of 41-50, 51-60 and 61-70 mm in dorso-ventral measurement (DVM). Each group was implanted with 3.02, 4.24 and 5.14 mm diameter nuclei. The oysters implanted with 3.02 mm dia. nucleus indicated the survival rate of 16.2, 39.1 and 61.4% in the respective groups; the oysters implanted with 4.24 mm dia. nucleus gave a survival of 49.4, 45.9, 56.7% and the oysters implanted with 5.14 mm dia. gave a survival rate of 51.1, 42.6 and 25.0% after 352 days of post -operative culture. The percentage pearl production was 26.3, 52.9 and 8.6 in the respective size groups implanted with 3.02 mm dia.; 36.0, 46.7 and 44.8% in three size groups implanted with 4.24 mm nucleus and 33.3, 43.8 and 55.0% in 41-50, 51-60 and 61-70 mm groups implanted with 5.14 mm dia. nucleus. The nacre thickness was high in three size groups implanted with 4.24 mm nucleus, which ranged from 1.63 to 2.21 mm and less in the groups implanted with 5.14 mm nucleus, where the nacre growth ranged from 0.67 to 0.74 mm and in the groups implanted with 3.02 mm dia. nucleus varied from 0.67 to 1.21 mm. With regard to gem quality pearls of A and B grades, it was 37.5% more in the size groups implanted with 3.02 mm dia. nucleus; 33.6% in the oyster implanted with 4.24 mm nucleus and 26.1 % in the oysters implanted with 5.14 mm group. It is known from the study that the size group of 51-60 mm was found to be the best in yielding more number of pearls, when implanted with 3.02 and 4.24 mm diameter nuclei. The same group of 51-60 mm, when implanted with largest dimension of nucleus of 5.14 mm yielded poor pearl production.

595. **Dharmaraj, S., K. Shanmugasundarm and C.P. Suja** 2005. Observations on the exploitation of clams in Tuticorin. *Mar. Mrish. Infor. Serv. T&E Ser.,* 184: 10.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Exploitation of marine molluscs is a seasonal activity in Tuticorin. Exploitation of windowpane oyster *Placuna placenta* was reported earlier in 2001 at Tuticorin Bay mainly for the collection of pearls and the empty shells for shell craft industry. This was followed by large scale collection of the windowpane oyster *P. placenta* in 2002 at Vellapatti near Tuticorin for utilization of their shells in cosmetic and paint industry, in poultry feed and lime preparations. In February 2004 large scale exploitation of clams had taken place in Tuticorin for shell craft industry.

596. **Dharmaraj, S and T.S. Velayudhan** 2005. Gastropod predation on the sacred chank, *Xancus pyrum* in the Gulf of Mannar. *Mar. Fish. Infor. Serv., T&E Ser*., 186: 14-15.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Gulf of Mannar, on the south-east coast of India, is rich in molluscan resources, chiefly the sacred chanks and pearl oysters. These populations in their natural habitat are subject to predation by gastropods, echinoderms and fishes. Serious damage was caused especially to bivalves in the natural habitat by the predatory gastropods like *Cymatium cingulatum* and *Murex virgineus*. Predation by *M. virgineus* on scared chank is interesting and worth noting. The predatory habit of *M. virgineus* on the bivalve (pearl oyster) has already been reported where the predator attaches on the right valve of the pearl oyster by extending its foot. When the foot of the predator is extended properly over target area and retracted in, the edge of the left valve of the prey is crushed against the spine of the shell of the predator thus causing a gap between the valves of the prey. Through the gap between the valves the proboscis of the predator is inserted and the soft tissues like hepatopancreas and gonad are sucked. The hard tissues of adductor muscle, foot and mantle are left uneaten.

597. **Dharma Raja, S.K and G. Balakrishnan** 1974. On the index of abundance of flyingfish populations in the inshore waters of Tamil Nadu and Pondicherry. *Indian J. Fish.*, 21(2): 566-568.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In the narrow coastal belt extending from Muthukadukuppam to point Calimere in Tamilnadu-Pondicherry region, the flying fish form an important seasonal fishery. The total landings fluctuate from year to year. The weighted index of abundance of flying fish fishery was calculated for the years 1966 to 1970 and compared with the trends in the yields of the fishery during those years. The weighted index of abundance was the highest during 1967 and lowest during 1970, whereas, the landings were higher in 1968 and lower in 1970.

598. **Dharmaraja, S.K., K. Vijayalakshmi, S. Haja Najmudeen, C.J. Prasad, M.B. Seynudeen, K. Anandan, M. Karthikeyan and G. Balakrishnan** 1987. An appraisal of the marine fisheries of Tamil Nadu and Pondicherry. *CMFRI Spl. Publ.,* 34: 9-53.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : Tamil Nadu and Pondicherry contiguous to it, since share a commonness both in fishing tradition and in fishery resources, are treated together in this report, though Tamil Nadu by itself is easily comparable with any other maritime state in the vastness of inshore resource as well as in the involvement of fishing activities. The states are endowed with rich resource potential capable of being developed. The combined coastline is about a thousand kilometers studded with many fish landing centers of intense activities. Tamil Nadu, descending to the tip of the peninsular India, has the unique advantage of facing three major seas, the Arabian Sea, Indian Ocean and the Bay of Bengal, and having the benefit at its disposal of both the monsoons, the South West and the North East. However, with regard to the information on fishermen population, infrastructure etc., these are also taken into consideration in this account.

599. **Dhevendran, K and P.K. Praseetha** 2004. Studies on L-asparaginase producing streptomycetes associated with seaweeds of Cape-Comarin, Tamil Nadu. *Seaweed Res. Utiln.*, 26(1&2): 245-252.

Address : Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum-695 581, India.

Abstract : Seaweeds and water samples were collected over a period of one year from Cape-comarin. Water samples were analyzed for the hydrographical parameters. However, they did not exert any specific influence on the distribution pattern of streptomycetes associated with seaweeds. The seaweeds harboured variety of pigments producing streptomycetes. Among the microbes, bacteria were predominant and the streptomycetes were meager in their associations. L-asparaginase which has pharmaceutical importance was synthesized by both seaweeds and the associated streptomycetes.

600. **Ditty Chacko, V. Deepak Samuel and Jamila Patterson** 2004. Effect of salinity and fly-ash on the embryonic

development of the big-fin squid, *Sepioteuthis lessoniana. J. Mar. Biol. Assoc. India*, 46(2): 162-168.

Address : Sugandhi Devadason Marine Research Institute, 44 Beach road, Tuticorin-628 001, Tamilnadu, India.

Abstract : Cephalopods breed in the near shore waters where the salinity fluctuations are more likely. Also, pollution from the adjoining industries is common in some of these areas. During the study, an attempt was made to find out the effect of salinity on the hatching of eggs of the bigfin squid, *Sepioteuthis lessoniana*. Embryonic development was found to be good at salinities 28ppt, 32ppt and 36ppt, while it was poor at 40ppt. No development was observed in 24ppt. Like wise, the effect of fly ash on the eggs of this species was tested at various concentrations in gram per liter of seawater. Mortality and premature hatching were observed at concentrations 25g, 109, 5g, 19, 0.5g and 0.lg. At 0.0lg concentration, the hatching was normal but the hatchings died within two days.

601. **Diwakar, K and K. Muniyandi** 2000. Truth of the Ocean. *Golden Jubilee Celebrations Souvenir 2000, Mandapam R.C of CMFRI, Mandapam Camp.* pp.84-87.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : It is not too much to say that water is life. Our planet is the only one in our entire solar system which has been blessed with water and ocean. You may recall that our earth is often called 'a watery planet' as 71% of the earth's surface is covered by the oceans with all the adventures and challenges they provide both to man and science. Today, parts of the world ocean are intensively exploited for recreation, military purposes, commercial shipping, fishing, extraction of gases, oil and other mineral resources.

602. **DOD.** 2001. Development of GIS based Information system for Gulf of Mannar. Aspects on Microbiology and Plankton. *Report submitted by Centre of Advanced Study in Marine Biology,* Annamalai University, 55 pp.

Address : Department of Ocean Development, Pallikaranai, Chennai - 601 302, Tamilnadu, India.

603. **DOD.** 2001. Development of GIS based Information System for Gulf of Mannar. Benthic fauna of Gulf of Mannar islands. *Report submitted by Zoological Survey of India, Chennai,* 214 pp.

Address : Department of Ocean Development, Pallikaranai, Chennai - 601 302, Tamilnadu, India.

604. **DOD.** 2001. *Resources Information System for Gulf of Mannar, India.* Department of Ocean Development, Government of India. 87 pp.

Address : Department of Ocean Development, Integrated Coastal and Marine Area Management Project Directorate, Chennai - 601 302, Tamilnadu, India.

Abstract : The information system can be used as a baseline to conduct monitoring of biodiversity in future. Mapping of corals, seagrass and mangroves using remote sensing and GIS has demonstrated that these tools can be excellently used for monitoring and management of the Gulf of Mannar. The overlay facility of GIS clearly indicated distribution of corals and seagrass with reference to depth. This can be used for demarcation of areas of conservation and protection. Earlier report indicated that the coral reef area of Palk Bay and Gulf of Mannar to be 94.3 sq.km. based on 1989-90 IRS 1A satellite data (SAC, 1994). In the present study, the coral reef and seagrass areas around the islands of Gulf of Mannar alone are estimated to be 100 and 85.5 sq.km respectively based on 1998 IRS 1D satellite data. The difference may be due to better satellite resolution and extensive field verification conducted using SCUBA diving and ROV. Eventhough 46 species of corals have been recorded with less percentage of live coral coverage, extensive areas of dead corals were observed. However, new coral colonies are regenerating around most of the islands. Therefore, if adequate protection measures are taken with the involvement of local community, there is a possibility of improving the coral reef distribution area.

605. **Donnon, J.** 1900. Report on the Inspection of the Pearl banks in March and April 1900. *Sess. Pap. Govt. Printers, Ceylon,* pp. 251-252.

606. **Dorairaj, K.** 1973. Hermaphroditism in the threadfin fish, *Polynemus microstoma* Bleeker *Indian J. Fish.*, 20(1): 256-259.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The occurrence of hermaphroditism in the small-mouthed threadfin fish, *Polynemus microstoma* Bleeker, collected from the Palk Bay and the Gulf of Mannar is reported for the first time. Hermaphroditism is found in both the lobes of the gonad. The two sex portions in the ovotestis, which are easily distinguishable by their colour, adhere along the entire length of the gonad in antero-posterior direction. The testicular portion is on

the inner' lateral side of the gonad. The relative size of the male and female portions of the ovotestis varies in different specimens. It is seen from the microsections that the two sex portions are separated by a thin connective tissue.

607. **Dorairaj, K., R. Soundararajan and D. Kandasami** 1980. Eel culture in India. *Mar. Fish. Infor. Serv. T & E. Ser.,* 23: 1-7.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The culture methods of two species namely the short finned Eel and long finned Eel commonly occurring in estuarine and fresh waters in India are discussed.

608. **Dorairaj, K., D. Kandasami and R. Soundararajan** 1981. On induced maturation in the Indian short-finned eel, *Anguilla bicolor bicolor* McClelland. *Indian J. Fish.,* 28(1&2): 233-239.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : After acclimatising *Anguilla bicolor bicolor* in seawater, various hormones viz., Gonadotraphin F.S.H., Gonadotraphin L.H. and Chorionic Gonadotrophin (Profasi) and carp-pituitary extracts were administered. Initially one male eel, which was given 2000 IU of Gonadotraphin L.H. through injections, reached spawning condition 144 days after the first injection. After partial spawning, the eels died on the same day. The number of stripped eggs was estimated to be 0.35 million. The mature eggs were spherical and relatively uniform in size measuring 1.00 mm (± 0.08 mm) in diameter. Attempts made for artificial fertilisation were not successful. Fully developed ovary of *A. bicolor bicolor* is described.

609. **Dorairaj, K., R. Soundararajan and D. Kandasami** 1984. Experimental culture of short-finned Eel *Anguilla bicolor* Meclelland. *Proc. Symp. Coastal Aquaculture*, 3: 883-891.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract: In this paper, the various techaiques adopted in the culture of eels (Anguilla spp.) and the results obtained in the experimental culture of the short-finned eel, *Anguilla bicolor bicolor* McClelland in running water and in recirculating running water have been dealt with. Experimental culture of the eel, *A. bicolor bicolor* in running water was conducted during 1974-76 at the Regional Centre of Central Marine Fisheries Research Institute, Mandapam Camp. The average size of the elvers stocked at the beginning of the experiment was 13 cm in length and 3 g in weight. It has been found that the average size of the eels at the end of one year was 28 cm in length and 43 g in weight. The average length at the end of second and third years were 38 cm and 44 cm and weights 143 g and 177 g respectively. The overall increase in growth obtained in this experiment was found to be not rapid and the probable reasons for the same are pointed out. Studies on conversion efficiency of different eel foods have shown that silver bellies give high conversion ratio and sardines low conversion ratio. Clams, prawns and mixed foods have also been found to give better conversion ratio than sardines. From this experimental culture the net production potential has been estimated to be 2.2. kg/sq.m in one year and 4.11 kg/sq.m in two years. In another experiment, the short-finned eel *A. bicolor bicolor* was cultured in re-circulating running water in an outdoor cement tank of 6 m length x 3 m width x 1 m height, with natural mud bottom. By suitable arrangements the water in the culture tank was automatically re-circulated after filtration and oxidation. About 1/3 of the water in the culture tank was drained out weekly and replenished with fresh water. At the beginning of the experiment 9 kg of eels, each eel, with an average weight of 43 g were stocked in the tank at a rate of 500 g per sq. m area. An eel feed in the form of a paste made of minced silver bellies, broken rice and oil cake mixed in 2 : 1 : 1 proportion with 0.4% multivitamins was given to the eels at a daily ration ranging from 5 to 10% of their body weight. At the end of five months the total weight had increased to 47.7 kg which works out to a net increase of 430 % of the initial stocking weight. The average weight of eel had increased from 43 g to 232.8 g in five months. The survival rate was 98.6%. The net production rate works out to 2.15 kg/sq m in five months period.

610. **Dorairaj, K., G. Mohanraj, V. Gandhi, A. Raju, V.S. Rengaswamy and J. Xavier Rodrigo** 1984. On a potentially rich milkfish seed collection ground near Mandapam along with the methods of collection and transportation. *Indian J. Fish.,* 31(2): 257-271.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A potential ground for milkfish (*Chanos chanos*) seed collection has been located at Manoli Island in the Gulf of Mannar, where fry and fingerlings of the species congregate in large numbers in the tidal pools under the dense shades of the mangrove bushes in April-May. The ecology of the ground, the methods and

results of fry and fingerlings collection, handling, and packing and transportation are mentioned.

611. **Dorairaj, K.** 1985. Some observations on the disease of the short finned eel *Anguilla bicolor bicolor* McClelland. *Symp. Ser. Mar. Biol. Assoc. India*, 6 : 906-909.

Address : Central Marine Fisheries Research Institute, Cochin 582 018, India.

Abstract : During experimental culture of the short-finned eel *Anguilla bicolor bicolor* in running water at Mandapam Camp, 7 kinds of diseases namely fungus disease, tail fin rot disease, gas disease, red pest and botches disease, swollen intestine disease, gill disease and cripple body disease were identified. The fungus disease was observed in elvers on their body surface as an outgrowth of whitish or greyish mass, spreading from the affected region. The tail-fin rot disease was noticed both in elvers and in growing eels. Mostly the glass eels were affected by the gas disease, when the O_2 or N level in the water was too high. The Red pest and botches disease caused by bacteria was observed in elver as well as in grown up eels, the visible symptoms of this disease being rash-like reddening of the body musculature, particularly near the abdominal and anal regions. The swollen intestine disease was found to attack both the elvers and the growing eels whereas the gill-disease and cripple body disease were observed only in grown up eels. Diagnosis and preventive measures for the 7 eel diseases are briefly discussed.

612. **Dorairaj, K.** 1995. Eel culture ***In***: *Trout, eel, freshwater prawns and cray fish. Handbook on Aquafarming, MPEDA, Kochi.* pp. 17-54.

613. **Dorairaj, K.** 1998. Economic and ecological diversity of marine fish resources. *Proc. Technical Workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*, 1998. pp.129-149.

Address : Central Marine Fisheries Research Institute, Madras Research Centre, Greams Road,Chennai 600 006.

Abstract : Marine capture fisheries are the major economic activity in Gulf of Mannar (GOM). The total area of GOM under Indian Exclusive Economic Zone is about 15000 sq.km. within 50m depth. A population of nearly 50000 people dwelling in 47 villages along the 180 km coastline boardering GOM on mainland side depend on the fishery and ancillary marine living biodiversity resource for their livelihood. It is needless to emphasise that to protect and conserve the genetic diversity of marine fishes the concept of 'Biosphere Reserve' is the best option. This genetic diversity has been acquired through thousands of years of evolutionary history. Further, for a fair and equitable sharing of the biodiversity resources by all stakeholders of GOM at the regional, national and global level on a sustainable basis, there should be a well prepared integrated coastal zone and MBR management plan.

614. **Douglas Lauwrie, R.** 1906. Report on the pearl oyster fisheries of the Gulf of Mannar, Part V. *Report on the Brachura collected by Prof. Herdman at Ceylon in* 1902: 349-432.

615. **Doumenge, F.** 1992. Mothers of pearl and pearls. Traditions and changes. *Bull. Inst. Oceanogr. Monaco. Sp.* 8: 1-52.

Address : Mus. Oceanogr., 98000 Monaco Ville, Monaco.

Abstract : For a thousand years, until the mid 20th Century, the pearl world market was controlled by Bombay traders, and supplied through a well integrated Arabian system which covered the Gulf under Bahrain leadership. Occasionally, local fisheries developed around the Gulf of Mannar, supplementing the Indian market. The present status and trend of the pearl market is an inheritance of a complex history. The domination of the Japanese production and trade suffers cyclic crises, and is confronted with rising competition from Australia and French Polynesia. The vanishing Arabian traditional pearl fishery in the Gulf, combined with a general depletion of natural pearl shells stocks, has definitively transferred the whole pearl production to a sophisticated aquaculture industry. Fierce marketing competition, added to complexity of production management, selects only a small number of individuals and companies able to survive.

616. **Durairaj, S and P. Pitchiah** 1981. Certain studies on the use of high density polythene woven socks as an improved packing for dried fish. *Seafood Export J.*, 13(9): 27-33.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The results of studies on the use of High Density Polyethylene (HDPE) woven sacks as an improved packaging of dried fish are presented. Prerequisites were found to be propionic acid treatment and drying to a moisture level below 35%. This packaging reduced excessive drying of samples during summer storage and also

prevented moisture uptake during monsoon storage. The extra cost involved in HDPE packing and propionic acid treatment is more than compensated by the extension of the shelf life and the retention of good organoleptic qualities.

617. **Durairaj, S.** 1982. Evolving quality standards for *Beche-de-mer. Seafood Export J.*, 14(3): 19-22.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The seacucumber industry (*Holothuria scabra*) in India is discussed. The following topics are considered; processing, chief defects, composition, exports and inspection, and future prospects. It is concluded that for a steady export market there is need for improving the curing practices of *beche-de-mer* to produce better products and to formulate quality standards.

618. **Durairaj, S., G. Chinnasamy and M.S. Mohamed** 1983. A bacteriological study of the natural flora of edible oyster, *Crassostrea madrasensis*. *Fish. Technol.,* 20(2): 111-114.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The total viable bacterial populations in the oyster *Crassostrea madrasensis* and the sea water from the edible oyster farm at Tuticorin were in the range of 10^3 to 10^4 per ml and 10^2 to 10^3 per ml respectively. The maximum most probable number of faecal coliform recorded during the one year period of study of both the oysters and seawater were 33 per 100 ml. Pathogenic bacteria *Salmonella* sp. *Vibrio cholerae*, coagulase positive staphylococci and faecal streptococci were absent in oysters and farm water. Study of 197 (98 taken from oyster liquid and 99 from oyster farm water) randomly isolated cultures indicated that gram negative asporogenus rod-like bacteria of the *Vibrio, Flavobacterium, Achromobacter* and *Pseudomonas* groups were the dominant flora of the oyster liquid as well as seawater.

619. **Durairaj, S., M.M. Nainar, M.K. Laine, R. Sudhakaran and S. Inbaraj** 1984. Study on the quality of *Beche-de-mer* in trade and shrinkage of specimens during processing. *Fish. Technol.,* 21(1): 19-24.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The *Beche-de-mer* industry in India is a cent percent export oriented industry being confined to south east coast in Palk Bay and Gulf of Mannar in Tamilnadu. Chemical quality of 180 trade samples of *Beche-de-mer* of four sizes collected from the *Beche-de-mer* curing centres of Ramanathapuram district was studied. Moisture ranged from 6.2 to 24.4% and sand content from 0.11 to 20.42% for all grades. Mean values of sand content are for grade I = 3.47%, grade 2 = 4.50%, grade 3 = 3.68%, grade 4 = 6.87%. Sodium chloride was almost constant for all grades at 5.7%. TVBN values ranged from 10 to 78.4 mg%. 44 laboratory samples of different grades were prepared following trade practice and examined for chemical quality. Mean moisture values are for grade 1 = 13.4%, grade 2 = 12.44%, grade 3 = 12.62% grade 4 = 12.08% and mean values of sand are for grade 1 = 0.70%, grade 2 = 0.90%, grade 3 = 1.16%, grade 4 = 2.15%. The percentage of shrinkage of the animals ranged from 56% to 60% for dried *beche-de-mer* of 7.5 cm size and above.

620. **Durairatnam, M and J.C. Medcof** 1954. Ceylon's red seaweed resources, Fisheries Research Colombo. 3, Ceylon. *Ceylon Trade J.*, 19(4): 1-6.

621. **Durairatnam, M.** 1956. Observations on some *Sargassum* seaweeds of Ceylon. *Rep. Fish. Res. Ceylon. Prog.*,2:4.

622. **Durairatnam, M.** 1961. Contribution to the study of marine algae of Ceylon. *Bull.Fish.Res.Stn.Ceylon*,10: 1-181.

623. **Durairatnam, M.** 1962. Some marine algae from Ceylon-I. *Bull. Fish. Res. Stn Ceylon*, 15: 1-16.

624. **Durairatnam, M.** 1963. Some marine algae from Ceylon-II. *Larvencia Lamouroux. Bull. Fish. Res. Stn. Ceylon.* 16(2): 19-28.

625. **Duraisamy, S and K. Gurusamy** 1981. Observations on Breeding and Frequency of Sex in the Isopod Crustacean *Ligia indica* of Tuticorin Coast. *Curr. Sci*., 50(8): 383-384.

Address : Department of Zoology, V.O. Chidambaram College, Tuticorin - 628003, Tamilnadu, India.

Abstract : The isopod *Ligia indica* inhabits the rocky shore of Tuticorin coast (Lat. 8°47'N: Long. 78°9'E) where boulders are found in large numbers. Even though a lot of information is available regarding water and salt balance, egg incubation and yolk utilization of *Ligia* sp., very little is known about breeding behaviour of

the genus. The present study deals with the breeding and frequency of sex in *Ligia indica* of Tuticorin coast.

626. **Durve, V.S and D.V. Bal** 1961. Some observations on shell-deposits of the oyster *Crassostrea gryphoides* (Schlotheim) *Proc. Indian Acad. Sci.,* 54B(1): 45-55.

627. **Durve, V.S.** 1963. A study on the rate of filtration of the clam *Meretrix casta* (Chemnitz). *J. Mar. Biol. Assoc. India.* 5(2): 221-231.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Study of organic production was initiated in the inshore waters of the Gulf of Mannar to determine the magnitude of production, its seasonal variations and the present yield in terms of carbon with a view to assess the fisheries potential. Organic production values determined with oxygen technique as well as C^{14} technique have been compared with values obtained elsewhere. Standing crop of phytoplankton determined as Harvey Pigment Units or total number of cells also have been compared with other observations made in Indian waters. Initial values of plant pigments and phytoplankton cells and increase of cells in the light bottle were found to follow more or less the same pattern as organic production. Analysis of the data indicated that values of plant pigment units can sometimes give erratic pictures of standing crop especially during turbulent conditions. It is found that the standing crop as well as organic production is high in the inshore waters of the Gulf of Mannar. The trend and magnitude of production are reflected in the fishery. It is also found that the present yield could be easily stepped up with a little more effort.

628. **Durve. V.S and K.V. George** 1963. Some physiological observations on the fry of *Chanos chanos* (Forskal) for their transport in plastic containers. *Indian J. Fish.,* 10(1&2): 1-10.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The problem of the transport of live fish, especially spawn and fry, have great interest, since last few decades. The methods given should take into consideration the physiological problems of fish transport, such as oxygen intake by the fish and the temperature variation in the water. The present work was undertaken with a view to studying the basic physiological problems.

629. **Durve, V.S and S.K. Dharmaraja** 1965. A study on the dimensional relationship in the clam *Meretrix casta* collected from two localities. *J. Mar. Biol. Assoc. India,* 7(1): 69-79.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Dimensional relationship in the clam *Meretrix casta* from two widely different localities of marine fish farm and natural clam beds of Athankarai estuary was studied. The study indicates a clear difference in the dimensional relationship among the clams of these two localities. This difference may be due to the different environmental conditions prevailing there. A study on the relationship between height and shell volume indicates that clams from the fish farm have heavier shells than those of Athankarai estuary.

630. **Durve, V.S and S.K. Dharmaraja** 1965. Effects of anaesthetics on the behaviour of mullet fingerlings and the scope of using these in different fishery procedures. *J. Mar. Biol. Assoc. India,* 8(1): 28-56.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Six different anaesthetics namely, Tertiary Butyl Alcohol, Chloral Hydrate, Chlorobutanol, Sodium Amytal, Sodium Barbital and Urethane have been used to study their effects in the fingerlings of the mullet *Liza lade,* at different concentrations. The behavioural changes of the mullet fingerlings in anaesthetized condition have been classified. The dosage of each anaesthetic to give the stages of sedation useful for tagging and transport of live-fish have been determined and discussed. Tolerance of fishes to anaesthetics and the narcotic potency of each anaesthetic has been determined. Fish tolerate lower concentrations of all the anaesthetics for 24 hours, except in Sodium Barbital where the tolerance limit is 16 hours. The narcotic potency is related to the molecular weight of the anaesthetic with the exception of Sodium Barbital. Experiments on the metabolism of anaesthetized fish indicate that the metabolism is appreciably reduced by anaesthesia, so that the survival time increases considerably. Thus the weight of fish in unit volume of water could at least be doubled during transport. Each anaesthetic and its useful doses are discussed in the light of the available literature to determine the suitability of each anaesthetic on merit. Chloral hydrate appears to be the most suitable of the chemicals studied.

631. **Durve, V.S and S.K. Dharmaraja** 1969. On the fatness of the clam, *Meretrix casta. Indian J. Fish.,* 16(1&2):170-173.

632. **Durve, V.S.** 1973. Experimental transplantation of the clam *Meretrix casta* in the marine fish farm. *Indian J. Fish.*, 20(1): 56-60.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Several hundred clams, *Meretrix casta* (Chemnitz) obtained from Athankarai estuary (Long. 79°E, Lat. 9° 20'N.) on 28th October 1964, were transplanted in the pond of the fish farm of the Central Marine Fisheries Research Institute, Mandapam Camp. During the period of study extending over six months, it was found that there was an initial high rate of growth in the seed clams immediately on transplantation. However, this rate of growth declined first slowly and then rapidly after five months. Probable causes for this uneven growth are discussed.

633. **Durve, V.S.** 1973. A note on the meat/shell ratio and shell volume in the clam *Meretrix casta*. *J. Mar. Biol. Assoc. India.* 15(2): 889-891.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The clam *Meretrix casta* (Chemnitz) from Athankarai estuary and three fish ponds differing in dissolved calcium content was studied. It was found that those living in the estuary having lower dissolved calcium concentration had lower meat/shell ratio, lower shell volume and thin shell than those living in the farm with high calcium content.

634. **Durve, V.S and K.V. George** 1973. Some observations on the index of condition of the clam *Meretrix casta* in relation to mud and water qualities. *Indian J. Fish.*, 20(2): 326-332.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The physiological condition (index of condition) of *Meretrix casta* was studied in relation to pH, salinity, DO, Total and Inorganic phosphate, silicates, Nitrites and Calcium and varying coarseness of mud of the experimental ponds and the results were compared with similar observations on natural clam beds in the Athankarai estuary-15Km west of Mandapam camp.

635. **Durve, V.S.** 1975. Change of form in the clam, *Meretrix casta* (Chemnitry) during its growth. *Indian J. Mar. Sci.*, 4(2): 207-208.

636. **Durve, V.S., V.S. Mujumdar and F.K. Gupta** 1981. On the biochemical composition of oyster *Crassotrea madrasensis* (Preston). *Ind. J. Zool.*, 9(2): 97-102.

Address : Deparment of Limnology and Fishery, University of Udaipur, Udaipur, India.

Abstract : In the present note, the results of the biochemical analysis made on farm grown oyster (*C. madrasensis*) of Tuticorin coast during the month of June have been reported. The size of the oysters ranged from 4.8-7.4 cms. in length and 95-120 g. in weight. All the oysters in June were in the prespawning phase of reproductive cycle. The oysters were shucked, ground in blender and dried in hot air overn to a constant weight. The material thus obtained was sealed in polythene bags and chemically analysed in the laboratory.

637. **Dwivedi, S.N.** 1973. Some aspects of the marine living resources of the Indian Continental shelf. *MBAI Spl. Pub. dedicated to N.K. Panikkar,* 227-240.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

Abstract : The continental shelf around India has played a significant role in the traditional exploitation and utilisation of living resources. Its physical characters, expanse and formation are discussed. These factors, apart from governing and modifying benthic production, are also responsible for supporting primary and secondary production in bathy-pelagic and pelagic zones. At the present time the exploitation of fish in India, out of the total area of 447.6 thousand sq. kilometers of shelf, is limited only to a small part of the continental shelf within a few kilometers from the coast line. The present fish catch can be doubled with the existing technology but require greater inputs. The production rates in selected areas have been discussed. The coastal productivity characteristics and the differences in magnitude of production in the shelf along the east and west coast of India have been brought out. It is suggested to start regional and national programmes along the shelf for each ecosystem and utilisation of backwater and estuarine areas of about 74,000 lac acres for aquaculture and intensive food production.

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638. **Eashwar, M., P. Chandrasekaran, G. Subramanian and S.V. Iyer** 1987. Effects on variations in biofouling assemblage and exposure conditions on the corrosion of mild steel. *Key Eng Mat*. 20-28 (pt 1-4), pp. pt 4, pp. 3265-3274.

Address : Central Electro Chemical Research Institute, Karaikudi, Tamilnadu, India,

Abstract : Results of a year's studies on biofouling and corrosion of mild steel in three different marine environments at Mandapam, India are presented. The locations showed great variations in assemblage of biofouling communities and seawater characteristics. Corrosion of mild steel was considerably influenced by both biofouling and environmental conditions. Data presented are the monthly, quarterly and cumulative rates of corrosion of mild steel at the three locations. Results indicate that algae accelerated corrosion considerably whereas barnacles were generally protective. The effects of tunicates were not evident. However, the severest corrosion was associated with the creation of favourable conditions for sulphate-reducing bacteria. In the waters of Palk Bay, these bacteria accounted for a corrosion value of 134. 5 mdd during one particular month and a quarterly corrosion value of 90.9 mdd.

639. **Eashwar, M., G. Subramanian and K. Balakrishnan** 1989. Corrosion and biofouling characteristics of zinc in Mandapam waters. *Bull. Electrochem.*, 5(10): 729-732.

Address : Offshore Platform and Marine Electro Chemical Centre, CECRI Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : Investigations have been carried out in natural seawater on the corrosion and biofouling characteristics of zinc. Results from 18 months immersion tests indicate that zinc has an annual corrosion rate of about 10 mdd and a biofouling rate of 1 kg/m^2/year in the coastal waters of Mandapam. Fouling on sacrificial zinc is more severe evidencing a complex, antagonistic interaction between zinc toxicity and pH. The involvement of marine sponges in the accelerated corrosion of zinc is also discussed.

640. **Eashwar, M., S. Maruthamuthu and K. Balakrishnan** 1990. Occurrence of thiobacilli in Tuticorin Harbour waters. *Indian J. Mar. Sci.*, 19(2): 107-109.

Address : Offshore Platform and Marine Electro Chemical Centre, CERI Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : The number of thiobacilli obtained as colony forming units on thiosulphate agar was the highest ever reported from marine sources. Seven isolates, out of 15 from enrichment cultures, were *Thiobacillus* spp., *T. thiooxidans* and *T. ferrooxidans* produced the most acidic conditions in liquid cultures. Laboratory experiments with decaying alga *Ulva lactuca* in seawater showed that thiobacilli were involved in the oxidation of protein sulphur. The study not only indicates the status of pollution in harbour waters, but also shows that thiobacilli may have wide distribution in coastal waters.

641. **Eashwar, M., G. Subramanian and P. Chandrasekaran** 1990. Marine fouling and corrosion studies in the coastal waters of Mandapam, India. *Bull. Electrochem.*, 6(8): 699-702.

Address : Corrosion Testing and Research Station, CECRI Unit, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : Results of a comprehensive study on marine fouling conducted in the coastal waters of Mandapam, India, are presented. Based on data from different tests, the effects of fouling organisms on the phenomena of corrosion and cathodic protection are discussed.

642. **Eashwar, M., G. Subramanian, P. Chandrasekaran and K. Balakrishnan** 1992. Mechanism for barnacle-induced crevice corrosion in stainless steel. *Corrosion Houston*, 48(7): 608-612.

Address : Offshore Platform and Marine Electro Chemical Centre, CECRI Unit, Harbor Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : The intrinsic susceptibility of stainless steels to corrosive attack by barnacles is a widely recognized phenomenon. Corrosion usually manifests itself in crevices, corresponding to the base of the barnacles' shell. The purpose of this investigation was to elucidate a mechanism for this corrosion phenomenon. Based on the results of the laboratory experiments, a model accounting for the factors involved in the nucleation and propagation of corrosion is presented. The roles of oxygen, bacteria, and the structure of the barnacle's calcareous base are highlighted.

643. **Eashwar, M and S. Maruthamuthu** 1995. Mechanism of biologically produced ennoblement. Ecological perspectives and a hypothetical model. *Biofouling*, 8(3): 203-213.

Address : Offshore Platform and Marine Electro Chemical Centre, CECRI Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : Literature on biofilm assisted ennoblement of sea immersed stainless alloys is critically reconsidered in terms of the microbial ecology of biofilm formation, succession and dynamics. An evaluation is made of the mechanisms put forth by various authors, taking account of the compatibility of the suggested models with the interfacial solution chemistry data published widely. It is argued on the one hand that the biofilm/metal interface should be strictly anaerobic, thus questioning the applicability of the oxygen reduction catalysis model, while, on the other, the concept of acid biofilm pH is carefully scrutinised. The neutral pH and passivity enhancement model appears most acceptable, and elegantly explains much of the otherwise anomalous test results. Finally, it is derived from the discussion that siderophores (iron chelators), produced by biofilm microorganisms at pHs close to neutral, may act as inhibitors and bring about the passivity improvement.

644. **Eashwar, M., S. Maruthamuthu, S. Palanichamy and K. Balakrishnan** 1995. Sunlight irradiation of seawater eliminates ennoblement-causation by biofilms. *Biofouling*, 8(3): 215-221.

Address : Offshore Platform and Marine Electro Chemical Centre, CECRI Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : It is reported for the first time that irradiation of seawater by sunlight eliminates the ennoblement-causing capacity of marine biofilms. In laboratory tests under strict conditions of darkness, freshly sampled Tuticorin seawater produced the previously reported 300 mV ennoblement whereas in the same seawater with prior, natural photo-irradiation there was little variation in the corrosion potential. The irradiation procedure did not alter the primary water quality characters, nor did it perturb the process of biofilm formation. The absence of ennobling in irradiated seawater was consistent for all of the four alloys examined. Supplementary tests indicated that adequate interpretation of the results was not possible with any of the mechanisms suggested in literature.

645. **Eashwar, M., S. Maruthamuthu, S. Sathiyanarayanan and K. Balakrishnan** 1995. Ennoblement of stainless alloys by marine biofilms:the neutral pH and passivity enhancement model. *Corrosion Sci.*, 37(8):1169-1176.

Address : Offshore Platform and Marine Electro Chemical Centre, CECRI Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : Biofilms from Tuticorin seawater caused appreciable ennobling of titanium in the presence of moderate illumination that allowed diatoms to grow in association with bacteria. In the dark, and with high light levels, ennobling was hindered. Based on present results and other literature data, it is hypothesized that pH values close to neutral nucleate the ennoblement phenomenon. Anodic polarisation and cyclic voltammogram data show that ennobling is accompanied by a decrease in passive current and an increase in both the passive region and the critical pitting potential. It is suggested that passivity enhancement by microbially produced inhibitors could be the major mechanism of ennoblement.

646. **Eashwar, M., G. Subramanian, P. Chandrasekaran, S.T. Manickam, S. Maruthamuthu and K. Balakrishnan** 1995. The interrelation of cathodic protection and marine macrofouling. *Biofouling*, 8(4): 303-312.

Address : Offshore Platform and Marine Electro Chemical Centre, CECRI Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : This paper presents and discusses the results of laboratory and field experiments on the interrelation of cathodic protection (CP) and marine macrofouling. Tests in the sea revealed that fouling settlements were greatly enhanced by CP. Calcareous shell-dwelling organisms such as barnacles and oysters, and a calcareous alga, *Jania rubens*, were particularly prolific on cathodically protected substrata. Laboratory studies with the oyster, *Crassostrea madrasensis* (L.), indicated that interfacial alkalinity generated by CP might enhance shell growth in the organism. The oyster reached a larger size on cathodically protected substrata than on the controls. Tests done in the presence and absence of fouling under natural conditions showed that fouling can bring about rapid decay of potential during interruption of the protective current, causing early corrosion. The implications of the findings to the performance of fixed marine and offshore structures are discussed.

647. **Easterson, D.C.V and S. Mahadevan** 1980. Review of open sea environmental conditions along Indian coast. *CMFRI Bulletin*, 29: 17-21.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The open sea environment in the east and west coasts of lndia plays a key role in deciding the future of mussel culture along Indian Coast. A review and analysis of the effects of various factors like wind, wave action, currents, tides, hydrology, upwelling and phytoplankton production are given.

648. **Easterson, D.C.V.** 1984. Food value of rotifer, brineshrimp and moina to postlarvae of *Penaeus indicus* reared in the laboratory. *CMFRI Spl. Publ.,* 19: 50-53.

649. **Easterson, D.C.V and D. Kandasamy** 1988. Biochemical changes in the oyster *Crassostrea madrasensis* with maturation. *CMFRI Bulletin,* 42(1): 203-209.

Address : Central Marine Fisheries Research Station, Cochin - 682 018, India.

Abstract : Central Marine Fisheries Institute has perfected the technique of culturing the common edible oyster *Crassostrea madrasensis* (Preston). Venkataraman and Chari 1951 had studied the fluctuation in biochemeical composition in the whole oyster meat for different months in the naturally growing oysters of Ennore, Madras. In the present paper a study has been made about the biochemical composition with maturity in male and female oysters cultured at Tuticorin, Tamil Nadu.

650. **Easterson, D.C.V.** 1998. Biodiversity, coastal zone and management strategies. *Proc. National Sem. Coastal Zone Management*, Institute for Coastal area studies, Manonmanium Sundaranar University, Tirunelveli.

Address : Central Marine Fisheries Research Station, Cochin - 682 018, India.

651. **Easterson, D.C.V.** 1998. Impact of marine pollution on the ecological resources. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve.* pp. 56-68.

Address : Central Marine Fisheries Research Institute, Tuticorin, India.

Abstract : Since the new Tuticorin Port became operational, the coast of Gulf of Mannar (GOM) is experiencing an accelerated growth in the rate of industrialisation. The achievements made in breeding, hatchery production and farming of shrimps in certain localities has promoted shrimp farming to a very large scale. Traditional saltpans too were replaced by shrimp farms. As a consequence, this chain of development has led to alteration of coastal morphology, marine pollution and different forms of damage to coastal ecosystems. This has caused serious damage to the maintenance of water quality, traditional fishing, the use of sea frontage and beach, and loss of coastal habitats and benthic life.

652. **Easterson, D.C.V and A.C.C Victor** 1998. *Report on initial environmental examination (IEE) of Sethusamudram Ship Canal Project: Living resources* CMFRI, Cochi. 181 pp.

653. **Easterson, D.C.V., S. Dharmaraj and A. Chellam** 2001. A report on windowpane oysters fishery in Tuticorin Bay. *Mar. Fish. Infor. Serv., T&E Ser.,* 168: 22-23.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The window pane oysters (*Placenta placenta*) are fished regularly for pearls and shells from Kakinada Bay of Andhra Pradesh and Okhamandal coast of Gulf of Kutch. Though not regular these oysters were fished in the year 1995 and after a lapse of five years another fishing was conducted during February-March 2000 for pearls and shells by the local fisherfolk in the Bay of Tuticorin. The size of oysters fished, their numbers and the incidence of natural pearls occurred in the oysters during February-March 2000 are reported here.

654. **Easterson, D.C.V., A.C.C. Victor, K.K. Appukuttan, M.J. Samuel and V. Vimalan** 2003. Production of colour modified pearls by environmental and dietary manipulations in *Pinctada fucata. 1st Indian Pearl Congress & Exposition,* 5th to 8th February, 2003. p. 32.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The colour of natural pearls is considered due to its genetic make up. In the present venture the possibility of producing pearls of desired colour was attempted outside its genetics on the hypothesis that any superfluous sub-toxic mineral uptake by the pearl oyster a lower invertebrate might find its way to the shell. Therefore by making the oyster to absorb a mineral of coloured salt of choice at sub-toxic level, the mineral can be made to be concentrated in the shell through the nacre secretion. Production of shell and pearl being the same biological process, pearls of choice colour might be possible by boosting the mineral uptake. On this hypothesis, four experiments (40 each) including a control each of 90 days duration were conducted with young pearl

oysters (DVM 29 - 35 mm) *Pinctada fucata* at their fast growth phase. In the control, pearl oysters were fed with *Isochrysis galbana* and reared in normal filtered seawater (FSW). In the first experiment oysters were reared in FSW and fed with a balanced microparticulate diet with Ferric chloride at 10 ppm level (MPD-Fe). In the second experiment oysters were reared with *Isochrysis* and FSW containing 10 ppm Ferric chloride (FSW-Fe) and in the third oysters were exposed to both MPD-Fe and FSW-Fe. At the end of the study, performances were compared with that of the control and the hypothesis was found valid. The percentage survival respectively for control and the above said three experiments was 42.5, 80, 50 and 35. The percentage increase in DVM (Dorso ventro measurement) respectively was 6.15, 10.84, 7.55 and 16.53 and in case of Hinge Length it was 3.39, 4.38, 1.99 and 5.50. The percentage increase in width was 4.07, 4.19, 2.35 and 4.65 respectively for control and the three experiments. The modified colour of the nacre deposition was bluish green. The percentage colour modification was observed to be 18.75% with MPD-Fe, 20% with FSW-Fe and 14.29% with MPD-Fe & FSW-Fe.

655. **Edin, S and C. Ydell** 1991. The role of the railway in marketing of fish on the east coast of India. *Fish Dev. Ser. Natl. Swed. Board Fish.*, 60: 62.

Address : National Swedish Board of Fisheries, Goeteborg (Sweden).

Abstract : The findings are presented of a study conducted to determine the role of Indian Railways in the marketing of fish from East Coast states: Andhra Pradesh, Tamil Nadu, Orissa and West Bengal. The following aspects are covered: railway history; freight traffic; the Indian railway system; marketing of fish by railway trains; fish transportation; railway transport compared with other means of transport; people in charge of the distribution of fish by rail, railway rates, railway handling of fish, traders opinions, road transportation and boat transportation. The marine fish marketing process in Visakhapatnam is described, detailing the quantities of fish dispatched from Visakhapatnam 1980-90, levels of the fish marketing chain, fresh/frozen fish trade, dry fish trade and types of containers and packing materials used for the fish. Details are also given of trial fish transportation by rail from Visakhapatnam using different routes and making cost analyses. A comparison is also made with the marketing system in Kanyakumari District.

656. **Edwin James, J., R. Asir Selin Kumar and A.D.S. Raj** 2004. Marine algal flora from some localities of southeast coast of Tamilnadu. *Seaweed Res. Utiln.*, 26(1&2): 33-39.

Address : Department of Botany and Research Centre, Scott Christian College, Nagercoil - 629 003, Tamilnadu, India.

Abstract : Studies on the distribution and seasonal changes in the marine macroalgal flora were made for a period of two years from June 2000 to May 2002 by making monthly collection of algae from intertidal and subtidal regions up to 1.0 m depth at five localities along east coastline of south Tamil Nadu, India namely Kanyakumari, Vattakottai, Kootapuzhi, Kudankulam and Idinthakarai. Totally 122 algal species belonging to Chlorophyta, Phaeophyta, Rhodophyta and Cyanophyta were recorded from these places. A maximum number of 99 algal species at Kudankulam and a minimum of 62 species at Kootapuzhi were recorded.

657. **Edwin James, J., R. Asir Selin Kumar, A.D.S. Raj and R. Sree Kala Devi** 2004. A comparative study on agar content in *Gracilaria corticata* J. Agardh, *G. fergusonii* J. Agardh and *Gelidium pusillum* (Stackh.) Le Jolis of Kudankulam and Kurumbanai, southeast and southwest coasts of India. *Seaweed Res. Utiln.*, 26(1&2): 63-67.

Address : Department of Botany and Research Centre, Scott Christian College, Nagercoil - 629 003, Tamilnadu, India.

Abstract : Studies were made on the yield and physical properties of agar in *Gracilaria corticata, G. fergusonii* and *Gelidium pusillum* growing in Kudankulam and Kurumbanai, southeast and southwest coasts of India from June 2000 to May 2002. The agar content in these algae ranged from 17.30% to 46.80% in Kudankulam and 27.50% to 52% in Kurumbanai coast. Maximum agar content (52%) was observed in *Gracilaria corticata* of Kurumbanai coast during November 2001 and minimum (17.30%) in *Gracilaria fergusonii* of Kudankulam coast in February 2001. Gel strength was maximum in *Gelidium pusillum* (271 g./cm^2) of Kudankulam coast during December 2001 and minimum in *Graci/aria fergusonii* (21 g./cm^2) of Kurumbanai coast in February 2001. Maximum gelling temperature (47°C) was observed in *Gracilaria corticata* during October 2001 and *Gelidium pusillum* during April 2001 of Kudankulam and minimum (33°C) was in *Gracilaria fergusonii* of Kudankulam coast and *Gracilaria corticata* of Kurumbanai coast during December 2001 and August 2000 respectively. Minimum melting temperature (53°C) was observed in *Gracilaria corticata* of Kurumbanai coast during April 2001 and maximum in *Gracilaria fergusonii* of Kudankulam coast during January 2001.

658. **Ellaiah, P., D. Kalyan, V.S. Rao and B.V. Rao** 1997. A new variety of *Chainia olivacea* from marine sediment off Gulf of Mannar. *Hindustan Antibiotics Bulletin,* 39(1&4): 50-55.

Address : Department of Pharmaceutical Sciences, Andhra University, Visakhapatnam, India.

Abstract : A new variety of *Chainia olivacea* was isolated from marine sediment off Gulf of Mannar. The morphological, cultural, physiological and biochemical characters were studied, compared to known species and identified as a new variety of *Chainia olivacea*. Antibiotic activity of the strain was tested against both Gram positive and Gram negative bacteria as well as fungi and yeasts. Sodium chloride tolerance was also tested.

659. **Emerson Kagoo, I and K. Ayyakkannu** 1992. Fauna and flora associated with *Chicoreus ramosus* of the southeast coast of India. *Proc. Second Workshop Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. Phuket Marine Biological Cent., 10: 184-187.

Address : CAS in Marine Biology, Annamalai University, Parengipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of a study conducted to determine the seasonal variation and orientation of the epifaunal, epiphytal and endolithic organisms associated with *Chicoreus ramosus* off the southeastern coast of India. The association of epizoic forms on the muricid was observed to vary in the 3 sectors studied - Cuddalore, Mandapam and Tuticorin. Barnacles were predominant in the Cuddalore and Tuticorin sectors and dominant in Mandapam with a maximum during the premonsoon season.

660. **Emilin Renitta, R., R. Ramkumar and Jamila Patterson** 2003. Harvest and handling of blue swimming crab, *Portunus pelagicus* in a major crab landing centre in Tuticorin coast. *Nat. Sem. Reef Ecosystem Remediation,* 24th to 26th Sep'03, SDMRI, Tuticorin, India. p. 45.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Vellapatti is one of the fishing villages of Tuticorin coast exclusively doing crab fishery for decades. The fishery comprises of *Portunus pelagicus*, *P. sanguinolentus*, *Charybdis feriata, C. natator* and *S. serrata* and among these, major portion of the catch is occupied by *P. pelagicus.* The data on the daily landings of crabs in Vellapatti were collected from May 2002 to June 2003. The total catch of *P. pelagicus* during this period was high (167.98 tons) followed by *Charybdis sp.* (2.404 tons) and S. *serrata* (1.211 tons). The quality of the water used to clean crabs, ice, crabs in the net, auction and steaming sheds in the landings were assessed. The Total Plate Count and pathogenic bacterial counts were higher than the permissible limit in all the tested samples. The fishery and their quality in the post harvest handling are discussed.

661. **Emilin Renitta, R and Jamila Patterson** 2004. Development of smoked products from marine gastropods. *J. Mar. Biol. Assoc. India,* 46(1): 73-79.

Address : Sugandhi Devadason Marine Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The marine gastropods *Chicoreus virgineus* and *Babylonia spirrata,* though constitute an important fishery along the southeast coast of India remain under utilized at present. Generally the meat of gastropods is considered a delicacy due its high protein and low fat content. Presently, along the east coast of India, only a smaller section of the fisherfolk consumes the meat of these gastropods. Many are still not aware of real value and delicacy of these seafood. For better utilization, the smoked products from *C. virgineus* and *B. spirata* meat were prepared and shelf life period assessed. The smoked product showed good protein content of 8.6% and 6.2% and less fat content of 3.3% and 3.3% respectively. The tests revealed that biochemically, microbiologically and organoleptically it is good and safe for human consumption till the end of the storage period. In *C. virgineus,* all the biochemical parameters were significant ($p<0.001$) however, the pH, moisture and TPC were not significant ($P>0.005$) in *B. spirata.* The organoleptic characters of the products such as odour and texture in the former species were statistically significant ($P<0.005$) whereas in the latter the colour, texture, flavour and overall acceptability were statistically significant ($p<0.01$) during storage period.

662. **Emmanuel Vijay Anand, P and N. Gopala Krishna Pillai** 1995. Studies on some aspects of biology and ecology of coral reef fishes of Lakshadweep with observations on other coral reef ecosystems of India. *CMFRI Spl. Publ.,* 61: 99-111.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Coral reef science now potrays itself through many specialized fields in the tropics. While the current concern on the world's coral reefs is to maintain ecological 'health', India faces the stupendous task of stepping up reef-related research in comparison to other developing countries. Despite important studies on the systematics

of corals, associated fishes, invertebrates and hydrographic surveys, there is an overall paucity in reef-related studies that could make available basic data and create environmental awareness among the concerned authorities and users.

663. **Emmanuel Vijay Anand, P and N. Gopala Krishna Pillai** 2002. Reproductive biology of some common coral reef fishes of India. *J. Mar. Biol. Assoc. India,* 44(1&2): 122-135.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The reproductive biology of some common coral reef fishes from the Lakshadweep (8° 11', 12° N and 71° 45' to 73° 45'E) and the Gulf of Mannar (8° 48' to 9° 14'N and 79° 9' to 79° 14'E) in the Indian EEZ during January 1991 to June 1992 is reported. Protogyny was prominent in labrids, while other species either matured synchronously or differentially, with males maturing earlier or later than females. Sex-ratio indicated that females were dominant in most species. Fecundity estimates varied greatly, from 700 to 2,25,850 ova per female. Whenever the environment is favourable the coral reef fish spawn on a daily, weekly, fortnightly and monthly basis. Total fecundity per year, therefore, is presumably very high. Most species appeared to be perennial spawners, some showed small breaks, while very few indicated biannual spawning. Continuous occurrence of juveniles in different size ranges confirmed the continuous spawning habits. Spawning activity was minimum during monsoon seasons, evidently an adaptation to tide over adverse environmental conditions prevailing at that time lest the eggs and larvae are transported far and wide. This was corroborated by peak settlement during pre-monsoon and post-monsoon seasons.

664. **Eswaran, C.R.** 1967. Seaweed and its uses. *Indian Seafood,* 4(3): 13-15.

665. **Eswaran, K., P.V. Subba Rao and O.P. Mairh** 2001. Impact of ultraviolet-B radiation on a marine red alga *Kappaphycus alvarezii* (Solieriaceae, Rhodophyta). *Indian J. Mar. Sci.,* 30(2): 105-107.

Address : Central Salt and Marine Chemical Research Institute, Marine Algal Research Station, Mandapam Camp 623 519, Tamilnadu, India.

Abstract : *Kappaphycus alvarezii* (Doty) Doty, an exotic alga to Indian waters is one of the best sources of kappa carrageenan. It was cultured and 60 days old algal fragments were subjected to UV-B radiation (280-320 nm) for 30 to 180 minutes, in the laboratory and analysed for pigments and carrageenan content. A gradual decrease in pigment levels, soluble protein content, carrageenan yield, and in the properties of carrageenan was observed as compared to control. More than 150 min exposure to UV-B radiation strongly inhibited pigment accumulation (63.90 to 92.20%), carrageenan yield (21.68 to 33.82%), gel strength (81.17 to 82.90%) and protein (48.42 to 58.20%).

666. **Eswaran, K., P.K. Ghosh and O.P. Mairh** 2002. Experimental field cultivation of *Kappaphycus alvarezii* (Doty) Doty ex. P. Silva at Mandapam region. *Seaweed Res. Utiln.,* 24(1): 67-72.

Address : Central Salt and Marine Chemical Research Institute, Marine Algal Research Station, Mandapam Camp 623 519 India.

Abstract : Field and laboratory growth patterns of *Kappaphycus alvarezii* (=Eucheumastriatum) an exotic alga to the Indian waters were studied from December 1995 to October 1996 (11 months) on the coast of Mandapam, Tamil Nadu, India. The biomass accumulation and growth rate (%per day) were much higher (nearly $3\%d^{-1}$) in the early days of cultivation during December to February than in other months. The plants cultivated at different depths (1.0 m, 1.5 m and 2.0 m) showed relatively more biomass and growth rates at 1.0 m depth below surface than other two depths. This is the first report where *K. alvarezeii* could be acclimatised for growth throughout the year in the Indian waters. There is very good scope for further experiment on large-scale cultivation of this alga in Mandapam region on southeast coast of India.

667. **Eswaran, K., M. Ganesan, C. Periyasamy and P.V. Subba Rao** 2002. Effect of ultraviolet-B radiation on biochemical composition of three *Ulva* species (Chlorophyta) from southeast coast of India. *Indian J. Mar. Sci.* 31(4): 334-336.

Address : Central Salt and Marine Chemical Research Institute, Marine Algal Research Station, Mandapam Camp 623 519 India, E-mail: eswar@hotmail.com

Abstract : The young plants of *Ulva fasciata, U. reticulata* and *U. lactuca* were subjected to UV(320-280 nm) radiation for 30, 60, 90, 120, 150 and 180 min. The changes in chlorophylls, carotenoids, protein, nitrate contents and reductase activities were studied. Compared to control, in UV exposed plants both pigments and protein concentrations were significantly decreased. The magnitude of such decrease was higher in *Ulva lactuca* than in

other two species. In contrast to this in vitro nitrate reductase activity was more severely affected in *U. reticulata*. The experiments clearly showed that the UV radiation has strong inhibitory effects on biochemical properties in all three *Ulva* species. However, the rate of inhibition is dependent on the duration of exposure of plants to UV (A B)-B radiation.

668. **Eswaran, K., P.K. Ghosh and B. Jha** 2005**.** Seaweed cultivation by CSMCRI : Retrospect, Prospect and Future strategies. *Proc. Ocean life food and Med. Expo.,* Aquaculture Foundation of India, Chennai. p. 394.

Address : Central Salt and Marine Chemical Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : Seaweeds mainly *Gelidiella acerosa, Gracilaria edulis, Hypnea* sp. and Eucheuma (*Kappaphycus*) are commonly used as a source for the extraction of phycocolloid like agar-agar and carrageenan in India. The agrophytes are commercially exploited from their natural habitat to feed the agar industries. Over-exploitation has led to depletion of the natural resources. To augment these resources and to have constant supply of raw material for agar production, cultivation of these seaweeds is the only alternative. Excellent technologies have been developed in India for the cultivation of the seaweed but India imports its requirement from other countries. The principles as well as the problems involved in the cultivation of these seaweeds are discussed in detail. The future strategies include socioeconomic problems faced in the cultivation of seaweeds is discussed.

669. **Eswaran, K., K.H. Mody, B. Jha and P.K. Ghosh** 2005. Pilot scale cultivation of *Kappaphycus alvarezii* (Doty) on the southeast coast of India and its carrageenan content. *Nat. Symp. Marine Plants, their chemistry and utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. p. 67.

Address : Central Salt and Marine Chemical Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : In order to test the possibility of cultivation of carrageenan yielding seaweed *Kappaphycus alvarezii* (Doty) was initially cultured on the Okha, Westcoast of India. Acclimatization and commercial cultivation of this alga was achieved on the coast of Mandapam, Southeast coast of India. Plants were cultivated by vegetative propagation of fragments in perforated polyethylene bags (bag culture - polythene and net bags), raft and open culture by the monoline rope method. Raft and net bag culture methods proved safe and suitable for large scale cultivation, as it prevented loss by grazing and drifting, produced plants free from epiphytes and allowed easy harvest. All the physiochemical factors remained favourable throughout the year for the survival and growth of the alga. *K. alvarezii* in Indian waters showed a daily growth rate between 0.4 and 11.4% with a mean of 4.0%, carrageenan yield between 32 and 54.7% and gel strength of 210-795 $g.cm^{-2}$.

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670. **FAO.** 1985. Tuna fishery in the EEZs of India, Maldives and Sri Lanka.

Address : FAO, P.O. Box 1505, Colombo 7, Sri Lanka.

Abstract : This paper attempts to summarize the present knowledge of those tuna resources in the EEZs of India, Maldives and Sri Lanka that are likely to be shared stocks. It contains a summary report, a survey of tuna fishery in the three EEZs and country reports from Maldives and Sri Lanka. The material was put together following a working group meeting of scientists from Maldives and Sri Lanka, with India represented by two observers from the Indian High Commission in Sri Lanka. The meeting was held 4-8 June 1984 at the National Aquatic Resources Agency (NARA), Colombo, Sri Lanka, and was held under the auspices of the FAO/UNDP project "Marine Fishery Resources Management in the Bay of Bengal" (RAS/81/051). Dr. K. Sivasubramaniam, Senior Fishery Biologist of the project, acted as convenor. The Director General of NARA, Dr. Onil Pereira, opened the meeting. "Marine Fishery Resources Management in the Bay of Bengal" is a component of the Bay of Bengal Programme. The project has a duration of four years; it commenced in January 1983. Its immediate objective is to improve the practice of fishery resources assessment among participating countries and to stimulate and assist in joint assessment and management activities between countries sharing fish stocks.

671. **FAO/UN.** 1962. Third report to the Government of India on the Pearl and chank beds in the Gulf of Mannar based on the Bank of Dr. Fancesso Baschiri Salvadori, FAO Fisheries biologist, *Rep. FAO, EPTA.*, 1: (1948:7).

672. **Farren, G.P.** 1905. Report on the ophisthobranchiat mollusca collected by Professor Herdman at Ceylon, in 1902. *Rep. Govt. Ceylon Pearl Oyster. Fish Gulf of Mannar Lond.* 3: *Suppl. Rep.*, 21: 329-364, Pls. 1-6.

673. **Fauvel, P.** 1930. Supplement to the littoral fauna in the Gulf of Mannar, Annelid Polychaeta. *Bull. Madras Govt. Mus. N.S., Nat. Hist. Sec.*, 1(2): pt1: 1-72.

674. **Fauvel, P.** 1953. Fauna of India: Annelida Polychaeta. *Indian Press Ltd., Allahabad*, 1-507.

675. **Felicia Shanthini, C., Jamila Patterson, J.K. Patterson Edward** 2002. A case study from Vellapatti fishing village of Gulf of Mannar, Southeast coast of India - Reef fisheries and socioeconomics. *SDMRI Res. Publ.*, 2: 79-84.

Address : Suganthi Devadason Marine Research Institute, 44, Beach Road, Tuticorin 628001, Tamil Nadu India; E-mail: felicia_prem@yahoo.co.in

Abstract : Vellapatti is a small fishing village in the southern part of Gulf of Mannar, situated 7 km north of Tuticorin town, Tamil Nadu, India. The people of this village solely depend on the coral reef ecosystem around Vaan and Koswari Islands for their livelihood. The community facilities, fishing grounds, fishing methods, species composition in the landings, market structure and the socioeconomic condition of the fisher folk were assessed. The problems in resource utilization have been addressed and suggestions are given for conservation and sustainable utilization of resources.

676. **Felicia Shanthini, C and Jamila Patterson** 2003. Halotolerant fungi in salted and sun dried fishes of Tuticorin, southeast coast of India. *SDMRI Res. Publ.*, 3: 97-100.

Address : Suganthi Devadason Marine Research Institute, 44 Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: felicia_prem@yahoo.co.in

Abstract : Fungi were isolated from salted and sundried fishes of Tuticorin, Tamil Nadu, India for a period of one year from Dec. 2000 to Nov. 2001. The common halotolerant fungi encountered are *Aspergillus* sp., *Penicillium* sp., and *Paecilomyces* sp. Among the total number of 200 isolates, 18% exhibited extreme halotolerance, while 80% were moderately tolerant and 2% were halophilic.

677. **Felix, S.** 1987. Better management practices for prospective shrimp farming. *Seafood Export J.*, 19(6): 29-32.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Constraints currently facing the shrimp farming industry in India are examined, which include: 1) improper site selection; 2) lack of adequate knowledge in planning and construction of ponds; 3) non-availability of required number of seed at the time of seed; 4) scanty information on feeds and their formulation; and 5) lack of trained personnel in water quality management.

678. **Felix, S and G. Jegatheesan** 1988. Intensive prawn farming for blue revolution. *Seafood Export J.*, 20(6): 9-10.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A discussion is presented on the development of the prawn culture industry in India and the role it plays in the country's export market.

679. **Felix, S and N. Sukumaran** 1988. Performance of *Penaeus indicus* and *Penaeus monodon* under mono and mixed culture systems. *Proceedings on Indian Fisheries Forum, Mangalore (India), 4 Dec 1987.* pp. 129-130.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : *Penaeus indicus* and *P. monodon* were cultured in earthen ponds of 1.0 ha size under mono and mixed culture system with a stocking density of 50,000 prawns/ha. Salinity of pond water was 29.0-36.0% and pH 7.8 - 8.1. *P. monodon* showed better growth both in mono and mixed culture (daily growth between 150.0 and 128.0 mg). Both prawns showed better growth and survival in monoculture probably due to less competition for food. Under monoculture, *P. monodon* and *P. indicus* recorded productions of 676.5 and 478.7 kg/ha respectively, while in mixed culture, total prawn production was 407.5 kg/ha (*P. monodon* 51.9%).

680. **Felix, S., N. Sukumaran, G. Jegatheesan and R. Sunderrajan** 1988. Prospects of shrimp farming by private firms- A case study. *CMFRI Spec. Publ.,* 40: 60-61.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Commercial research and development project on prawn culture was established by the Tata Oil Mills Co., Ltd, in 1981 at Pulicat. Experiments were conducted in earthern ponds of size ranging from 0.4 to 1.25 ha. Stocking rates ranging from 50,000 to 1,50,000 prawns/ha were attempted and production to the tune of 0.5 to 1.0 tonne/ha/crop were achieved. Survival rates over 80% could be maintained in all the crops. An artificial feed which was formulated with shrimp meal, trashfish and vitamin-mineral mix along with other usual ingredients with a protein content of 40% was proved to be better than the conventional feed. Effect of design of a pond, aging of a pond, stocking density, stocking size, and various hydrobiological parameters (salinity, dissolved oxygen and pH) were also studied.

681. **Felix, S.** 1989. Effect of 17- α methyl testosterone on the growth of ornamental fish, *Xiphophorus maculates*. *Indian J. Fish.,* 36(3): 263-265.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : To access the relative growth promoting efficiency of an androgenic hormone, 17 **a** methyl testosterone on platy, *Xiphophorus maculatus*, the hormone incorporated feed was fed to the fish through pelleted diets at five concentrations viz., 5.0, 10.0, 25.0, 35.0 and 50.0 ppm. From the results obtained it is explicit that the hormone MT has promoted the growth rate to a significant level ($P > 0.01$) over the control. While the 35 ppm concentration recorded a maximum growth rate (5.38 ± 0.36 mg/d) a drastic reduction in the growth rate (2.88 plus or minus 0.19 mg/d) was observed at 5 ppm level. A similar growth pattern was observed at 50 ppm hormone level also.

682. **Felix, S., I. Rachel and N. Sukumaran** 1990. Prospects of subsoil saline water-based shrimp farming. *Seafood Export J.,* 22(9&10): 26-27.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Shrimp farming is gaining momentum throughout the world. Shrimp production is based on water resource utilization, and it can be classified in three categories - culture systems depending on (1) brackish water source; (2) seawater and (3) subsurface saline water. The first two categories are commonly in use; however, the third category could also be used in shrimp farming. In this paper, shrimp farming prospects of subsoil which is saline water-based are discussed in relation to salinity, site selection, river mouth problems, and predatory effects of crabs and fishes. Emphasis is laid on protection from natural calamities.

683. **Felix, S.** 1993. Techno-economic viability of an integrated aquaculture (fish-cum-duck) system. *Proc. Aquaculture Development in India- Problems and Prospects,* Trivandrum (India), 27-29 Nov, 1990. (*eds.*) P. Natarajan and V. Jayaprakas. pp. 79-82.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Integrating the ducks on top of the pond (a complete integration in fish culture) has several potential advantages. The losses of nitrogen and energy due to fermentation, evaporation and non-reversible coagulation

of the manure are eliminated in such integrated fish culture systems and thus the nutritional value of the manure is preserved. The income generation through duck eggs also added to the net return from the integrated system. The results of the experiment conducted in two identical ponds of 0.1 ha (20 x 50 m) size indicated that the daily fish production in the integrated system was to the tune of 18.5 kg/ha, (4810 kg/ha/crop) while the control system recorded a fish production of 13.4 kg/ha/day (3484 kg/ha/crop). It was also observed that the fishes, *Labeo rohita* and *Cirrhinus mrigala* showed relatively better growth rate by recording weight increments of 31.7 and 28.8 percent respectively over their counterparts in the control system. The economic feasibility of the integrated system is also discussed.

684. **Felix, S., I. Rachel and V. Sundararaj** 1994. Wide prevalence of ciliate infestation in shrimp aquaculture systems in Tamil Nadu. *Seafood Export J.*, 25(14): 31-34.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : An occurrence of ciliate group of parasite *Zoothamnium* sp. was noticed to be infesting the shrimp aquaculture system of Tamil Nadu. The gross signs of infestation, etiology, diagnosis, control, treatment, etc. has been described.

685. **Felix, S and A. Rajeev** 2004. Effectiveness of seaweed based bioactive substances against multiple drug resistant shrimp pathogens. *Seaweed Res. Utiln.*, 26(1&2): 117-120.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Extracts from two seaweeds viz. *Gracilaria verrucosa* and *Ulva lactuca* were tested against shrimp bacterial pathogens viz. *Vibrio alginolyticus* and *Vibrio parahaemolyticus.* Among the seaweed samples, *Gracilaria verrucosa* showed better inhibitory activity against both *V. alginolyticus* and *V. parahaemolyticus.* Butanol extracts of *Gracilaria verrucosa* recorded the maximum inhibitory activity against the shrimp pathogen *V. parahaemolyticus* and *V. alginolyticus*. Other solvents viz. acetone, ethanol and propanol showed less activity against these two multi-resistant antibiotic shrimp bacterial pathogens.

686. **Felix, S., A. Rajeev and P.H. Robins** 2004. Immune enhancement assessment of dietry incorporated marine alga *Sargassum wightii* (Phaeophyceae/ Punctariales) in tiger shrimp *Penaeus monodon* (Crustacia/ Penaeidae) through prophenoloxidase (proPO) systems. *Indian J. Mar. Sci.*, 33(4): 361-364.

Address : Department of Aquaculture, Fisheries College and Research Institute, Tuticorin 628 008, Tamil Nadu India; E-mail: sfelix@sancharnet.in

Abstract : An experiment of 30 days duration was conducted to test the efficacy of the seaweed *Sargassum wightii*, as immunostimulant in tiger shrimp *Penaeus monodon*. The shrimps were fed with the experimental diets coated with different concentrations of the brown algae *S. wightii* viz. 10, 20 and 30 g/kg. They were challenged with a marine pathogen *Vibrio parahaemolyticus* to assess the increase in survival rate if any due to immune enhancement. Another group of shrimp was used for drawing the haemolymph to estimate the increase in the level of prophenoloxidase activity. Samplings for the above said analysis were carried out at regular intervals of 3 days viz. 1st, 3rd, 6th, 9th and 12th days. The highest prophenoloxidase activity (0.62) and the highest survival rate (83%) were recorded on the 12th day with the experimental diet (10 g/kg). Hence the 10 g/kg of *S. wightii* added to the diet could be an eco-friendly and economically viable immunostimulant for penaeid shrimps.

687. **Felix, S., P.H. Robins and A. Rajeev** 2004. Pro-PO based assessment of eco-friendly immunostimulation in *Penaeus monodon* (H. Milne Edwards). *Indian J. Fish.*, 51(4): 401-405.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract: A 30-day experiment with *Penaeus monodon* was conducted to evaluate the efficacy of seaweed *Ulva lactuca* as marine immunostimulant. The shrimps were fed with the experimental diets coated with different concentrations of *Ulva lactuca* viz., 100, 250, 750 and 1000 mg/kg. One group of animals were challenged with the marine pathogen *Vibrio parahaemolyticus* to assess the lethal dose in terms of their survival rate. The other group was used for drawing the haemolymph to assess the increase in the. The highest prophenoloxidese activity (0.72) and the highest survival (75%) were recorded on the 1st day of 750 mg/kg of the experimental diet. Hence the 750 mg/kg of *Ulva lactuca* addition in the diet would prove to be an eco-friendly and economically viable immunostimulant.

688. **Fernandes, A.A., V.K. Das and N. Bahulayan** 1991. Harmonic tidal analysis at a few stations using the least squares method. *Mahasagar,* 24(1): 1-12.

Address : National Institute of Oceanography, Dona Paula, Goa- 403 004, India.

Abstract : Using the least squares method, harmonic analysis has been performed on hourly water level records of 29 days at several stations depicting different types of non-tidal noise. For a tidal record at Mormugao, which was free from storm surges (low frequency noise range less than 10 cm), the amplitudes and phases were in agreement with those published by the International Hydrographic Bureau (IHB), Monaco, within ± 1 cm and ± 3° respectively. Incidentally this happens to be the range of agreement between the results of harmonic analysis by two methods, viz. the least squares method and the Admiralty semigraphic method - for a tidal record at Bedwell (in Canada). For the records at Madras, Visakhapatnam, Tuticorin and Paradip, all of which were contaminated by occurrences of storm surges exceeding 20 cm, the amplitudes and phases of the principal constituents M_2, S_2, N_2, K_1 and O_1 were in agreement with those published by I HB within ± 2 cm and ± 15° respectively, whereas for other constituents the tidal constants, specially the phases, were generally not reliable.

689. **Fernandez, C.H and N.S. Sukumaran** 1995. Effect of crystalline aminoacids on the growth performance of Indian white shrimp, *Penaeus indicus* (Milne Edwards). *J. Aquacult. Trop.,* 10(3): 245-260.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The effect of incorporation of crystalline amino acids such as arginine, lysine, methionine, and tryptophan in test diets on the growth performance of the white shrimp *Penaeus indicus* were studied. In a 60 day feeding trial, juvenile *P. indicus* (15-25 mm) were fed with diets based on squid meal and fishmeal with amino acid mixtures incorporated at 0.4, 0.6 and 0.8% and the same incorporated individually at 0.1% in fishmeal-based diets. Growth rate, Food Conversion Ratio (FCR), Protein Efficiency Ratio (PER), Consumption Unit, Assimilation, Metabolism, Gross Growth Efficiency (GGE), Net Growth Efficiency (NGE), Specific Growth Rate (SGR), and Daily Growth Rate (DGR) were better on the diet based on squid meal with the synthetic amino acid mixture incorporated at 0.6% level.

690. **Fernando, A.** 1981. Community development and infrastructure facilities for improving the socioeconomic conditions of fishermen. *Proc. Sem. Role of Small-scale Fisheries and Coastal Aquaculture in Integrated Rural Development,* 6-9 December 1978, Madras. Central Marine Fisheries Research Inst., Cochin, India. *CMFRI Bulletin,* 30A : 53-56.

Address : Fish Exporters Chamber, Tuticorin - 628001, Tamilnadu, India.

Abstract : Certain suggestions are made to develop the fisheries sector and to improve the socioeconomic conditions of fishermen. The existing indigenous crafts should be mechanised with suitable inboard and outboard engines and adequate landing and berthing facilities should be provided at all minor ports. The existing training facilities at the Fishermen Training Centres should be strengthened and additional courses beneficial to fishermen introduced. Infrastructural facilities such as processing units, cold storage, fish curing yards and roads should be provided at every fishing village, together with social and community amenities. Steps should be taken to provide adequate facilities for distribution, transport and marketing of fish. Alternate jobs to fishermen during the lean fishing season should be created. Distress relief for fishermen and their families may be provided by all the states. Fishermen Cooperative Societies should be given fishing rights in tanks, ponds and reservoirs.

691. **Fernando, S.J and T. James** 1972. Mechanisation of catamarans. Mechanisation of catamarans. *Proc. Sem. Mariculture and Mechanized Fishing, Madras, India,* 28 and 29 Nov. pp. 148-149.

Address : Indo-Belgium Fish. Project Muttom, Kanyakumari District, Tamilnadu, India.

Abstract : The fields of development open to the project are outlined. It is stated that 10,000 catamarans are awaiting mechanisation along the 50 miles of coastal belt in Kanyakumari District. At first, out-board engines will be imported, but it is hoped that Indian industrialists will enter the field. The mechanisation of boats will bring other activities such as maintenance, which will create employment. The requirements for an ideal small fish boat are laid down and it is stated that experiments are being conducted with an F.A.O. design. Jetty facilities may have to be built and marketing investigation is urged. The authors call for unity in this enterprise.

692. **Fondekar, S.P and R.S. Gupta** 1976. Arsenic content in waters of parts of the northern Indian Ocean. *Indian J. Mar. Sci.,* 5(2): 235-238.

Address : National Institute of Oceanography, Dona Paula-403 004, Goa, India.

Abstract : A survey of total arsenic concentrations was carried out to evaluate the extent and magnitude of its occurrence in the waters of the Bay of Bengal, Gulf of Mannar and south-eastern Arabian Sea. Concentration of total inorganic arsenic varied from <1 to 18-75 µg/litre (av. 2-55 µg/litre). Arsenic concentration was the highest in Gulf of Mannar. It was found to be below the limit of detection in the oxygen minimum layer.

693. **Foote, R.B.** 1888. Notes on Rameswaram Island-I. *Madras Christian College Magazine* (July). pp. 828-840.

694. **Foote, R.B.** 1889. The coral reefs of Rameswaram Island. *Scott.Geogr. Mag.*,6:257-285.

695. **Francis, T., N. Sukumaran, M. Devaraj and V. Sundararaj** 1991. Induced breeding of major carps using OVAPRIM. *Fish Chimes,* 11(7): 25-27.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Breeding experiments were conducted on Indian major carps using ovaprim in the carp hatchery at Manimuthar Dam, India. *Labeo fimbriatus* (the Cauvery Carp), *Catla catla* (Catla) and *Cirrhinus mrigala* (Mirgal) were bred successfully using ovaprim (0.3 to 0.5 ml/kg) during their late breeding season. The fertilisation and hatching rate were found to be better in ovaprim induced carps than in the control.

696. **Francis, T and N. Sukumaran** 1992. Influence of salinity on energy utilization of *Etroplus suratensis* (Bloch). *J. Aquat. Trop.,* 7: 21-26.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Metabolic rates, oxygen consumption and ammonia excretion were studied in the brackishwater fish *Etroplus suratensis*, acclimated and tested at 30° C in salinities 8.75, 17.5, 26.25, 35 ppt. Oxygen consumption increased with increase in salinity only up to 26.25 ppt. However, maximum value of ammonia excretion (22.5 ± 1.87 ml/kg/hr) and ammonia quotient (0.238 ± 0.059) were in 35 ppt. Ammonia excretion values in 8.75, 17.5, and 26.25 ppt were statistically lower ($P < 0.01$) than the corresponding values in 35 ppt, while ammonia quotient values except in 8.75 ppt were significantly lower ($P < 0.01$) than those in 35 ppt. The random activity of fish showed a decreasing trend from 8.75 ppt up to 26.25 ppt followed by higher activity in 35 ppt (19.07 ± 1.17 counts/hr). The difference in random activity at different salinities indicates the dichotomy of *E. suratensis* under stress conditions.

697. **Francis, T and K. Rahman** 1994. Hormones involved in fish reproduction. *Fish Chimes,* 13(11): 27-30.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The neuroendocrine system plays in timely releasing of appropriate harmones which also help in the reproduction of the fish species. Various hormones and organs involved in fish reproduction are described.

698. **Franklin, T., P. Pitchiah and R. Palanivelu** 1989. Ecosytem analysis. Ocean resource study in Indian Ocean off Rameswaram coast through remote sensing technique. *Coastal Zone: Proc. Symp. Coastal and Ocean Management, 2* (pt2), pp. 1799-1804.

Address : Anna University, Chennai - 600 025, Tamilnadu, India.

Abstract : An attempt has been made to study the ocean resources in relation to the prevailing ecosystem off Rameswaram coast, India in Indian Ocean. The study was conducted by digital image processing of MSS data using MIDAS computer, which includes enhancement techniques and classification methods. Three distinct water classes could be identified and delineated from the MSS data and it is found that these three classes correspond to three different ecosystems in the study region. The analysis of TM data using VAX-11/780 system also confirms the existance of three water classes. The spectral signatures for the three water classes have also been generated from the digital numbers extracted from satellite data. This entire system provides a potential fishing ground for the economic variety of fishes and prawns.

699. **Freda Chandraseharan, A.D. Issac Rajendran and A.P. Valsan** 1951. Certain observations on the hydrography and biology of the pearl bank, Tholayiram paar off Tuticorin in the Gulf of Mannar in April, 1949. *J. Madras Univ.,* 21B: 48-74.

Address : Marine Biological Station, Tuticorin - 628 001, Tamilnadu, India.

700. **Freda Chandraseharan and K. Sudhakar** 1968. Observation on the hydrography and planktology of pearl banks of Gulf of Mannar. *Madras J. Fish.,* 1: 28-33.

Address : Marine Biological Station, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Various workers have in investigated the hydrological conditions and planktology of the waters in the Gulf of Mannar. Much of the early studies on plankton and hydrological features in the Gulf of Mannar around Krusadai Island.

701. **Freda Chandraseharan, A.D. Issac Rajendran and C. Malu Pillai** 1968. Salinity and temperature variations over pearl and chank beds off Tuticorin. *Madras. J. Fish.*, 4: 21-27.

Address : Marine Biological Station, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The temperature and salinity variations in the sea are to a large extent responsible for the general distribution, migration and relative abundance of organisms. The pioneering work in this field in Indian waters has been that of Sewell (1929) who, as early as in 1925, has made extensive observations; in the seasonal variations of surface temperature and salinity of the Bay of Bengal. Subsequently similar work has been undertaken by many workers at various places along the east coast of India.

702. **Freda Chandraseharan and S. Victor Chandra Bose** 1973. A note on the whale shark, *Rhincodon typus* Smith netted off Manapad. *J. Mar. Biol. Assoc. India,* 15(1): 438-439.

Address : Marine Biological Station, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The capture of a 540 cm male whale shark on 2-2-1973 off Manapad, Gulf of Mannar is recorded here with measurements of body proportion.

703. **Freda Chandrasekharan** 1988. Status report on marine fisheries development in Tamil Nadu. *CMFRI Spec. Publ.* 40:81.

Address : Department of Fisheries, Madras, Tamilnadu, India

Abstract : The declaration of Exclusive Economic zone extending up to 200 miles from the coastline has provided a great opportunity to exploit the fishery resources. The fishery resources, the number of traditional craft, mechanised fishing boats and other shore facilities available are indicated. The various schemes implemented by the Department to increase marine fish production in Tamilnadu are outlined. Future plans of the Department for maintaining and improving the fishery is also discussed.

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704. **Gallene, J and R. Hall** 1992. Exploratory fishing for large pelagic species in south Indian waters. *BOBP/WP/81/GCP/RAS/118/MUL*.

Address : Bay of Bengal Programme, Madras, India.

Abstract : Despite the substantial increase in the traditional small craft fishing fleet off Tamilnadu, India, production has remained more or less constant in the last few years, indicating that fisheries resources within the range of this fleet have been fully exploited. From the Sixties, however, introduced small fishing craft in neighbouring Sri Lanka have been operating in deep sea waters and reporting good catches of large pelagic species, particularly shark. Although Tamil Nadu is geographically well placed for the exploitation of these resources, the potential has not been realised. In order to introduce fishing for large pelagic species in Tamil Nadu by demonstrating the experience in Sri Lanka, a sub-project for fishing demonstrations in Tamil Nadu was established in 1989. The executing agency was the Tamil Nadu Department of Fisheries with technical and financial support from the Bay of Bengal Programme (BOBP), which had played a part in this development in Sri Lanka. A 10 m FRP boat (SRL 15) tested in Sri Lanka's commercial offshore fisheries was selected for the exploratory fishing trials from a base in Tamil Nadu, the Chinnamuttam fishing harbour near Cape comorin. The results and the conclusions of these trials are reported in this paper.

705. **Ganapathy, A.** 1986. On the landing of *Rhincodon typus* Smith along Adiramapatinam Coast, Tanjore District, Tamilnadu. *Mar. Fish. Infor. Serv. T & E. Ser.,* 66: 37.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of *Rhincodon typus* Smith are discussed.

706. **Ganapati, P.N and R. Nagabhushanam** 1958. Record of a new Pholad, *Panitella* sp. from Shingle Island (in the Gulf of Mannar) with a notes on its distribution. *Curr. Sci.,* 27: 394.

Address : Department of Zoology, Andhra University, Waltair, India.

Abstract : The shell is oval in outline measuring 30mm in length and 17mm in breadth. The distinct umbonal-ventral sulcus dividing the shell into 2 regions is present. The callum is well developed. The protoplax is absent and the mesoplax is transverse in one piece. The metaplax and hypoplax are characteristically absent.

707. **Ganapati, P.N and A.L.N. Sarma** 1972. Bivalves and gastropods of the Indian seas. *Proc. Ind. Nat. Sci. Acad.,* 38B: 240-250.

708. **Gandhi, A.** 1998. On the landing of a Hammer head shark (Linnaeus) at Therkuvadi (Gulf of Mannar). *Mar. Fish. Infor. Serv. T & E Ser.,* 154: 17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : On 15th November 1997, a trawler landed a gigantic female hammerhead shark *Sphyrna zygaena* locally called as 'Komban shura' at Therkuvadi landing center. The morphometric measurements of *Sphyrna zygaena* are given in this paper.

709. **Gandhi, V and G. Mohanraj** 1986. Results of experimental monoculture of milkfish in marine fishfarm at Mandapam. *J. Mar. Biol. Assoc. India,* 28(1&2): 63-73.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of the experiments conducted during 1980-82 on the monoculture of milkfish (*Chanos chanos*) at the marine farm, Mandapam, Tamil Nadu, India, are presented. In a 0.25 ha earthern pond, each experiment was conducted for a period of 10 months. Fertilization with 1000 kg/ha of chicken manure and 400 kg/ha of N-P-K (12-24-12) was carried out in the first experiment. Supplementary feed at the rate of 5-10% body weight of the fish was given in the second experiment. The stocking density of 4000 fingerlings/ha yielded 216 kg/ha in the fertilized pond with a survival rate of 89.7%, and 852 kg/ha in the unfertilized pond with 63% of survival.

710. **Gandhi, V., G. Mohanraj and R. Thiagarajan** 1986. Biology and biometry of milkfish *Chanos chanos* (Forsskal). *J. Mar. Biol. Assoc. India*, 28(1&2): 169-177.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Observations made on the length-weight relationship for adult milkfish (*Chanos chanos*), ova-diameter frequency distribution, relationship between fecundity and total length, fecundity and standard length, and weight and fecundity are presented. The regression lines for 17 morphometric characters in relation to the standard length were worked out. Snout to anal origin grows faster than snout to ventral origin. Head length shows faster rate of growth than head depth. The stomach content revealed the presence of diatoms predominantly. Fecundity varied between 1,424 and 5,321 thousands in the fish in the size range of 1,100-1,340 mm.

711. **Gandhi, V., A. Raju, V.S. Rengaswamy, G. Mohanraj and K. Dorairaj** 1988. Further observations on the suitability of the marine fish farm at Mandapam for the culture of milkfish and grey mullets. *Indian J. Fish.*, 35(3): 178-185.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The paper gives an account on the culture of milkfish *Chanos chanos* and the grey mullet *Valamugil seheli* under mono and polyculture systems in the saltwater ponds at Mandapam, Tamil Nadu, India during the period 1982-1983. Ponds of 2,400 m^2 (two ponds), 450 m^2 (2 ponds) and 200 m^2 (3 ponds) were used for conducting the culture experiments. The stocks were fed with a supplementary feed. The growth of fish was better in polyculture experiments. The rate of production of *C. chanos* was 354-443 kg/ha with a survival of 73.2-79.9% in monoculture and 422-872 kg/ha with 56.7-70.0% survival in polyculture experiments. *V. seheli* indicated a production of 200-290 kg/ha and 67-89 kg/ha with the survival rates of 22-91% and 13.3-20.7% in mono and polyculture experiments respectively.

712. **Gandhi, V.** 1998. Studies on the Ecology and Biology of Butterfish, *Scatophagus argus* in Mandapam Coastal Region. *Ph.D Thesis.* Madurai Kamaraj University, Madurai. 200 pp.

Address : Centre for Marine and Coastal Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai – 625 021, Tamil Nadu, India.

Abstract : The biology and ecology of the spotted scat, *Scatophagus argus* was studied as it has economic and ornamental value. Detailed studies on biometry, length weight relationship, food and feeding habits, reproduction and population growth parameters were carried out. Variations in body structure, number of dorsal spines, anal spines, dorsal rays and anal rays were observed. The scat had 11 dorsal spines, 15-17 dorsal rays, 4 anal spines and 14-15 anal rays. The body was solid, angular and deeply compressed and the fins were yellowish with light brown markings between the rays. The length weight relationship indicated that the value of the exponent 'n' was considerably below 3. There was a sudden increase in weight of the fish on attainment of first maturity which occurred for the males in the size group 120-129 mm and for the females in the size group 140-149 mm. Analysis of covariance to test the equality of length and weight relationship in males and females revealed significant difference between the sexes. Studies on food and feeding habits clearly indicated that scats are omnivorous and generally prefer phytoplankton, filamentous algae, *Ulva* spp., coral polyps, sea anemones, bivalves, lepas, prawns and other crustaceans and alphids. Variations in moisture content in muscles, liver, and gonad between male and female fishes were observed. It was found out that the moisture content in muscles, liver and gonad was dependent on the content of carbohydrate and lipids in these organs. It was also observed that the moisture content greatly decreased during the development of gonad and spawning. The size of ova varied according to the stages of development of ova. It was also observed that the spawning of scat fish occurs twice a year; one during northeast monsoon and the other during southwest monsoon. In the present study maturity of gonad, both in male and female fishes, was observed. The study clearly indicated that the development and percentage of occurrence of gonad are related to the size of the fishes. The mean gonado-somatic indices of male and female fishes were greater than the grand mean (1.00 in male and 5.31 in female) during the southwest and northeast monsoon months coinciding with spawning season of the scat. Physico-chemical parameters of surface and bottom waters of the locations in Gulf of Mannar and Palk Bay, where from the fishes were collected, were studied. No significant variations in temperature values of atmosphere, surface water and bottom water of Palk Bay and Gulf of Mannar were observed. In the Gulf of Mannar, atmospheric, surface water, and bottom water temperatures ranged between 26ºC and 32.2ºC, 23.6ºC and 32ºC, and 25.7ºC and 32ºC respectively, whereas in Palk Bay they ranged from 25.7ºC to 33ºC, 26.2ºC to 32ºC, and 26.4ºC to 32ºC respectively. Similarly no variations in pH values of surface and bottom waters of Gulf of Mannar and Palk Bay were observed as it ranged from 8.1 to 8.8 in both the stations. Narrow variations were recorded in the salinity and dissolved oxygen concentrations of the surface and bottom waters of the Gulf of Mannar and Palk Bay. The salinity values ranged from 29.6 to 36 ppt at the surface and 28.7 to 36 ppt at the bottom in the Gulf of Mannar. In the Palk Bay region it ranged from 26.3 ppt to 35.4 ppt at the surface and 26.9 ppt to 35.6 ppt at the bottom. The concentration of dissolved oxygen of surface and bottom waters between Gulf of Mannar and Palk Bay showed only narrow variation. It ranged from 4.9 ppm to

9.7 ppm in the Gulf of Mannar and from 4.3 ppm to 8.6 ppm in the Palk Bay region. The dissolved nutrients phosphate, nitrate, nitrite, and silicate estimated for both the surface and bottom waters of the two study sites, showed no significant variations in the concentrations of dissolved phosphate in surface and bottom waters of Gulf of Mannar and Palk Bay and it ranged from 0.9 ppb to 14.1 ppb at the surface and from 0.9 ppb to 10.7 ppb at the bottom. Similarly, narrow differences only were recorded in the concentrations of dissolved silicate between the stations and it ranged from 0.04 ppm to 1.19 ppm in the surface water and from 0.08 ppm to 1.22 ppm in the bottom water. The concentrations of dissolved nitrate in the surface water ranged from 10.51 to 89.29 ppb and in the bottom water it ranged from 10.55 to 95.52 ppb for the two study sites. The concentration of dissolved nitrite in the surface water ranged from 10.51 to 64.43 ppb in the surface and in the bottom it ranged from 10.51 to 55.05 ppb in both the stations. Gross primary productivity (GPP) ranged from 22.04 to 165.37 mg.C/m^3/hr and net photosynthesis ranged from 8.82 to 79.15 mg.C/m^3/hr in the Gulf of Mannar. Conversely in the Palk Bay, the GPP range was 33.58 to 160.33 mg.C/m^3/hr and NPP ranged from 10.18 to 146.96 mg.C/m^3/hr. The study concludes that the Scat fish is suitable for aquarium, because of its attractive appearance, friendly behavior with other organisms, slow growth, and hardiness to withstand stress. Boiled lettuce, spinach, steeped oatmeal, aquarium plants like *Nitella* spp., and *Riccia* spp., were the favorable feed items for the scat fish in aquarium. The time taken for rearing of fry in aquarium was calculated and it took 18 days to attain a length of 20mm. The study concludes that these findings would help the fishermen to know the proper harvest time to catch the Scat fish from the Gulf of Mannar and Palk Bay.

713. **Gandhi, V.** 2000. Fishing methods of Gulf of Mannar. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp.47-49.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In order to present recent information regarding the fishing method of Gulf of Mannar, this article has been written. Different types of crafts and gears have been described. Recently motorization of indigenous craft has been introduced. Most of the nets have been fabricated by synthetic or nylon threads. Information regarding the size of the craft, material used for the construction of boat, horse power and the trade mark of diesel engine, length, width and mesh size of the net are presented. Fin fishes and shellfishes which are caught in this region are also given.

714. **Ganesan, M., R. Kannan, K. Rajendran, C. Govindasamy, P. Sampathkumar and L. Kannan** 1991. Trace metals distribution in seaweeds of the Gulf of Mannar, Bay of Bengal. *Mar. Poll. Bull.*, 22(4): 205-207.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India.

Abstract : The trace metal distribution in seaweeds of Indian coasts has been well documented. However, there is no information on the trace metal content of the seaweeds occurring in the Gulf of Mannar region of the Bay of Bengal. The present study reports the distribution of Mn, Fe, Cu and Zn in 18 species of seaweeds collected from two stations of the Gulf of Mannar.

715. **Ganesan, M., R. Kannan, K. Rajendran, C. Govindasamy, P. Sampathkumar and L. Kannan** 1991. Changes in biomass of agarophytes at Pudumadam and Tuticorin, Gulf of Mannar. *Seaweed Res. Utiln.*, 13(2): 105-114.

716. **Ganesan, M.** 1992. Ecobiology of seaweeds of the Gulf of Mannar with special reference to hydrography and heavy metals. *Ph.D. Thesis*, Annamalai University, India, 164 pp.

717. **Ganesan, M and L. Kannan** 1994. Seasonal variation in the biochemical constituents of economic seaweeds of the Gulf of Mannar. *Phykos*, 33(1&2): 125-135.

Address : Central Salt and Marine Chemical Reserch Institute, Marine Algal Research Station, Mandapam Camp - 623 519, India.

Abstract : Seasonal variation in the biochemical constituents like primary productivity, total chlorophyll, protein, carbohydrate and lipids in *Gracilaria corticata* J. Ag, *Sargassum wightii* Greville, *Padina gymnospora* (Kuetz.) Vickers and *Acanthophora spicifera* (Vahl.) Boergs. collected from two stations of Gulf of Mannar were studied for two years from April 1989 to March 1991. The primary productivity varied from 0.13 to 4.10 mg.C/g/hr, chlorophyll from 0.02 to 0.73 mg/g (f.wt), protein from 0.08 to 28.29 mg/g (f.wt), carbohydrate from 0.02 to 1.94 mg/g (f.wt), and lipid from 0.04% to 14.60% (dry.wt). Of the four seaweeds, *G. corticata* and *P. gymnospora* showed higher photosynthetic productivity and *A. spicifera* showed the lowest productivity. Brown algae showed higher chlorophyll, protein, carbohydrate and lipid content than red algae. Biochemical contents were generally

more during the monsoon and postmonsoon seasons. Among the various physico-chemical parameters, salinity, dissolved oxygen, light penetration and nutrients influenced the biochemical constituents of seaweeds.

718. **Ganesan, M and L. Kannan** 1995. Iron and manganese concentrations in seawater, sediment and marine algae of Tuticorin coast, southeast coast of India. *Indian J. Mar. Sci.* 24(4): 236-237.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Seasonal variation in Fe and Mn concentrations were determined in seawater sediment and algae (Padina gymnospora and Acanthophora spicifera) in the vicinity of Tuticorin Port. Fe and Mn were appreciably higher than other parts of the Indian coast. High content of Fe and Mn were observed in seawater during northeast monsoon (November and December) and postmonsoon (January and March) seasons and in sediment Fe and Mn concentrations were high during monsoon (July to October) and postmonsoon (January, February) seasons due to increasing inputs of land runoffs. Algae also concentrated more metals during monsoon and postmonsoon seasons. Significantly higher Fe concentration in algae than other parts of the Indian coast reflects the intensity of Fe pollution in Tuticorin Coast.

719. **Ganesan, M and L. Kannan** 1995. Seasonal distribution of intertidal seaweeds and seagrasses at two selected places of the Gulf of Mannar. *Phykos.* 34(1&2): 135-144.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : Seasonal variation in the distribution and biomass production by the intertidal seaweeds and seagrasses was studied for a period of one year from April 1988 to March 1989 at two stations, Pudumadam (Station 1) and Tuticorin (Station 2) in the Gulf of Mannar located along the Southeast coast of India. Twenty six species of macroalgae and two species of seagrasses were recorded from Pudumadam and 31 species of macroalgae and 3 species of seagrasses were recorded from Tuticorin. Phaeophyceae and Rhodophyceae produced more biomass at Pudumadam, whereas the biomass of Chlorophyceae was more at Tuticorin. *Sargassum wightii* and *Gracilaria corticata* at station 1 and *Ulva lactuca*, *Padina gymnospora* and *Acanthophora spicifera* at station 2 were found to be dominant and occured round the year producing more biomass during monsoon season.

720. **Ganesan, M and L. Kannan** 1996. Mercury concentration in some seaweeds from the Gulf of Mannar, *Phykos*, 35(1&2): 151-160.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

721. **Ganesan, M and K. Rama Rao** 1999. Effect of spacing of seed material on biomass of *Gracilaria edulis* (Gmel.) Silva in cultivation. *Seaweed Res. Utiln.*, 21(1&2): 69-72.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : In order to achieve maximum biomass of *Gracilaria edulis* on culture ropes, different spacing intervals of seed material (vegetative) on the culture rope were tried. The spacing distances employed were 6 cm, 12 cm and 18 cm. A maximum biomass of 1000 gm was recorded in 12 cm spacing after 145 days of growth with 24.15 cm in length, 0.15 extension growth rate (EGR).

722. **Ganesan, M., O.P. Mairh, K. Eswaran and P.V. Subba Rao** 1999. Effects of salinity, light intensity and nitrogen source on growth and composition of *Ulva fasciata* Delile (Chlorophyta, Ulvales). *Indian J. Mar. Sci.*, 28(1): 70-73.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : Effect of two levels (low and high) of salinity (20 and 35 ppt), light intensity (26 and 72 μ E m^2s^1) and nitrogen source (as nitrate and ammonia) on growth rates, chlorophyll a and b, carotenoids, protein, carbohydrate and lipid composition of *Ulva fasciata* were studied in a 3 x 2 factorial laboratory experiment. Specific growth rate (SGR) was maximum at high light intensity and high salinity. Low light intensity and high salinity enhance the accumulation of pigments, protein, carbohydrate and lipid contents. Ammonium in the form of NH_4SO_4 is relatively better nitrogen source for maximum growth and biochemical composition of *U. fasciata*.

723. **Ganesan, M., P.V. Subba Rao and O.P. Mairh** 1999. Culture of marine brown alga *Padina boergesenii* (Dictyotales, Phaeophyta) at Mandapam coast, southeast coast of India. *Indian J. Mar. Sci.*, 28(4): 461-463.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : Field culture of *Padina boergesenii* Allender and Kraft (fairly rich in iodine 0.3% of dry weight) was carried out using spore liberation on rafts in lagoon area of Krusadai Island and open sea at Ervadi along the Mandapam coast. Two crops (720 g fresh weight (fwt)/0.25 m^2 and 525 g fwt/0.25 m^2 respectively) were achieved at Krusadai Island and one crop (610 g fwt/0.25 m^2) was obtained at Erwadi. The results indicated that the alga can be cultivated by this technique.

724. **Ganesan, M., O.P. Mairh and P.V. Subba Rao** 2000. Seasonal variations in growth and spore production of marine brown algae *Padina boergesenii* and *P. tetrastromatica* (Dictyotales/ Phaeophyta) in the Mandapam region, southeast coast of India. *Indian J. Mar. Sci*., 29(3): 253-257.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam Camp - 623 519, Tamilnadu, India; Central Salt and Marine Chemicals Research Institute, Bhavnagar 364 002, Gujarat, India.

Abstract : Growth of *Padina boergesenii* Allander and Kraft and *P. tetrastromatica* Hauck in Mandapam region were studied monthly for two years along with seasonal variation in tetraspore shedding and diurnal periodicity of spore output for *P. boergesenii*. Two peaks in biomass were observed with maximum biomass of *P. boergesenii* during January'93/ February'94 (2500 g fr.wt./m^2 and 4200 g fr.wt./m^2) and again a small peak during July'93/ August,94 (1200 g fr.wt./m^2 and 1300 g fr.wt./m^2). Maximum biomass of *P. tetrastromatica* was recorded during January'95 (740 g fr.wt/m^2) and February'95 (730 g fr.wt./m^2) and again a second peak in May'93 (410 g fr.wt./ m2). Relative growth rate (RGR g fr.wt./day) varied from 0.003 to 0.07 in *P. boergesenii* and 0.006 to 0.07 in *P. tetrastromatica*. Extension growth rate (EGR mm/day) ranged from 0.1 to 2.6 in *P. boergesenii* and 0.1 to 2.06 in *Padina tetrastromatica*. Tetraspore output in *P. boergesenii* showed distinct seasonal periodicity with two peaks, one in December/January'93 (19,260/g fr.wt. and 6300/g fr.wt) and another peak in August'94 (32,261/ g fr.wt). Diurnal periodicity in spore liberation showed maximum number of spores (1538/g fr.wt) released during night hours between 2200 and 0200 hrs. The present study on biomass and sporulation suggests single harvest in a year during January and February may not disturb natural population of *P. boergesenii* and *P. tetrastromatica* in the intertidal habitats. The present study also revealed ideal season (December and August) and time (2200-0200 hrs) for bulk collection of tetraspores to start cultivation of the algae from the spores.

725. **Ganesan, M., O. P. Mairh and P.V. Subba Rao** 2001. Effect of shelf life of brown algae *Sargassum wightii* (Fucales / Phaeophyta) and *Turbinaria conoides* (Fucales/ Phaeophyta) on alginic acid yield. *Indian J. Mar. Sci.*, 30(2): 108-110.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp 623 519, Tamil Nadu, India.

Abstract : Two brown algae *Sargassum wightii* and *Turbinaria conoides* were collected from the shores of Mandapam, (south east coast of India) then dried in air under sun and shade separately and stored at room temperature (30±2°C) for a period of 120 days. Their alginic acid yield was determined at regular intervals of 15 days period. In sun dried *Sargassum wightii*, (moisture content 84.81±2.31%), slight increase in alginic acid was observed from 30 days to 105 days whereas in shade dried alga (moisture 81.17±2.19%), slight decrease in alginic acid yield was obtained on 120th day. In the case of Turbinaria conoides, depletion of alginic acid yield was more in shade-dried alga (moisture 81.82±1.68%) and lesser in sun dried alga (moisture 83.96±2.5%). Therefore algae dried under direct sunlight and then stored in polythene bags increases the shelf life of above algae with respect to alginic acid content.

726. **Ganesan, M., B. Jha and P.V. Subba Rao** 2004. Influence of post-harvest treatment on shelf life and agar quality in seaweeds *Gracilaria edulis* (Rhodophyta/ Gigartinales) and *Gelidiella acerosa* (Rhodophyta/Gelidiales). *Indian J. Mar. Sci.*, 33(3): 269-275.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp 623 519, Tamil Nadu India; E-mail: ganesandr@yahoo.com

Abstract : The effect of acetic acid and alkali (KOH) pretreatments on the shelf life of *Gracilaria edulis* and Gelidiella acerosa were studied with respect to the agar yield and physical properties. Algae collected from the

Gulf of Mannar, southeast coast of India were treated with 1) 0.5% acetic acid for 1 hr, 2) 1% KOH for 1 hr and 3) 0.5% acetic acid 1 hr followed by neutralization in 1% KOH for 1 hour. *Gracilaria edulis* pretreated with acid + alkali gave the maximum agar yield (69.2 ± 12.3%), gelling temperature (50.5 ± 1° C) and melting temperature (82.5 ± 1.5° C). However no improvement in gel strength was recorded over control. Acid treated *Gelidiella* acerosa yielded the maximum agar (59.2 ± 3.9%) while exhibiting a gel strength of 295.1 ± 18.6 g.cm^2, a gelling temperature of 53 ± 2.5° C and a melting temperature of 88.7 ± 0.7° C. When the pretreated algae were stored for 4 months, for *G. edulis* agar yield remained same but its physical properties decreased gradually. In *G. acerosa* agar yield and melting temperature were constant, but gel strength and gelling temperature decreased drastically. It is suggested that agar industry can treat *Gelidiella acerosa* with acetic acid and *Gracilaria edulis* with acetic acid and KOH prior to storage. This will help to increase the agar yield and its physical properties on immediate use and maintain agar yield on long term use.

727. **Ganesh Babu, T., P. Nithyanand, E. Kannapiran, A. Veera Ravi and S. Karutha Pandian** 2004. Molecular identification of bacteria associated with the coral reef ecosystem of Gulf of Mannar Marine Biosphere Reserve using rRNA sequences. *Proc. Nat. Sem. New Frontiers in Marine Bioscience Research, January 22-23, 2004.* pp. 47-53.

Address : Department of Biotechnology, Alagappa University, Karaikudi - 630 003, Tamilnadu, India.

Abstract : With an objective of identifying the bacterial diversity associated with coral reef ecosystem of Gulf of Mannar Marine Biosphere Reserve, bacteria were isolated from the coral tissues. Isolates exhibiting different morphological features were selected for molecular identification. Nine isolates exhibited differences in morphological features and these bacteria were subjected to molecular identification. 16S rRNA genes were successfully amplified from the genome of the selected isolates using Universal Eubacterial 16S rRNA primers. The resultant amplification products were subjected to Amplified ribosomal DNA restriction analysis (ARDRA) using Hinfl to identify different polymorphic groups among amplicons. The ARDRA analysis revealed five different polymorphic groups. Based on the results of ARDRA analysis, 16S rDNA amplicons of the five representative strains were subjected to automated DNA sequencing. Partial 16S rDNA sequences obtained were compared directly with sequences in the NCBI database using BLAST as well as with the sequences available with Ribosomal Database Project (RDP). The sequence analysis revealed that four isolates belong to the *Bacillus* sp and the fifth one being *Enterobacter cloacae*.

728. **Ganga Devi, T., V. Shoba and T. Vasudevan Nair** 1996. Abundance of iodine in marine algae of Cape Comorin. *Indian J. Mar. Sci.*, 25: 363-364.

Address : Division of Marine Chemistry, Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum- 695 007, India.

Abstract : Concentrations of iodine in 18 species of marine algae (green, brown and red) from Cape Comorin were analysed by the alcoholic potash method. The values ranged from 2.54 to 70.85 mg/l00 g dry weight. High iodine content was observed in red algae (av. 38.07) as compared to green (av. 29.07) and brown (av. 27.18 mg/ 100g dry weight) algae.

729. **Ganga Devi, T., S. Sreekumari, G.S. Ammal, V. Shoba and T. Vasudevan Nair** 1996. Organic constituents (mannitol, carbohydrate, lipid and protein) of marine algae of Cape comorin: A preliminary study. *Seaweed Res. Utiln.,* 18(1&2): 67-72.

730. **Ganga Devi, T., V. Shoba and T. Vasudevan Nair** 1999. Survey of iodide in different water bodies of four southern districts of Kerala and Kanyakumari of Tamil Nadu. *Seaweed Res. Utiln.,* 21(1&2): 149-154.

731. **Gardiner, J.S.** 1900. Coral reefs of Indian Region. *Rep. Br. Ass. Advmt. Sci.,* 1900: 400.

732. **Geetha, A., T.S. Naomi and K.J. Mathew** 1990. Studies on the occurrence and abundance of planktonic gastropods other than petropods and heteropods from the EEZ of India and adjoining seas. *Proc. First Workshop Scient. Result. FORV Sagar Sampada* 5-7 June 1989. pp. 165-177.

733. **George, K.C.** 1971. Salt water fish farming. *Seafood Export J.,* 3(1): 7-14.

734. **George, K.V.** 1978. Prawn farming. *CMFRI Spec. Publ.,* 3: 116-121.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Prawn culture methods presently adopted in different parts of the world can be broadly classified into two categories *viz.*, extensive and intensive methods. Extensive prawn farming consists of just holding, growing and harvesting prawns in the impoundments, whereas intensive culture involves selective stocking of the ponds with prawn fry obtained either from natural sources or by artificial breeding, and raising them by careful rearing under controlled conditions.

735. **George, M.J and K.H. Mohamed** 1960. An assessment of marine prawn fishery resources of Kanyakumari District - southwest coast of India. *Proc. IPFC,* 12(11): 210-219.

736. **George, M.J.** 1973. The lobster fishery resources of India. *Proc. Symp. Living Resources of the Seas around India, Cochin, December1968 Cochin, India.* CMFRI. pp. 570-580.

Address : National Institute of Oceanography, Regional Centre, P.B. 1913, Ernakulam, Cochin-682 018, India.

Abstract : The increasing demand for frozen lobster tails from world markets has brought the Indian spiny lobster to the lime light. An assessment of the total lobster resources of the country is made. Among half a dozen species of spiny lobsters reported from the different coastal areas and which are enumerated, *Panulirus homarus* is the most important from the commercial point of view. Details of the distribution of the different spp along the coastline are given. Kanyakumari District on the south-west coast is the area with the maximum production. An estimate of the population of this and nearby areas is made both by the fishing success method as well as the Petersen method of tag recovery. The 2 population estimates are quite in agreement. based on the population estimates the present rate of exploitation is also calculated. Species of potential commercial importance obtained in recent exploratory cruises in deeper waters off Kerala are mentioned.

737. **George, M.J., K. Nagappan Nayar and S. Mahadevan** 1973. Underwater observations on a collection of shrimps from the Gulf of Mannar off Tuticorin. *Rec. Zool. Surv. India*, 67 : 357-365.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : While SCUBA diving (by K.N.N. and S.M.) in connection with the under water survey of the pearl oyster and chank fishery in the Gulf of Mannar region off Tuticorin on the southeast coast of India a few shrimps were collected. On detailed examination, most of them were found to be new records from this region and opportunity is taken to report them here. One male of 14 mm in length and one female measuring of l5 mm in total length, collected from 15 m depth.

738. **George, M.J and P. Philip Samuel** 1993. Biochemical genetics of selected commercially important penaeid prawns. *CMFRI Spl. Publ.*, 56: 48-56.

739. **George, P.C.** 1964. Our current knowledge on the food and feeding habits of the Indian mackerel *Rastrelliger kanagurta*. *Proc. Symp. Scombroid fishes, MBAI*, 2: 571-573.

740. **George, P.C.** 1988. New horizons in fishery development planning. *CMFRI Spec. Publ.*, 40: 1-3.

Address : 3-D Saraswathy Nilayam, Jawahar Nagar, Trivandrum - 695 041, India.

Abstract : Fishery-policy planning at state and central levels covering research, training and development during the last few decades has been more or less singularly focused towards increasing production and utilisation of modern technology to achieve the projected targets. The demand for increased production to meet domestic needs and export targets was the main compulsion.

741. **Ghosh, S.N., A. Mitra and A.N. Bose** 1988. Standardization in brackishwater fishfarm management for optimum production through mathematical modelling. *CMFRI Spec. Publ.*, 40: 43-44.

Address : Indian Institute of Technolgy, Kharagpur, India.

Abstract : The necessity to improve upon the management and performance of brackishwater farming for the culture of finfish and shellfish is receiving considerable attention from various national governments and International agencies. Existing knowledge and concepts primarily under Indian conditions in the management of brackishwater aquacultural systems are examined, highlighting the need towards formulation of a mathematical model for predicting the optimum fish growth and production. Parameters influencing the growth and survival of the selected species in a highly complex dynamic physico-chemico-biological environment are considered.

742. **Gillet, F.P.** 1981. Small-scale fisheries development projects at Muttom, Kanyakumari district - A case study. *Proc. Sem. Role of Small-scale Fisheries and Coastal Aquaculture in Integrated Rural Development, 6-9 December 1978, Madras*. Central Marine Fisheries Research Inst., Cochin, India 1981. *CMFRI Bulletin*, 30A : 97-101.

Address : Kottar Social Service Society, Fisheries Development Projects, Muttom, Kanyakumari District, Tamil Nadu, India.

Abstract: The programmes and results of the Indo-Belgian Fisheries Project (1968-1973) at Muttom for the development of the traditional fisheries are reviewed. A pioneering effort was made towards mechanisation of the catamaran and tests were conducted on beach-landing crafts. Nylon net webbing centres were also started. On conclusion of the Project, development activities were taken up by the Kottar Social Service Society in 1974. Marketing Associations ("Sangams") have been started. A Boat Building Training Centre functions for the benefit of the local youth. Pilot experiments are conducted for improving the operational aspects of the traditional fisheries. The progess of the Society's Fisheries Development projects is presented. The problems of the small-scale fishermen are discussed. The question of treating mechanisation of the indigenous crafts as a local problem or as a problem of national and global significance is considered.

743. **Gillet, F.P.** 1985. Small is difficult. The pangs and success of small boat technology transfer in south India. *Rugby UK Intermediate Technol. Development group ITDG.* 50 pp.

Address : Centre for Appropriate Technology, 5 Jawahar St., Nagercoil, Kanyakumari 629001, India.

Abstract : An account is given of the recent developments in boat-building technology in South India, which started in 1981 when the Centre for Appropriate Technology initiated aid to the Boat Building Centre at Muttom regarding new technology. Details are given of the various problems encountered during the development and the success of the process of technology transfer relating to small plywood boats used for marine fishing by the artisanal fishermen in the area.

744. **Girijavallaban, K.G and S. Rajapackiam** 1983. Farming the coastal land at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.*, 47: 13-15.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, Tamilnadu, India.

Abstract : This study reveals the resources and site development for construction of coastal farm in swampy land.

745. **Girijavallaban, K.G., S. Krishna Pillai, R. Marichamy, C.V. Mathew, T.S. Naomi, P. Siraimeetan, K.Ramachadran Nair, Rani Mary Jacob, G. Subramaniya Bhat and K.J. Mathew** 1983. Trends in secondary production in the inshore waters of the seas around India. *Mar. Fish. Inf. Serv. Tech. Ext. Ser.*, 47: 1-8.

Abstract : The pattern of the occurrence and abundance of zooplankton along the Indian coasts from Bombay on the west coast up to Madras on the east coast is described. Regular weekly or fortnightly samples of zooplankton were collected from fixed stations as surface tows for 10 minutes using a half metre ring net made of nylobolt of 0.4 mm mesh size. The samplings were carried out from motorboats at Bombay, Tuticorin, Mandapam and Madras. At Vizhinjam a catamaran was used for making the collections and at other centres country crafts were used for the purpose of plankton collections.

746. **Gnanamuthu, C.P.** 1943. The Foraminifera of Krusadai Island in the Gulf of Mannar. *Bull. Madras Govt. Mus. New. Ser., Nat. Hist. Section*, 1(2): pt.5: 1-21.

Address : Krusadai Biological Station, Gulf of Mannar, Tamil Nadu, India.

747. **Gnanamuthu, C.P.** 1947. The occurrence of termites at Krusadai Island. *Curr. Sci.*, 16(5): 154-155.

Address : Krusadai Biological Station, Gulf of Mannar, Tamil Nadu, India.

Abstract : During a brief stay at the Biological station at Krusadai Island in the Gulf of mannar, the author noticed termite tunnels along the wood work of the windows in the laboratory and collected a number of workers. However, during a few nights spent there, no alate forms were obtained, but a few of these which had fallen previously (probably the day before) into a glass container were preserved. Dr. Gardener, Forest Entomologist, Dehra Dun has kindly identified them to belong to *Coptoterms ceylonicus* Holmgren.

748. **Godwin Wesley, S.** 2004. Bioaccumulation of heavy metals by the intertidal molluscs of Kanyakumari waters, India. *Poll. Res.*, 23(1): 37-40.

Address : Department of Zoology, Scott Christian College, Nagercoil - 629003, Tamil Nadu, India.

Abstract : The concentration of zinc, copper, manganese and iron in the mantle, foot and gills of four gastropods and a bivalve were determined. The gastropod *Turbo intercostalis* recorded the maximum accumulation for zinc, iron and copper. The other gastropod *Fasciolaria filamentosa* recorded the highest manganese concentration. Except for zinc all the other three metals were highly concentrated in the gills the former was concentrated more in the mantle.

749. **GOI/UNDP/GEF.** Project for strengthening the management of the Gulf of Mannar Marine Biosphere Reserve. *MSSRF Publ.,* 51 p.

Address : M.S. Swaminathan Research Foundation, Chennai-600 113, Tamilnadu, India.

Abstract : The overall objective of this project is to conserve the Gulf of Mannar's globally significant assemblage of coastal biodiversity. The Gulf of Mannar Biosphere Reserve (GoMBR) located in Southern India's Gulf of Mannar harbors marine and coastal biodiversity of global significance. The core area of the reserve is comprised of 21 islands from between 1 and 4 kilometers offshore along 150 kilometers of coastline. These uninhabited islands and their surrounding shallow waters comprise the Gulf of Mannar Marine National Park (GoMMNP). The core area is in turn surrounded by a "buffer zone" extending for 10 kilometers out in every direction, including the coastal area where the people live. This diversity of the Reserve is principally threatened by over harvesting of marine resources, habitat destruction, and to lesser more localized extent, civic pollution. By the end of this project, management of the GoMMNP will have been strengthened and the attendant biodiversity conserved. Conservation will be carried out through "traditional" protected area work in the core area, integrated management and amelioration of threats to biodiversity in the buffer zone, and by substituting sustainable activities for existing non-sustainable livelihoods and overcoming other barriers' to sustainability in the buffer zone. The Park will be zoned for management of priority habitats, and buffer zone communities will be full participatory stakeholders in park management. Degradation of priority habitat areas will have been stopped, and active management of key species and plant communities underway. Technical and administrative staff of local and national institutions will have been trained in integrated coastal area management. An integrated GoMBR management program characterized by an ethic of equitable stewardship and an enabling institutional, policy, regulatory and financial framework will have been established.

750. **Gokhale, S.V.** 1990. Marine fisheries Research and Survey in India. *Seafood Export J.,* 22(4): 5-12.

751. **Gokul, A and K. Venkataraman** 2003. Status and biology of coral reef associated xanthid Crabs in Gulf of Mannar Biosphere Reserve. *Nat. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 32.

Address : Marine Biological Station, Zoological Survey of India, 130, Santhome High Road, Chennai-600 028, Tamilnadu, India.

Abstract : A detailed survey on the diversity of coral associated brachyuran crabs was conducted in all the 21 islands of Gulf of Mannar Biosphere Reserve. In the present study 21 species of the brachyuran crabs were collected and identified. When a comparison was made with all the other groups of the brachyuran fauna, the xanthid group dominates in the number of individuals. Xanthid associations in live coral were less when compared to that of the dead corals. The available crabs associated in the dead corals are *Chlorodiella nigra, Leptodius exaratus, Leptodius euglyptus, Paraactaea cavipes, Cymo andreossyi, Demania baccalipes, Pilodius areolatus, Etisus laevimanus and Phymodius nitidus*. The diversity, association and the biology of the xanthid crabs are studied. All the surveys were conducted using snorkels. The xanthid crabs were collected by gently taping and breaking the corals with hammer and the crabs were picked with forceps. The collected crabs preserved with 5% formalin. Among the xanthids the *Chlorodiella nigra* is widely distributed in reef areas of all the Islands. The abundance of Xanthid crabs was high in the Mandapam group of Islands than Keelakarai and Tuticorin group. The length breadth frequency of xanthids was correlated with the coral size and the influence of the size of the gaps in the branches of the host coral and the size of the crab was discussed.

752. **Gopakumar, S.D.** 2002. Studies on optimum dietary protein requirement for *Penaeus semisulcatus* de Hann. *J. Mar. Biol. Assoc. India,* 44(1&2): 220-225.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Optimum protein requirement in green tiger prawn *Penaeus semisulcatus* using different protein diet ranging from 20,25,30,35,40,45% was studied. Since the protein source need appeared to be similar in amino

acid profile of the experimental organism viz., *P. semisulcatus*, shrimp meal was used throughout the study. The composition of the shrimp meal was 74.5% moisture and 18.2% protein in live weight. The protein content of the dried shrimp was 71.3%. The study indicated the optimum dietary protein requirement for the species as 40%. Since the percentage weight at 35% protein diet was close to that of 40%, a range between 35-40% was taken as optimum for growth.

753. **Gopalakrishna Pillai, N and K. Dorairaj** 1985. Results of the trawling survey by an institutional boat Cadalmin II in the Palk Bay and Gulf of Mannar, Mandapam, during 1977-80. *Indian J. Fish.,* 32(1): 123-132.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : During the course of the trawling survey conducted in 1977-80 R.V. Cadalmin II (13.3 m, 100 BHP) landed from the Palk Bay and Gulf of Mannar a total of 46.366 kg of all fish at an annual average catch rate of 57.5 kg as a result of a total fishing effort of 806.3 h. Silverbellies formed 80% of the catch. The sub-areas 9-78/1F, 9-79/2B, 2C, 3B, 3C, 3D, 4A, 4B and 4C were found to be most productive. April-June in the Palk Bay and October-December in the Gulf of Mannar were the best seasons for trawling. Over 70% of the catch came from 4-10 m depth. When compared with earlier studies, a change was noticed in the composition of fish species in this region. The estimated potential yield for all the eight sub-areas surveyed in the Palk Bay and seven sub-areas in the Gulf of Mannar was 874.6 t and 473.7 t, respectively.

754. **Gopalakrishna Pillai, N.** 1989. Need for a sound knowledge on the icthyofauna of the locality, where work is taken up - spawning season and spawning grounds. *Summer Inst. Fish. Eggs and Larva,* pp. 1-11.

755. **Gopalakrishna Pillai, N and P.K. Katiha** 2004. *Evolution of fisheries and aquaculture in India, CMFRI.* 240 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 628 018, India.

Abstract : The fisheries sector plays a vital role in the Indian economy. It addresses various issues like food and nutritional security, employment, livelihood support and socioeconomic status of fishing communities. The sector provides employment and income to over 5 million fishers and fish farmers, majority of whom live in over 3600 coastal villages, besides fisher hamlets along major river basins and reservoirs in the country. The fish production in India registered an excellent growth during the past half century and reached 6 million t in the year 2002 from a meagre 0.75 million t in 1950. The fishers primarily depend on fisheries in these waters for their livelihoods. The fisheries sector in India contributes to nearly Rs. 220 billion, which is 1.4% of the total national gross domestic product (GDP) and 4.6% of agricultural GDP. The sector is one of the major contributors to foreign exchange through export. In India, the seafood export industry is mainly with the private sector.

756. **Gopalakrishnan, K., B.C. Varghese, D.M. Ali and P.P. Pandian** 1991. Deep sea finfish resources of Indian Exclusive Economic Zone (beyond 100 meters depth). *Proc. Nat. Workshop Fishery Resources Data and the Fishing Industry,* 14-15 october, 1988, Visakhapatnam. (eds) D. Sudarsan and V.S. Somvanshi. Fishery Survey of India. pp. 80-88.

Address : Fishery Survey of India, Visakhapatnam, India.

Abstract : The finfish resources survey beyond 100 m depth in EEZ of India reveals distribution pattern with widely varying densities in the different regions. The estimated biomass from the area under study is about 360 thousand tonnes with a potential yield of 1.48 tonnes of this, 63.37% is available from Southwest Coast, 14.39% from Northeast Coast, 18.89% from upper east coast and 3.34% from Wadge Bank and Gulf of Mannar. In both coasts the abundance of finfish resources decreases with increasing depth.

757. **Gopalakrishnan, P., D. Manikandavelu and A. Srinivasan** 1994. Ecological pertinency of Uppodai backwater (Tuticorin) for aquaculture. *J. Ecobiol.,* 6(1): 73-75.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The Uppodai River in the vicinity of Tuticorin coast receiving salt pan effluents was investigated for a period of about two years. The observed spatial and temporal variations of depth (0.74-1.76 m), temperature (23.9.3° c), dissolved oxygen (3.3-4 ppm), pH (6.5-8.4), salinity (6.5-13.2 ppt), hardness (69.1-162.2 ppm), phytoplankton (3859-12804cells/m^3), zooplankton 85-13449 organisms/m^3, lead to consider that this ecosystem can serve as a habitat for some euryhaline aquatic flora and fauna. Aquaculture prospects of this region have also been discussed in the light of above facts.

758. **Gopalakrishnan, P., D. Jude, N. Neethiselvan and G. Sugumar** 2002. Standardization of mesh size of gill nets for the commercial expoitation of Kawakawa *Euthynnus affinis* (Cantor) in Thoothukkudi coastal waters, Southeast coast of India. *J. Food Sci. Technol.*,39(2): 107-113.

Address : Fisheries College and Research Institute, Thoothukkudi - 628 008, Tamilnadu, India.

Abstract : *Euthynnus affinis* forms notable fishery in Thoothukkudi coastal waters with peak season from June to September. *Euthynnus affinis* is captured in small meshed gillnets popularly called "PODIVALAI" with mesh size ranging from 60 mm to 115 mm. The present study deals with the standardization of mesh size to capture the commercially significant length group (476-600 mm) of *E. affinis* and its enmeshing pattern in gillnets with three different mesh sizes. The optimum mesh size for the commercial exploitation of *E. affinis* in Thoothukkudy coastal waters is found to be 104.2 mm. Further, the study recommends to discourage the use of gill net with 50 mm mesh size for the capture of *E. affinis* as this net captures the juveniles of *E. affinis*.

759. **Gopinadha Pillai, C.S.** 1967. Corals. *Souvenir, 20th Ann. CMFRI*, 121-124.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Corals are objects of beauty and utility. They are found only in the sea, mainly in tropical and subtropical regions. Only very few, other than students of biology know that they are sedentary animals possessing a hard internal or external skeleton. They have attracted the attention of the biologists only recently and several problems related to them are still not explained to our fullest satisfaction. Earlier naturalists regarded them as marine plants, probably due to their sedentary habit and plant-like growth form. It was only in the latter half of the eighteenth century Peyssonnel proved the animal nature of corals. But even middle nineteenth century students of natural history assigned them a place only between animals and plants and were accordingly called 'zoophytes'.

760. **Gopinadha Pillai, C.S.** 1967. Studies on Indian Corals-1. *J. Mar. Biol. Assoc. India*, 9(2): 399-401.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Montipora manauliensis*, a new acroporid coral from Gulf of Mannar is described and its affinities are discussed. This foveolate species is characterised by a massive corallum with gibbosities, small calices and well developed septa.

761. **Gopinadha Pillai, C.S.** 1967. Studies on Indian Corals-2. *J. Mar. Biol. Assoc. India*, 9(2): 402-406.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A new species of *Goniopora viz. nigra* and three new species of *Porites viz. minicoiensis, mannarensis* and *exserta*, from the seas around India are described and their affinities are discussed.

762. **Gopinadha Pillai, C.S.** 1967. Studies on Indian corals-3. *J. Mar. Biol. Assoc. India*, 9(2): 407-409.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Dendrophyllia indica*, a new species of stony coral from the pearl banks of Tuticorin in the Gulf of Mannar is described and it's affinities are discussed.

763. **Gopinadha Pillai, C.S.** 1967. Studies on Corals. *Ph.D., Thesis* submitted to University of Kerala. 338 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The present work entitle " Studies on Corals" systematic and ecological studies on the stony corals of the seas around India was carried out at the suggestion and guidance of Dr. S. Jones, Director, Central Marine Fisheries Research Station, Mandapam Camp during the period April 1964 to April 1967. Corals from the Laccadives, Tuticorin, Palk Bay and Gulf of Mannar around Mandapam and Andaman Islands were studied and total of 125 species belonging to 34 genera and 1 subgenus were described in detail. Photographic illustration is given for all the forms described herein except for a few species that are well known. Three species are described as new to science, while names are suggested for one Goniopore and two Porites already described but not named according to binomial system. A brief account of the horizontal distribution of corals and the factors that probably control their zoning on the fringing reefs of Palk Bay (Mandapam) are described. The composition of the coral fauna around Mandapam is also discussed.

764. **Gopinadha Pillai, C.S.** 1969. Catalogue of corals in the reference collection of CMFRI. *CMFRI Bulletin*,7:23-30.

765. **Gopinadha Pillai, C.S.** 1969. Corals and Coral Reefs. *Souvenir, Symp. Coral and Coral Reefs*. pp. 9-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The appealing architectural design and the impressive colours of the living corals as well as of the, dried skeletons of corals cannot fail to satisfy our aesthetic sense. They are a spectacular group of aquatic denizens and are regarded covered curios and objects of decorative value. Corals have had tremendous impact on the social, cultural and economic aspects of human society even from time immemorial. They are instrumental in the formation of extensive reefs throughout the tropics by the continued activity of several multi-billions of them for thousands of years. They are assisted in their ceaseless task by the calcareous algae and by many other marine animals. A coral reef is thus a natural object built up in the sea, and is a centre of attraction for the naturalist, the geologist and the common man alike. A reef may extend a few meters to several hundred kilometers and is composed of enormous masses of limestone, with multitudes of living animals, the dominant being reef-corals. They often project above the surface of ocean waters forming the foundation of panoramic islands, or may remain submerged, being capable of sinking even man's mightiest ship.

766. **Gopinadha Pillai, C.S.** 1969. The distribution of corals on a reef at Mandapam (Palk Bay) S. India. *J. Mar. Biol. Assoc. India*, 11(1&2): 62-72.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Small coral reefs of fringing type are found in the Palk Bay and Gulf of Mannar at the southeastern coast of India. They are located chiefly around the various Islands lying between Tuticorin and Rameswaram in the Gulf of Mannar, and in Palk Bay at Mandapam and along the eastern side of Rameswaram Island. Early references to some of these reefs are made by Foote (1880) Thurston (1895) and Sewell (1932,1935) who referred largely to the raised up reefs of the Rameswaram Island. In this account an attempt is made to describe the structure of a shallow-water reef at Mandapam (Palk Bay). The horizontal distribution of the various corals on the reef is discussed in relation to a few possible factors that might influence the distribution. This account is based on a study of the reef which was visited as and when conditions permitted, for over a period of three years.

767. **Gopinadha Pillai, C.S.** 1971. Composition of the coral fauna of the Southeastern coast of India and the Laccadives. *In. Regional variations in Indian Ocean coral reefs.* (*eds*) D.R.Stoddart and Sir E.M. Yong, zoological society of London, Acad. Press, London. pp. 301-327.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Coral reefs of fringing nature are found both in the Gulf of Mannar and Palk Bay on the southeastern coast of India. In the Gulf of Mannar, they are scattered mostly around the various islands lying between Tuticorin and Rameswaram. The reefs of Palk Bay are confined to the northern and eastern coasts of Rameswaram Island and the northern side of Mandapam. Investigations on the corals of this area, between Long. 79^{o} 4'E and 79^{o} 15'E and Lat. 9^{o} 10'N and 9^{o} 18'N, have revealed the occurrence of 117 spp divided among 33 genera. Of these, 110 spp of 26 genera are hermatypic and the rest ahermatypic. The most conspicuous components of the coral fauna of this area are the members of the families Acroporidae, Poritidae and Faviidae. It is feared that the coral reefs of southeast India are fast deteriorating due to natural as well as artificial causes some of which are also discussed in this paper. The Scleractinia of the Laccadive Archipelago are still poorly known except for some information from Minicoy and Chetland Island. To the present a total of 69 spp belonging to 26 genera are known from the archipelago, all of which are known to occur at Minicoy Atoll. A comparison of the coral fauna of southeastern India and the Laccadives is also presented.

768. **Gopinadha Pillai, C.S.** 1972. Stony corals of the seas around India. *I Proc. Symp. Corals and Coral reefs*, MBAI. pp. 191-216.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Three hundred and forty species of scleractinian corals of seventy six genera have been hitherto recorded from the seas around India, including the Maldives, the Laccadives, Ceylon, Palk Bay and Gulf of Mannar along the Indian coast, the Andaman and Nicobar Islands and the Mergul Archipelago. Out of these, 253 species divided among 49 genera are hermatypic and the rest ahermatypic. The Maldivian coral fauna, as it is known, includes 166 species of 66 genera and that of the Laccadives, 73 species divided among 29 genera. A total of 90 species assignable to 39 genera is known to occur in Ceylon. The Palk Bay and Gulf of Mannar around Mandapam are known to harbour a total of 117 species belonging to 32 genera. The coral fauna of Tuticorin in the Gulf of Mannar has not been fully investigated and only 21 species of 19 genera have been

hitherto recorded. The Andaman Islands are known to have 68 species divided among 31 genera and the Mergui Archipelago (west of 98° 30'E) has 65 species of 31 genera. The deeper waters of Bay of Bengal and the Arabian Sea, between the longitudes 60'E and 98° 30'E and north of latitude 1° S, around the Indian subcontinent, other than the various localities already mentioned, are known to have 25 species belonging to 15 genera. These are mostly ahermatypic. A good many genera and species are common to the various localities mentioned but a few are peculiar to one or the other area.

769. **Gopinadha Pillai, C.S and P.V. Ramachandran Nair** 1972. Productivity studies on some hermatypic corals by means of both oxygen measurements and ^{14}C method. *Proc. Symp. Corals and Coral Reefs, MBAI.* pp.43-58.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The hermatypic corals harbour boring filamentous algae in their skeleton as well as symbiotic zooxanthellae in their soft tissue. These imprisoned algae produce much more quantity of oxygen by photosynthesis than the respiratory needs of the coral. Various attempts have been made in the past to estimate the oxygen production of corals and there was apparently disagreement among authors on the role of boring algae in the total production. In this work an attempt is made to evaluate the percentage of oxygen production contributed by the boring algae and the symbionts of a few species of reef building stony corals. From Palk Bay and Gulf of Mannar around Mandapam (S.India). The gross production was estimated by dark and light bottles by Winkler technique, converting the oxygen values into carbon equivalents. The share of zooxanthellae was then determined by incubating the isolated symbionts with $NaH_{14}CO_3$. A marked difference was observed in the two sets of values thus obtained. In the light of the present results the role of the boring algae in the productivity of reef corals is discussed.

770. **Gopinadha Pillai, C.S and P.A. Thomas** 1972. Frequency of occurrence of *Heterosaccus indicus* Rhizocephala on the edible crab *Neptunus pelagicus* in the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 14(2): 867-869.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Heterosaccus indicus* Boschma parasites the blue swimming crab *Neptunus pelagicus.* During January 1967, the authors examined 1836 crabs caught by crab traps in the vicinity of the Regional Center of Central Marine Fisheries Research Institute, Mandapam camp. While 12.2 percent of the total population examined was found to be infested, 28.1% of the females had parasites. The ratio of female hosts to male was 1:1.3. It was also observed that 5.8% of the infested crabs possessed more than one parasite.

771. **Gopinadha Pillai, C.S.** 1973. Coral resource of India with special reference to Palk Bay and Gulf of Mannar. *Proc. Symp. Living Resources of Seas Around India.* pp. 700-705.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Coral formations are found within the seas around India, in tht Gulf of Kutch, in Andaman and Nicobar Islands, in Palk Bay and Gulf of Mannar on the eastern coast and in the Laccadive Archipelago. In the former areas we have fringing reefs whereas the whole of Laccadives are atolls. These reefs harbour a rich and varied coral fauna of appreciable economic importance. The black coral of commerce *Antipatharia* is found to occur in the Gulf of Mannar and in the Laccadives at a depth of about 5 to 200 metres. But the feasibility of their commercial exploitation sti1l remains to be ascertained. The blue coral *(Heliopora)* is available in large scale in Laccadives at moderate depths. The most important commercially valuable corals of the Indian coasts are the scleractinias. They form a major source of calcium carbonate and are used in the preparation of calcium carbide, lime and cement, besides as building blocks and in the construction of roads. The corals from Palk Bay and Gulf of Mannar around Mandapam are brought ashore in large quantities for the above purposes affording livelihood for about 500 people. A quantitative estimation of the potential exploitable stock is yet to be made. In the present paper a qualitative analysis of the commercially important corals of this area, based on field studies and survey of the exploited stock, is given. A few problems on conservation are also suggested.

772. **Gopinadha Pillai, C.S.** 1975. An assessment of the effects of environment and human interference on the coral reefs of Palk Bay and Gulf of Mannar along the Indian Coast. *Seafood Export J.*, 7(12): 1-13.

773. **Gopinadha Pillai, C.S.** 1977. The structure, formation and species diversity of South Indian reefs. *Proc. 3rd Inter. Nat. Symp. Coral reefs, Miami,* 1: 47-53.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A well developed reef, the 'Mannar Barrier' stretches along the southeast coast of India, from

Rameswaram Island to Tuticorin in a northeast, southwest direction, to a distance of nearly 140 km. This formation is bridged by a shallow ridge, 'Adam's Bridge' to the reefs of Ceylon. On the leeward side of the reef flat, there are 20 small Islands, which are more or less 5 sq. km in size and mostly of the same elevation as the mainland coast. Since sediment supply was considered inadequate on the flat for the formation of these Islands, it is suggested that they are parts of the mainland, which got separated by a wide subsidence in sub-Recent time during which Ceylon also finally severed its connection from the mainland of India. This subsidence caused a wide lagoon-like portion of the sea resulting in the 'Mannar Barrier'. The fringing or patch-reefs found on the leeward side of the sand cays, as well as in the Palk Bay are Secondary Formation on shallow waters where granite or laterite substratum was exposed by erosion. While the southern part of the barrier has very few species dominated by *Pocillopora damicornis*, *Acropora spp.*, *Montipora spp.* and *Turbinaria spp*., the northern portion has a rich diversity of genera and species dominated by Poritids and Faviids, along with Pocilloporidae and Acroporidae. The encrusting calcareous algae are very significant as a reef builder at the south, while insignificant down north.

774. **Gopinadha Pillai, C.S and K.K. Appukkuttan** 1978. Distribution of molluscs in and around the coral reefs of the southeastern coast in India. *J. Bomb. Nat. Hist. Soc.*, 77: 26-47.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The report presents the results of a synecological analysis of the molluscan fauna associated with the different hard and soft substrates in and around the fringing coral reefs of Palk Bay and Gulf of Mannar around Mandapam between the longitudes 79°8' and 79° 14' E, and latitudes 9° 12' and 9° 18' N. This study forms part of a programme of survey of the reef-associated living resources of the seas around India. An attempt has been made to identify and to assess the comparative dominance of the molluscan communities in the different habitats as also to delineate the physical and biological factors that influence their selection of habitats. The molluscs of this area are fairly well known, thanks to the works of Hornell (1915, 1917, 1922, 1951), Gravely (1927), Satyamurthi (1952, 1956), Rao (1970), Jones (1970). Silas (1968) and many others whose contributions are listed by Nair and Rao (1974). Though about 450 species are known from this area, there appears to be little attempt in the past to discuss the synecological aspects of molluscan distribution but for the work of Rao and Sundaram (1972). Satyamurthi (1952, 1956) has mentioned the natural habitat of many species he has described. The present collection includes only 112 species roughly one fourth of the known species, partly because we have not accounted the many dead shells found except from the raised reefs. In the recent past, there has been considerable destruction to reefs due to indiscriminate quarrying of corals and this has directly caused a dwindling of the molluscs associated with the reefs.

775. **Gopinadha Pillai, C.S.** 1983. Structure and generic diversity of recent Scleractinia of India. *J. Mar. Biol. Assoc. India*, 25(1&2): 78-90.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : An updated check-list indicates that the Recent Scleractinian fauna of India, including Lakshadweep, Gulf of Kutch, Southeast coast of India and the Andaman and Nicobar Islands, has a total of 199 species divided among 71 genera. Out of these, 50 genera and 155 species are herma types and the rest 44 species of 21 genera are ahermatypes. Lakshadweep is known to have a total of 31 genera with 78 species. A comprehensive list of coral from Gulf of Kutch is provided for the first time in this paper which includes 24 genera and 37 species. A total of 94 species divided among 37 genera is hitherto known from the southeast coast including Palk Bay and Gulf of Mannar. The scleractinians of Andaman and Nicobar Islands include 59 genera and 135 species of which 47 genera with 100 species are hermatypes and the rest ahermatypes. The occurrence of the various species in the four major coral growing areas are indicated in the check-list. None of the genus is endemic. The Andaman and Nicobar Islands fauna is perhaps the richest both in number and diversity of elements, and includes a few genera and species which are less common in the Indo-Pacific, but recorded from the eastern Indian Ocean. The regional variations of the coral fauna of India is briefly discussed.

776. **Gopinadha Pillai, C.S.** 1986. Recent corals from the southeast coast of India. pp. 107-201. ***In***: *Recent advances in Marine Biology,* (ed.) P.S.B.R. James, Today and Tomorrow's Prin. & Pub., New Delhi, 1986: 591 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The recent stony corals of the southeast cost of India collected by the author from the small islands extending from Tuticorin to Rameswaram in Gulf of Mannar and the shallow waters of Mandapam in Palk Bay are described and illustrated providing a comprehensive account of the coral fauna of this region. The present

account deals with 92 species divided among 36 genera of which 10 genera are ahermatypes and the rest reef builders. Yet another genus *viz., Madracis* of the family pocilloidae was once obtained from the deep waters of Gulf of Mannar. But is not considered in this work due to taxonomic difficulties. Among the species of *Montipora* described *M. jonesi* is new to science. A synopsis of the various species is provided under each genus discussed and detailed descriptions are provided based on material collected. A major attempt was made to solve many problems of synonyms that have resulted in a remarkable reduction of the species recognised by earlier authors. As far as possible ecological notes under each species is provided with specific location of their occurrence to facilitate future collection and determination.

777. **Gopinadha Pillai, C.S and S. Jasmine** 1991. Conservation and management of coral reefs. ***In***: *Coastal Zone management in Tamilnadu,* (*eds*) R. Natarajan, S.N. Dwivedi and S, Ramachandran, India, pp. 222-228.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

778. **Gopinadha Pillai, C.S.** 1996. Coral reefs of India, Their conservation and management. ***In***: *Marine Biodiversity: Conservation and management,* (eds.) N.G. Menon and C.S.G. Pillai. CMFRI, Cochin, India, pp. 16-31.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

779. **Gopinadha Pillai, C.S.** 1997. A brief resume of research and understanding of the reef corals and coral reefs around India. *Proc. Reg. Workshop on the Conservation and Sustainable Management of Coral Reefs*, CRSARD, Madras. No.22: C13-C26.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The researches on the various aspects of corals, and coral reefs of the seas around India, including the oceanic atolls and continental Islands have a span of more than a century. However it is not the intention here to present an exaustive review of all those work and the available results obtained by Indian and foreign investigators; but only a half hearted attempt to elucidate some of the aspects as gleaned from literature and personal observation of the author. More than a hundred scientific reports are available in various Indian and foreign publications on the reef corals and coral reefs of India not to speak of the large number of articles available in literature on the living reef associated resources of our waters. Majority of them are from the last 30 years. The section on references in this communication is only selective and many references cited in the text are not carried over to the reference section to save space.

780. **Gopinadha Pillai, C.S.** 1998. Scleractinian fauna. *Proc. Technical Workshop Biodiversity of Gulf of Mannar Marine Biosphere Reserve,* 1998: pp. 110-117.

Address : Sreesailam, Mallasery P.O. Pathanamthitta - 689 646, India.

Abstrat : The coral formations of Gulf of Mannar (GOM), along the Indian coast are located between Tuticorin (Long. 78°, 9'E; Lat. 8°, 48' N) and Rameswaram Island (Long. 79°, 14' E. and Lat 9°, 14' N) and stretches to a distance of about 140 km. The coral formations are mostly centred around 20 small islands that arise from a shelf 25 km wide and 35 m deep (Stoddart and Fosberg, 1972). The shelf is linked to the north east coast of Sri Lanka by Adams Bridge, a continuous chain of islands and intertidal shoals (Walther, 1981). Stoddart and Fosberg (1972) opined that the coral formation of GOM is of barrier type, though Pillai (1977) felt that the growths are of typical fringing type around small islands on wave eroded platforms, subsequent to a large subsidence of eastcoast of India. A recent estimate of the extent of the reef by remote sensing shows that the area is about 64.9 sq. km.

781. **Gopinatha Menon, N.** 1973. Note on a specimen of *Tachysurus platysomus* without pelvic fins. *Indian J. Fish.,* 20(2): 679-681.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : A single specimen of *Tachysurus platysomus,* from the trawl net catches from the Gulf of Mannar, without pelvic fins is described with reference to similar findings elsewhere. There are many instances of the total absence of the paired and unpaired fins among fishes (Dawson, 1964). But there are only few records of abnormalities among siluroid fishes.

782. **Gopinatha Menon, N.** 1974. On buccal papilloma of *Tachysurus platysomus* (Day). *J. Mar. Biol. Assoc. India,* 16(1): 317-320.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : Buccal papillomas were observed in the floor of the buccal cavity of a catfish *Tachysurus platysomus* collected from Mandapam (Gulf of Mannar) in the trawl net. The size of the tumor varied from 3 mm to 10 mm. The tumor was lobulated with keratinised surface and the epithelial tissue was supported by connective tissue stroma. All the specimens collected till now with tumor were females.

783. **Gopinatha Menon, N.** 1979. On a new myxosporidian *Henneguya tachysuri* sp. nov. from the marine catfish *Tachysurus thalassinus* Ruppell from the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 21(1&2): 196-198.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Henneguya tachysuri* sp. nov. was found in the subcutaneous muscles of the marine catfish *Tachysurus thalassinus* caught off Gulf of Mannar at Tuticorin. The parasite causes bleeding ulcers in the body of *T. thalassinus.* The occurrence of the parasite and its possible damage to the host is of economic interest as *T. thalassinus* is an important commercial fish.

784. **Gopinatha Menon, N.** 1984. Observations on the intraovarian ova of a few tachysurids from Indian waters. *Indian J. Fish.,* 31(2): 250-256.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : Three different groups of intraovarian ova, “a”, “b” and “c”, are noticed in the ovary of mouthbrooding tachysurid catfishes; the former two groups are small nonyolked and reproductively nonfunctional and the last group is yolked, opaque and functional. The group “a” and “b” ova are sequentially arranged, respectively in the oviducal and posterior region while the group “c” ova occupy the anterior three-fourths of the ovarian cavity. There is a certain ratio in the number of ova of the three groups, probably characteristic of each species. All the nonfunctional ova of the groups “a” and “b” and ripe functional group “c” are spawned in a bunch and taken into the mouth of the male, where only the group “c” ripe eggs develop into young ones.

785. **Gopinatha Menon, N.** 1984. On the biology of the flat mouthed catfish *Tachysurus platystomus* (Day) from Mandapam. *Indian J. Fish.*, 31(2): 293-308.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : As determined from length-frequency studies of *Tachysurus platystomus*, one-, two-, three- and four-year-old fish respectively attain 178, 256, 310 and 366 mm size. As indicated by the opercular bone, the corresponding sizes were at 173, 256, 349 and 387 mm and as by vertebrae, they were 177, 272, 340 and 388 mm. The length-weight relationship was significantly different for males and females. Low values of relative condition factor during December to February period was due to spawning. Yolked larvae were found to feed on planktonic organisms, even when they were in the mouth of the male parent. Even though the individuals of the species spawn only once and over a short period, the population as a whole may probably breed over November to February every year. Females and males first mature at 230 and 220 mm respectively. Fecundity varied from 32 to 40 ova in fish ranging from 230 to 390 mm in total length.

786. **Gopinatha Menon, N.** 1986. Age and growth of the marine catfish *Tachysurus thalassinus* (Ruppell) from Mandapam waters. *Indian J. Fish.*, 33(4): 413-425.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Employing six different methods, the age and growth of *Tachysurus thalassinus* at Mandapam, Tamil Nadu, India are determined. By length-frequency, it is found to attain 250 mm at the end of first year, 370 mm at the end of second year and 450 at the end of third year. Transparent rings in the pectoral-spine sections showed that the species attains 258.3 mm at the end of one year, 347.4 mm at the end of two years and 441.6 mm at the end of three years. The lengths at age as derived from vertebral studies are 260.9 mm in one year, 355.9 mm in two years and 436.5 mm in three years. Based on alternating opaque and transparent zones in the opercular bone, the mean back-calculated lengths at the ages one to three are 251.3 mm, 345.5 mm and 445.1 mm, respectively.

787. **Gopinatha Menon, N and V.N. Bande** 1987. Taxonomic considerations and general distribution of commercially important cat fishes. *CMFRI Bulletin,* 40: 5-11.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : The taxonomy of our commercially important marine catfishes is still in a state of uncertainity. The nomenclature has suffered a lot of changes brought about by various taxonomists. When some authors have

used the genus name *Tachysurus*, and hence the family name Tachysuridae, others preferred the name *Arius* and the family name Ariidae.

788. **Gopinatha Menon, N and C. Muthiah** 1987. Biology of the important species of catfishes. *CMFRI Bulletin,* 40: 60-69.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : Information on the biology of the tachysurid catfishes from Indian waters is very meagre, and in the following account an attempt is made to compile all the published accounts and unpublished data collected from various centers on the biology of commercially important tachysurids of our waters.

789. **Gopinatha Menon, N and L.P. Devi** 1990. Studies on the biomass in the deep scattering layer of the Indian EEZ. *Proc. First Workshop Scientific Results, FORV Sagar Sampada,* 5-7 June 1989. pp. 257-271.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

790. **Gopinatha Menon, N.** 1990. Preliminary investigation on the fish biomass in the deep scattering layers of the EEZ of India. *Proc. First Workshop Scientific Results, FORV Sagar Sampada,* 5-7 June, 1989. pp. 273-280.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

791. **Gopinatha Menon, N.** 1991. Oral incubation in marine catfishes of the family Tachysuridae. *Indian J. Fish.*, 38(1): 30-34.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract: Mouth breeding in several species of tachysurid catfishes was observed during 1970-76. In all tachysurids male is the brood-carrier. Large, yolked and ripe functional ova as well as small and non-yolked, non-functional ova were extruded at the time of spawning. After retaining the large functional ova in the mouth, the non-functional ova were probably eaten by the male parent. Efficiency in fertilization and transfer of eggs was brought about by enlarged pelvic fins of female. The oral cavity of the incubating male got enlarged to receive large number of eggs and the oral epithelium secreted large quantity of mucus for the safe carrying of eggs or embryos in the mouth. The incubating parent usually went without food, although the fry fed in the parent's mouth. Incubation in *Tachysurids thalassinus* lasted for 28-30 days.

792. **Gopinatha Menon, N.** 1996. Impact of bottom trawling on exploited resources, pp. 97-102. ***In***: *Marine biodiversity Conservation and Management,* (*eds*) N.G.Menon and C.S.G. Pillai, CMFRI. 205 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Today's Indian marine fisheries face challenging problems in trying to achieve the kind of sustainability that will assure its own long-range survival.

793. **Gopinatha Menon, N.** 2003. Catfishes. ***In*** : *Status of Exploited Marine Fishery Resources of India,* CMFRI, Cochin, India. pp. 110-119.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Among a wide variety of coastal demersal fish species, the marine catfishes assume prime dominance, by virtue of their abundance in the coastal grounds, vulnerability, migration and behavior. Compared to many other demersal fishes, catfishes are within the affordable range of poor/middle, class fish eaters. They have a wide distributional range in the Indo-Pacific region, all along the Indian coastal waters upto the middle shelf with preferential concentration on muddy grounds of 30-70 m depths. They migrate both vertically (diurnal migration) and horizontally (seasonal) in small schools to large shoals in response to seasonal climatic/hydrographic variations, drift pattern, biology and reproductive behaviour of the species. Although the young ones live at the bottom, the adults frequently visit column/surface water and move in shoals along the prevailing drifts of the southwest and southeast monsoon, and become amenable to a variety of fishing gears. Marine catfishes belonging to the family Tachysuridae are grouped under three genera *Tachysurus* (= Arius), *Osteogeneiosus* and *Batrachocephalus* in Indian waters with 21 species under the former genus and one species each in the latter two genera. Of the 23 species recorded from the Indian waters, 11 appear in the commercial fisheries with characteristic species abundance and seasonal variation in different regions. The genus *Batrachocephalus*, represented by a single species *B. mino,* has only rare occurrence in the Gulf of Mannar and Palk Bay. The species diversity in the commercial fisheries has dwindled since the nineties to 4-6 species along the southeast coast and 2-4 species in southwest region of India. A drastic decline in their production in the above regions was also noteworthy.

794. **Gopinathan, C.P.** 1986. Differential growth rates of micro-algae in various culture media. *Indian J. Fish.*, 33(4): 450-456.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Growth and multiplication of three algae, *Isochrysis galbana, Tetraselmis chuii* and *Nitzschia closterium*, belonging to three different algal classes, was studied in the laboratory, using four culture media. The algae yielding different differential growth rates in the media, the experiment proved that no available culture medium is uniformly effective in all the cases, unless supplemented with either trace elements or vitamins, according to the specific requirement of the algae.

795. **Gopinathan, C.P., P. Siraimeetan, J. Xavier Rodrigo and M. Selvaraj** 1989. "Glowing sea" phenomenon due to the swarming of *Noctiluca miliaris* on the southeast coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 97: 16-17.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : The glowing sea was first recorded on 12th October 1988, based on phytoplankton samples collected from the inshore area of Tuticorin.

796. **Gopinathan, C.P and J. Xavier Rodrigo** 1991. Investigations on primary production and related parameters in the inshore waters of Tuticorin, Tamilnadu, *J. Mar. Biol. Assoc. India*, 33(1&2): 33-39.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Primary production and related parameters were studied in the inshore waters of Tuticorin during 1985-87. The annual cycle of primary Production indicated three peak periods, first during March-April, second during July and the third during September-October. Production was low in the winter months of November-January. The average primary production was estimated as 350 mgC/m^2/day with relatively higher values of 1600 mgC/m^2/day in April and low values of 114 mgC/m^2/day observed in November. The chlorophyl1 *a* values showed a direct relation with the primary Production. The hydrological parameters including nutrients of the water column showed definite seasonal fluctuations. The nutrients, especially phosphates and silicates showed an inverse relationship with primary production while nitrates indicated a positive correlation. Blooming of *Trichodesmium theibautii* during summer (April-June) and of dinoflagellates during northeast monsoon (October-December) were observed to be regular phenomena. The important dominant group of phytoplankton encountered in the study belonging to the species of diatoms *Chaetoceros, Skeletonema* and *Thalassiosira* and phytoflagellates such as *Isochrysis, Pavlova, Chromulina* and *Dicrateria.* The role of environmental factors in the production of organic matter and the observations of earlier workers are briefly discussed.

797. **Gopinathan, C.P., V.K. Pillai and J. Xavier Rodrigo** 1994. Influence of thermal effluents on the growth characteristics of phytoplankton in the waters of Tuticorin Bay. *Symp. Nutrients and Bioactive Substances in Aquatic Organisms, Cochin, Kerala (India), 16-17, September 1993.* (eds) K. Devadasan, M.K. Mukundan, P.D. Antony, P.G.V. Nair, P.A. Perigreen and J. Joseph. Cochin India Society of Fisheries Technologists, India. pp. 235-246.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper reports the results of investigations conducted in 1990, on the physico-chemical aspects of Tuticorin Bay waters in relation to the abundance of phytoplankton. Selected species of phytoplankton were experimentally cultured to study the influence of thermal effluents. For this purpose cultures were raised in media collected from 4 stations, showing different extents of pollution. Four species of nannoplankton, namely, *Isochrysis galbana* (Haptophyceae), *Dicrateria inornata* (chrysophyceae), *Tetraselmis gracilis* (Chlorophyceae) and *Chaetoceros calcitrans* (Bacillariophyceae) were grown in the water samples collected from selected stations. The experiments showed stimulatory trend of growth for the first 7-8 days and gradual inhibitory effect on the multiplication in subsequent days. Among them, the phytoflagellates (*Isochrysis, Dicrateria* and *Tetraselmis*) showed good growth in the samples of media collected from locations near to the pollution source. The rate of production of both *Tetraselmis* and *Dicrateria*, which are known to exist in the polluted waters, indicated enhanced growth in the Bay waters. The growth of the diatom, *Chaetoceros* has been found to be uniform except in the sample collected from the point nearest to the source of pollution. Though the long-term effects of these samples have not been studied, the experiments revealed the possible effects of thermal effluents on the phytoplankton population in the waters of Tuticorin Bay.

798. **Gopinathan, C.P., J. Xavier Rodrigo, H. Mohamed Kasim and M.S. Rajagopalan** 1994. Phytoplankton pigments in relation to primary production and nutrients in the inshore waters of Tuticorin, southeast coast of

India. *Indian J. Mar. Sci.*, 23(4): 209-212.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, Kerala, India.

Abstract : Annual variation of primary production and chlorophyll-a of the inshore area of Tuticorin indicated three peak periods, during March-April, June-July and September-October. The multiple regression analysis indicated significant levels of correlation by chlorophyll-a and nitrates with primary production. Among nutrients only nitrate and phosphate have influence on primary production.

799. **Goud, T.V., M. Srinivasulu, V.L.N. Reddy, A.V. Reddy and Y. Venkateswarlu** 2002. Novel bromotyrosin-Derived metabolites from the sponge *Psammaplysilla purpurea*. *Proceedings of the National Conference on Utilization of Bioresources - NATCUB-2002, October 24-25, 2002.* pp. 29-31.

Address : Natural Products Laboratory, Organic Division - I, Indian Institute of Chemical Technology, Hyderabad - 500 007, India.

Abstract : Two new bromotyrosine derived metabolites (1 and 2) have been isolated along with known compounds 3,5-dibromo-4-methoxy phenyl acetonitrile, 3-bromo-4-methoxy phenyl acetonitrile, 3-bromo-4-hydroxy phenyl acetonitrile, 1-hydroxy uracil and a steroid 5 alpha , 8 alpha uepidioxy cholest u6-ene u3 beta u0l from the sponge *Psammaplysilla purpurea*. Compounds 1 and 2 were characterized by interpretation of their spectral data.

800. **Goud, T.V., P. Krishnaiah, S.M. Reddy, M. Srinivasulu, M.R. Rao and Y. Venkateswarlu** 2005. Chemical investigation of the marine sponges *Clathria reinwardti* and *Haliclona cribricutis*. *Indian J. Chem*., (B Org. Med.). 44(3): 607-610.

Address : Natural Products Laboratory, Organic Chemistry, Indian Institute of Chemical Technology, Hyderabad - 500 007, India; E-mail: luchem@iict.res.in

Abstract : Diethylene glycol dibenzoate (DEGDB) (1) and two fenvalerate isomers (4 and 5) have been isolated from the sponges *Clathria reinwardti* and *Haliclona cribricutis* respectively. Two other diethylene glycol esters (2 and 3) are also synthesized. The structures of the compounds have been established by means of spectroscopic analysis, optical rotations and comparison with known compounds. These compounds are evaluated for their antimicrobial and pesticidal activities.

801. **Govindan, T.K.** 1970. Some noteworthy miscellaneous marine fishes of India. *Seafood Export. J.,* 2(9): 12-26.

Address : Therampurath, Kumbalam, Cochin - 682 013, India.

802. **Govindan, T.K.** 1970. Seacucumbers. *Seafood Export J.*, 2(12): 23-26.

Address : Therampurath, Kumbalam, Cochin - 682 013, India.

Abstract : Seacucumbers are a sort of animals so called because of their resemblance to cucumber in shape as well as their near immobility, living strewn on the shallow sea beds like the vegetable on its creepers. They belong to the family Holothuriidae among the invertebrate animals of aquatic origin and about 500 species have so far been reported from different parts of the world. While the surfaces of some varieties are smooth, they are thick and leathery with uneven growths in some others. The ventral sides of the bodies, which serve as their creeping soles are slightly flattened and are of lighter colour than the dorsal sides. Even though the ordinary varieties are dull coloured with gray, brown or black tints, the deep water ones are often coloured purple, maroon or violet. The ventral creeping soles are provided with sucker-like growths, either arranged in three rows or distributed unevenly, which aid their locomotion. Just like in the other orders of life, different species of sea cucumbers exhibit widely differing sizes.

803. **Grace Mathew** 1994. On the perch fishery of Tuticorin during 1978-80. *J. Mar. Biol. Assoc. India*, 36(1&2):28-33.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The present paper deals with the studies on perch resources *viz.* the rock-cods, the snappers and the pigface breams mainly, which are abdundant in the seas off Tuticorin. Perches are one of the most important groups of demersal fishes with immense developmental potentialities. The present study relates to the period 1978-'80. This fishery was fairly good in this area, during this period, employing both indigenous craft and gear as well as the mechanised units. At Tuticorin, during this period 73.3% of perches were landed by indegenous craft and gear whereas the remaining 26.7% were fished by the mechanised units including the large fishing trawlers of the Fishery Survey of India. This fishery, by and large was supported mainly by fishes of the family Lethrinidae, Serranidae, Lutjanidae, Plectorhychidae. There is a well defined peak season for this fishery during July-October period followed by a smaller peak in April-May.

804. **Grace Mathew** 1994. Exploratory trawl fishing off Tirunelveli coast. *J. Mar. Biol. Assoc. India*, 36(1&2):152-160.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : The results of exploratory trawling carried out from 1968 to 1980 on the continental shelf and slope off Tirunelveli Coast, between 07° and 09°N are discussed. Attempt is made to study the relative abundance of major groups of demersal fishes, their seasonal, depthwise and areawise distribution. This throws light into the potentialities of ground fish resources in this area. The Fishery Survey of India trawlers based at Tuticorin, conducted trawling for demersal fish, yielding a production rate of 129.6 kg per hour, revealing the existence of fairly rich fishing grounds in this area especially of perches and elasmobranchs. Perches constituted 33.35% of the total catch in these trawlers. Elasmobranchs ranked next forming 24-26% of the catch. The percentage of perches was as high as 53% and 61% in 08°N sub-areas 6 B and 6 C during 1976. Perches being a quality fish with high demand and in view of its abundance, its exploitation could be intensified considerably.

805. **Gravely, F.H.** 1927. The littoral fauna of Krusadi Island in the Gulf of Mannar: Hydrozoa, Anthozoa, Scleractiniae. *Bull. Madras. Govt. Mus. New. Ser.,* 1: 25-30.

806. **Gravely, F.H.** 1927. The littoral fauna of Krusadi Island in the Gulf of Mannar: Polyzoa. *Bull. Madras. Gov. Mus., New Ser.,* 1(1): 89-94.

807. **Gravely, F.H.** 1927. The littoral fauna of Krusadai Island in the Gulf of Mannar: Isopoda. *Bull. Madras Govt. Mus., N.S., Nat. Hist. Sec.,* 1(1): 117-118.

808. **Gravely, F.H.** 1927. Littoral fauna of Krusadai Islands in the Gulf of Mannar: Archanida and Insecta. *Bull. Madras Govt. Mus. N.S. Nat. Hist.,* 1(1): 161-162.

809. **Gravely, F.H.** 1927, The littoral fauna of Krusadai Island in the Gulf of Mannar: Echinodermata. *Bull. Madras Govt. Mus. N.S. Nat. Hist.,* 1(1): 163-173.

810. **Gravely, F.H.** 1927. Littoral fauna of Krusadai Island in the Gulf of Mannar: Urochordata. *Bull. Madras. Govt. Mus. New. Ser., (Nat. Hist.),* 1(1): 175-180.

811. **Gravely, F.H.** 1930. Supplement to the littoral fauna of Krusadi Island in the Gulf of Mannar: The Alpheidae of Krusadai Island. *Bull. Madras Govt. Mus. N.S., Nat. Hist. Sec.,* 1(2): 77-79.

812. **Gravely, F.H.** 1927. Littoral fauna of Krusadai Island in the Gulf of Mannar: Amphipoda Gammaridae. *Bull. Mad. Govt. Mus. N.s., Nat. Hist.,* 1(2): 123-128.

813. **Gravely, F.H.** 1927. The littoral fauna of Krusadai Island in Gulf of Mannar: Decapoda and stomatopoda. *Bull. Madras Govt. Museum N.S., Nat. Hist. Sec.,* 1(2): 135-155.

814. **Gray, J.E.** 1983. Sponges from Ceylon. *Ann. Mag. Nat. Hist.,* 12(4): 266-267.

815. **Gunasekaran, A.** 1961. Processing the flesh of the pearl oyster *Pinctada vulgaris* Schum. *Indian Fish.Bull.,*8: 11.

816. **Gupta, A.** 1997. Study of coastal water pollution in Tamil Nadu. *J. Eco. Environ. Mon.,* 7(2): 89-93.

Address : Department of Zoology, New College, Chennai - 600 014, Tamilnadu, India.

Abstract : Tamil Nadu covers the area of about 1,30,069 sq.km. The coastal stretch is 1026 km. Population is about 55 million. The number of coastal industries (large and medium) are 50 (includes 20 aquaculture farms). Major industrial locations are at Madras, Ennore, Cuddalore, Avudaiyarkoil, Ottapidaram, Tuticorin. Major types of industries are chemicals, fertilizers and aquaculture. Total waste generation (effluent) in Million m^3/day is about 0.378 (includes 0.253 from aqua culture farms). Solids (MT/day) is 9,112. All these pollutants are mixed in the coastal areas. Hence, the analysis of water is earned out to understand the quality of water as the fish farming and agriculture is always affected. Aquatic life has also some effect of this pollution. The various parameters studied are temperature, salinity, dissolved oxygen, pH, turbidity, ammonia nitrogen, nitrate nitrogen, total nitrogen, inorganic phosphate phosphorus, total phosphorus, cadmium, mercury, lead and petroleum hydrocarbon at inland, coastal and offshore locations.

817. **Gupta, N.K.** 1956. Studies on the digenetic trematodes of marine fishes from the Gulf of Mannar (India). *Res. Bull. Punjab Univ.*, 89: 61-83.

818. **Gurumani, O.N and S. Krishnamurthy** 1994. Some aspects of processing and quality control of *Beche-de-mer* for export. *CMFRI Bulletin*, 46: 81-84.

Address : Export Inspection Agency, Madras-600 014, Tamilnadu, India.

Abstract : This paper deals with some aspects of processing of *Beche-de-mer* which will improve the quality and specification for export.

819. **Gurusamy, R., H. Mohamed Kasim and P. Siraimeetan** 1989. A note on the subsistence fishery of Periasamipuram in Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 102: 9-11.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : The survey of Periasamipuram, one of the fishing villages has revealed that there are about 250 families in the village, among them 41 are actively engaged in fishing activity.

820. **Gurusamy, R and T.S. Balasubramanian** 1994. On two large specimens of devil ray *Manta birostris* landed at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.*, 127: 15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, India.

Abstract : Two female specimens of devil ray locally known as 'Kombu thirukkai' were landed at Tuticorin north fish landing center. The morphometric characters were observed and given in this paper.

821. **Gurusamy, R.** 1994. Scientific, common and vernacular names of commercially important fin and shell fishes of Tamil Nadu. *Mar. Fish. Infor. Serv. T & E Ser.*, 134: 17-27.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, India.

Abstract : The scientific, common and vernacular names of marine fin fishes and shell fishes are listed in this report.

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822. **Habib Mohamed, T.A.M and S. Rajapackiam** 2000. Marine ornamental fishes (in Tamil). *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI.* pp. 83-85.

Address : Department of Zoology, K.M. College, Adirampattinam- 614701, Tanjore Distirct, Tamilnadu, India.

823. **Haldar, B.P and K.Z.R. Rao** 1975. A note on *Siphonosoma* sp. a giant Sipunculida from south India.

Address : Zoological Survey of India, 27 J.L. Nehru Rd., Calcutta -- 700016, India.

Abstract : *Siphonosoma* sp measuring 618 mm was collected at Rameswaram Island. From its description it is most closely related to *S. arcassonense*.

824. **Hannah Vasanthi, R., A. Saraswathy and G. Victor Rajamanickam.** 2002. Natural antioxidants in some marine macroalgae of the Gulf of Mannar. *SDMRI Res. Publ.* 2: 159-164.

Address : Department of Industries and Earth Sciences, Tamil University, Thanjavur-613005, Tamilnadu, India.

Abstract : Free radicals produced during normal metabolism play a vital role in mediating deleterious effects that affect cellular metabolism. This often leads to the development of many diseases such as coronary artery disease, diabetes, cataract and cancer. Considerable attention has been made towards naturally occurring antioxidants in plants and their antioxidant potential has been evaluated. The significance of these natural antioxidants (Vitamin A, E and C) in disease management and their usefulness in the production of nutraceutical products have also been highlighted in higher plants, and its products such as vegetables, fruits, spices, cereals, vegetable oils, tea and wine. However, marine algae have not been utilized in estimating the natural antioxidants as a whole present in them and screening for their antioxidant potential. Hence in the present study the natural antioxidants present in some marine macroalgae of common occurrence in the coastal regions to the Gulf of Mannar has been estimated. It has been noted that in general the algae belonging to Phaeophyceae possess higher amounts of natural antioxidants, followed by the Chlorophyceae and Rhodophyceae.

825. **Hannah Vasanthi, R., A. Saraswathy and G. Victor Rajamanickam** 2002. Vitamin - E (Tocopherol) content in some marine macroalgae of Gulf of Mannar. *Seaweed Res. Utiln.,* 24(1): 107-110.

Address : Department of Biotechnology, SASTRA - Deemed University, Thanjavur-613 402, Tamilnadu India.

Abstract : Vitamin-E was analysed in 14 species of macroalgae collected from the intertidal area of Gulf of Mannar at the intervals of 3 months from March to December, 2001.The tocopherol content in most seaweeds varied markedly with season. In general, high concentrations of tocopherol was seen in the brown algae followed by the green and red algae. *Padina boergesenii, Sargassum polycystum* and *Dictyota dichotoma* exhibited high concentrations of tocopherol among the Phaeophyceae and *Enteromorpha compressa, Caulerpa racemosa and C. sertularioides* among Chlorophyceae analysed. Among the red algae *Gracilaria edulis* and *G. foliifera* exhibited high tocopherol content in December.

826. **Hannah Vasanthi, R and G. Victor Rajamanickam** 2003. Variations in the chemical constituents present in *Hypnea valentiae* at Tuticorin and Mandapam coast - An environmental impact. *Seaweed Res. Utiln.,* 25(1&2): 115-121.

Address : School of Chemical & Biotechnology, Shanmuga Arts, Science, Technology and Research Academy (SASTRA), Deemed University, Thanjavur-613 402, Tamilnadu, India.

Abstract : Chemical analysis of the marine red algae *Hypnea valentiae*, a carrageenan yielding seaweed collected from Tuticorin and Mandapam coasts in the Gulf of Mannar region was carried out for proteins, carbohydrates, lipids, fat and water soluble vitamins and the major, minor and trace mineral elements. This was to find out the amount of various chemical constituents at Tuticorin coast, a highly polluted area and compare the same with those collected from the Mandapam coast. The study reveals that the algae collected from the Tuticorin coast exhibit high levels of heavy metal due to bioaccumulation and low levels of nutrients. However, the micronutrients such as vitamin A, E and C are high in Tuticorin samples. Hence, toxicological studies are necessary before large-scale commercial exploitation in the nutraceutical industries.

827. **Hannah Vasanthi, R., G. Victor Rajamanickam and A. Saraswathy** 2003. Fatty acid profile of some marine macroalgae in and around Rameswaram coastal waters. *Seaweed Res. Utiln.,* 25(1&2): 123-126.

Address : School of Chemical and Biotechnology, Shanmuga Arts, Science, Technology and Research Academy

(SASTRA), Thanjavur - 613 402, Tamilnadu, India.

Abstract : The fatty acid profile of selected seaweeds namely *Ulva reticulata, Padina boergesenii* and *Hypnea valentiae* were estimated using gas chromatography. All these seaweeds possess both saturated and unsaturated fatty acids in considerable amount. *P. boergesenii* contains high amount of palmitic acid (17.39 mg/g of lipid) and the unsaturated fatty acid, oleic acid (7.65 mg/g of lipid) and linoleic acid (2.25 mg/g) of lipid compared to the other seaweeds analysed. The essential fatty acids namely linoleic, linolenic and arachidonic acid were present in all the seaweeds analysed. Hence, this study enlightens the possible role of these seaweeds to be used in food and medicine.

828. **Hannah Vasanthi, R. A. Jaswanth, A. Saraswathy and G. Victor Rajamanickam** 2003. Screening of haematinic activity in some marine macroalgae. *SDMRI Res. Publ.*, 3: 118-121.

Address : Department of Biotechnology, Shanmuga Arts, Science, Technology and Research Academy, Deemed University, Thanjavur - 613 402, Tamil Nadu, India.

Abstract : With rising tide of interest in plant nutrient for food and medicine, harvest from the ocean are riding a wave of popularity. A number of land derived plants exhibit haematinic activity. However, marine algae have not been screened for haematinic activity. Ethanolic extracts of the macroalgae *Hypnea valentiae*, *Padina boergesenii*, *Sargassum polycystum* and *Ulva reticulata* were screened on albino rats for the haematinic activity. The extracts of *Hypnea valentiae* and *Padina boergersenii* (200 mg/kg p.o) exhibited significant haematinic activity, which was evidenced from the increased haemogram profile obtained in anemic male albino rats, as compared with the control rats.

829. **Hannah Vasanthi, R., A. Jaswanth, A. Saraswathy and G. Victor Rajamanickam** 2003. Control of urinary risk factors of stones by *Padina boergesenii* (Allander and Kraft), a brown algae in experimental hyperoxaluria. *J. Natural Remedies*. 3(2): 189-194.

Address : School of Chemical and Biotechnology, SASTRA, Deemed University, Thanjavur-613402, India; Department of Pharmacology, Periyar Coll. of Pharmacy for Women, Trichy-21, India; Capt. S.M. Drug Res. Inst. Ayurveda, Arumbakkam CECRAS, Chennai - 600 106, India; Department of Disaster Management, SASTRA, Deemed University, Thanjavur-613402, India.

Abstract : In view of the continued screening of seaweeds of the Gulf of Mannar for biological activity *Padina boergesenii*, the most common species along the Mandapam coast was identified to study the various biological effects. *Padina* spp, exhibits diuretic effect hence, the antiurolithiatic effect of *Padina boergesenii* was tested in hyperoxaluric male albino rats. Urolithiasis was induced in rats by feeding 3% glycolic acid along with pyridoxine deficient diet. The effect of the seaweed extract (ethanolic) at different doses was determined by comparing with the controls. The ethanolic extract of *Padina boergesenii* at a dose of (150 & 200mg/kg p.o) significantly reduced the calcium excretion to normal level and significantly decreased oxalate excretion, thus reducing the risk of calcium oxalate super-saturation in urine as compared to the pyridoxine deficient control rats. The extracts also slightly elevated phosphorous, decreased uric acid and raised the magnesium excretion. Protein and creatinine elimination was effectively normalized by the extracts. The antiurolithiatic activity exhibited by the ethanolic extract is related to the in that algae which is discussed.

830. **Hannah Vasanthi, R., A. Jaswanth, V. Krishnaraj, G. Victor Rajamanickam and A. Saraswathy** 2003. *In-vitro* Snake Venom Detoxifying Action of Some Marine Algae of Gulf of Mannar, Southeast Coast of India. *Phytotherapy Res*., 17(10): 1217-1219.

Address : Department of Biotechnology, SASTRA, Deemed University, Thanjavur-613402, India; Department of Pharmacology, Periyar Coll. of Pharmacy for Women, Trichy, India; Dept. of Dept. of Disaster Mgmt., SASTRA, Deemed University, Thanjavur, India; Captain S. Murti Drug Res. Inst., Arumbakkam (CCRAS), Chennai, India.

Abstract : The extract of the brown seaweed *Padina boergesenii* and the red seaweed *Hypnea valentiae* was found to detoxify *(in vitro)* the venom of *Naja nigricollis*. There was a remarkable reduction in the mortality of albino mice after intraperitoneal (i.p.) administration of reconstituted venom with the extract compared to those challenged with the venom only. The survival of the animals exposed to the venom incubated with the different concentrations of the extract was used as the *in vitro* detoxification parameter.

831. **Hannah Vasanthi, R., G. Victor Rajamanickam, A. Saraswathy and A. Jaswanth** 2004. Tumoricidal effect of the red alga *Acanthophora spicifera* on Ehrlich's ascites carcinoma cells. *Seaweed Res. Utiln.*, 26(1&2): 217-223.

Address : Centre for Advanced Research in Indian System of Medicine, SASTRA Deemed University, Thanjavur-613 402, Tamilnadu, India

Abstract : Alcholic extracts of the red alga *Acanthophora spicifera* from the vicinity of Mandapam coast, Tamil Nadu, India was tested for its tumoricidal effect in Ehrlich's ascites carcinoma cells developed in mice. *A. spicifera* exhibited tumoricidal activity at a dose of 20 mg/kg b.w as compared to the standard drug, 5-flurouracil. This was evidenced by the increase in the mean survival time, decrease in tumor volume and viable cell count. The smear study exhibited membrane blebbing, vacuole formation and reduction in staining intensity, which further ascertained the tumoricidal activity.

832. **Hannah Vasanthi, R., A.C. Dorni, K.S. Vidhyalakshmi and G. Victor Rajamanickam** 2005. Free radical scavenging and antioxidant activity of a red algae *Acanthophora spicifera* - Relation to its chemical composition. *Seaweed Res. Utiln.,* 28 (1): 119 –125.

Address : Sri Ramachandra Medical College & Research Institute (Deemed University), Porur, Chennai- 600 116 and Centre for Advanced Research in Indian System of Medicine (CARISM), SASTRA Deemed University, Thanjavur- 613402, Tamilnadu, India.

Abstract : Dietary antioxidants from plants are believed to help in preventing a number of diseases through free radical scavenging activity. In view of the continued screening of seaweeds of the Gulf of Mannar for biological activity, *Acanthophora spicifera* one of the most common species along the Mandapam coast was identified to study the free radical scavenging and antioxidant activities by in-vitro methods. The percentage inhibition of lipid peroxides and the nitric oxide radical scavenged was found to be 58.59% and 82.28% respectively; whereas the total antioxidant activity was found to be 2342.26 µg/ml as compared to the standard Vitamin E. The antioxidant activity is probably due to the presence of the natural antioxidants such as Vitamin A, E and C in the algae and the secondary metabolite such as polyphenols, which was scanned using HPTLC fingerprinting and quantified.

833. **Hashimi, N.H., R.M. Kidwai and R.R. Nair** 1981. Comparative study of the topography and sediments of the western and eastern continental shelves around Cape Comorin. *Indian J. Mar. Sci.,* 10(1): 45-50.

Address : National Institute of Oceanography, Dona Paula, Goa 403004, India.

Abstract : Western and eastern continental shelves around Cape Comorin show 3-well-defined regions of depositional environments each having its own characteristic features. The environments extend from Cochin to Quilon, Quilon to Cape Comorin and Cape Comorin to Tuticorin. Topographically the region between Cochin and Quilon is smooth with sub-bottom reflections on the echogram whereas between Quilon and Cape Comorin and from Cape Comorin to Tuticorin the continental shelf is uneven and periodic bed forms (ripples/waves) are observed in the latter area. Sediments of the 1st region are characterized by a high percentage of fine grained sediments (62.4% silt and clay) whereas the 2nd and 3rd regions have 4.3 and 12.8% respectively. The carbonate content increases from 21.9% off Cochin to 37.4% off Quilon and 71.4% off Tuticorin. Differences in the 3 sedimentary environments are attributed to the variations in the depositional and erosional processes prevailing in the region.

834. **Hegde, S.B., T. Nandagopal, K.M. Thirupathayya and C.B. Srinivasan** 2000. Physico-chemical and mineralogical characteristics of fly ashes of some thermal power stations, Tamil Nadu, India. *ZKG International*. 53(3): XV-XVI.

Address : Dalmia Institute of Science and Industrial Research, Salem, India.

Abstract : The fly ash samples from the Mettur, Tuticorin and Neyveli power stations in Tamil Nadu have been studied for their physico-chemical and mineralogical properties. Mettur and Neyveli ashes met Indian Standard specification (IS) : 3812 for use as pozzolans and admixtures. Tuticorin fly ash is coarser and requires further grinding to meet the above IS specification for the same purposes. X-ray studies reveal that quartz, mullite, rutile, hematite and feldspars are detected in all the fly ashes studied. Minerals like maghemite, C3A and calcium anhydrite were detected only in the Neyveli fly ash.

835. **Hemalatha, R and R. Rengasamy** 1993. Studies on *Gracilaria edulis* (Gmelin) Silva. *Phykos*, 32 (1 & 2) : 65-75.

Address : University of Madras, Madras 600 025, Tamilnadu, India.

Abstract : The red alga *Gracilaria edulis* Silva was studied under varying laboratory conditions. Among the six different media viz., ASP2, ASP6, SWM3, Grund, F/2, PES, PES/2 and PES/4 tried, maximum algal growth was

observed in PES/2 medium. Different concentrations of NO_3, NH_4 and PO_4 affected growth Chl a, PE, PC and APC, total protein and agar yield of the algae. Growth was maximum at 0.9 mM $NaNO_3$, 0.2 mM NH_4 and 0.04 mM PO_4. Nitrate and ammonium enrichment enhanced phycobilins and protein. The Chl-a was maximum at 0.001 mM and that of phycobilins at 0.005 mM PO_4 concentration. Reduced levels of nitrate, ammonium and phosphate enhanced agar yield while increased levels decreased the SO_4 content and improved its quality.

836. **Herdman, W.A.** 1902. *Report on pearl fisheries of Ceylon. 1901*. pp. 541-545.

837. **Herdman, W.A.** 1903. Introduction, *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 1: 1-16.

838. **Herdman, W.A.** 1903. Description of the pearl oyster banks of Gulf of Mannar. *Rep. Govt. Ceylon Pearl Oysters Fish. Gulf of Mannar,* 1: 99-121.

839. **Herdman, W.A.** 1903. Observations on the sea around ceylon and especially in the Gulf of Mannar. *Rep. Govt. Ceylon Pearl Oyster Fish Gulf of Mannar,* 1: 122-124.

840. **Herdman, W.A.** 1903. Observations and experiments on the life history and habits of the pearl oyster. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 1: 124-125.

841. **Herdman, W.A.** 1903. *Report to the Govt. of Ceylon on the pearl oyster fisheries of the Gulf of Mannar.* Pt. 1:1-125.

842. **Herdman, W.A.** 1903. The pearl fisheries of Ceylon. *Nat. Proc. Meet. Mem. R. Inst.*, 17: 279-287.

843. **Herdman, W.A.** 1904. History of the principal pearl banks. Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar, 2: 1-36.

844. **Herdman, W.A.** 1904. Anatomy of the pearl oyster *(Marganitifera vulgaris, Schumr). Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 2: 37-76.

845. **Herdman, W.A.** 1904. *Report to the Govt. of Ceylon on the pearl oyster fisheries of the Gulf of Mannar.* Pt. II: 1-77.

846. **Herdman, W.A., J.B. Herdman and F.J. Bell** 1904. Report on the Echinodermata collected by Professor Herdman at Ceylon in 1902. *Rep. Govt. Ceylon Pearl Oyster Fish Gulf of Mannar,* 2: 137-150.

847. **Herdman, W.A and J. Hornell** 1905. Notes on the pearl formation in the ceylon pearl oyster. *Spolia Zelan.,* 2(8): 200-201.

848. **Herdman, W.A.** 1905. *Report to the Govt. of Ceylon on the pearl oyster fisheries of the Gulf of Mannar.* Pt.III, 160 pp.

849. **Herdman, W.A.** 1905. *Report to the Govt. of Ceylon on the pearl oyster fisheries of the Gulf of Mannar.* Pt. IV. 140pp.

850. **Herdman, W.A.** 1905. The present condition of the pearl banks. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 3: 37-48.

851. **Herdman, W.A.** 1905. The great pearl fishery of 1905. Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar. 4: 71-76.

852. **Herdman, W.A. and J. Hornell.** 1906. Pearl production. *Rep. Govt. Ceylon pearl Oyster Fish. Gulf of Mannar,* 5: 1-42.

853. **Herdman, W.A.** 1906. General summary and recommendations. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 5: 109-136.

854. **Herdman, W.A.** 1906. Discussion of faunistic results. *Rep. Govt. Ceylon Pearl. Fish. Oyster Gulf of Mannar.* 5: 433-448.

855. **Herdman, W.A.** 1906. *Report to the Govt. of Ceylon on the pearl oyster fisheries of the Gulf of Mannar-with supplementary reports upon the Marine Biology of Ceylon* (in 5 parts in the many plates) Royal Society London.

856. **Herre, A.W.C.T.** 1945. Notes on fishes on the Zoological museum of Stanford University: XX, New fishes from China and India, a new genus and new Indian record. *J. Washington Acad. Sci.,* 35(12): 399-404.

857. **Hickson, S.J.** 1931. Three species of Alcyonaria from the Gulf of Mannar. *Bull. Madras Govt. Mus. New. Ser. (Nat. Hist.),* 1(2 pt 2): 81-89.

858. **Hoon, V.** 1997. Coral reef of India: Review of their extent, condition, research and management status. *Regional workshop on the conservation and sustainable management of coral reefs,* Proceedings No.22, CRASARD. B1-B22.

Address : Bay of Bengal Programme, FAO, Chennai, Tamilnadu, India.

Abstract : The major reef formations in India are restricted to the Gulf of Mannar, Palk bay, Gulf of Kutch, Andaman and Nicobar Islands and the Lakshadweep Islands. While the Lakshadweep reefs are atolls, the others are all fringing reefs. Patchy coral is present in the inter-tidal areas of the central west coast of the country. Coral reefs in India are being damaged and destroyed at an increasing rate. They face serious problems of stress from anthropogenic pressures and interference. However we cannot be precise about how much and where, because of special difficulties of monitoring underwater. The Reef condition is generally poor and declining in near shore waters and areas of high population density. Relatively pristine reefs are located around uninhabited Islands or ban-ier type reefs located away from population centers. Sedimentation, dredging and coral mining are damaging near shore reefs, while the use of explosives and bottom nets in fishing are damaging off shore reefs in specific sites. Although institutions and laws are sufficient in theory to manage and protect the reefs in India, authorities in the field have taken little effective action in implementing these laws.

859. **Hornell, J.** 1910. An explanation of the irregular cyclic character of the pearl fisheries of the Gulf of Mannar. *Madras Fish. Bull.,* 8.

860. **Hornell, J.** 1913. The chank bangle industry, *Mem. Asiat. Soc. Bengal,* 3(7): 407-448.

861. **Hornell. J.** 1914. The sacred chank of India. *Madras Fish Bull.,* 2(7): 1-181.

862. **Hornell, J.** 1916. Notes upon two exploring cruises in search of trawl grounds off the Indian and Ceylon Coasts. *Madras Fish. Bull.,* 8: 23-24.

863. **Hornell, J.** 1916. The Indian Conch (*Turbinella*) and its relation to Hindu life and religion. *Rep. Mar. Zool. Okhmandal Kathiawar* (India), pt.2.

864. **Hornell, J.** 1917. The Indian industry: its history and recent revival. *Madras Fish. Bull.,* 11(4): 119-150.

865. **Hornell, J.** 1921. The common molluscs of South India. *Madras Fish Bull.,* 16.

866. **Hornell, J.** 1922. Pearl formation in the Indian pearl oyster. *J. Asiat. Soc. Bengal,* 18: 213-219.

867. **Hornell, J.** 1922. The Indian pearl fisheries of the Gulf of Mannar and Palk Bay. *Madras Fish. Bull.,* 16: 1-188.

868. **Hornell, J.** 1924. Report on the inspection of pearl banks in the Gulf of Mannar and Palk Bay in March and April 1923. *Madras. Fish. Bull.,* 17: 199-214.

869. **Hornell, J.** 1949. The study of Indian Molluscs I, II & III. *J. Bombay Nat. Hist. Soc.,* 48: 303-334.

Abstract : The commonest objects on Indian sea-beaches are the shells of those soft-bodied animals called by zoologists mollusca and popularly known as shellfish. These names appear at first sight to be contradictory, for while the scientific term signifies that the animals are soft-bodied, the popular name implies that they are encased in a hard, protective covering, the shell. Combining the two ideas we get a fairly clear comprehension of their outstanding and obvious characteristics-soft-bodied animals protected by an outer casing or armour, usually hard, composed of some form of limy or calcareous material, and without any internal skeleton except in very

exceptional instances of which the cuttlefishes are examples; sometimes both external and internal skeletons are wanting of these many garden slugs are familiar instances; others are the naked-gilled seaslugs (Nudibranchs), often of brilliant colouring and fantastic form. In the Volutes (Volutidae) the shell is generally large and of beautiful colouring and shape. The animal is often larger than its shell can accommodate and as a consequence the operculum in these is wanting. The radula usually has but a single longitudinal row of teeth. In the order, Eulamellibranchia, gill filaments are united at regular intervals by cross branches. Except in the oysters and a few others, two adductor muscles are present. Many have the edges of the mantle lobes united at three places posteriorly and the margins are often prolonged into tubular siphons, sometimes quite short, sometimes extremely elongate.

870. **Hoyle, W.E.** 1904. Report on the cephalopoda collected by Professor Herdman at Ceylon in 1902. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 2: 185-200.

871. **Hussain, S.M., V. Ragothaman, V. Manivannan** 1996. Distribution and species diversity of recent benthic Ostracoda from the Gulf of Mannar off Tuticorin, Tamilnadu. *J. Palaeontol. Soc. India.* 41: 17-20.

872. **Hussain, S.M., V. Ragothaman, V. Manivannan** 1996. Distribution of ostracoda in waters off Tuticorin, southeast coast of India. *Indian J. Mar. Sci.,* 25(1): 78-80.

Address : Department of Geology, University of Madras, A.C. College Campus, Madras - 600 025, Tamilandu, India; Department of Geology, Government Arts College, Salem - 636 007, Tamilnadu, India.

Abstract : The mean values of temperature, salinity and dissolved oxygen determined during four different months (January, April, July and October) are as follows: 26.6°C, 30.24×10^{-3} and 3.1 ml/1; 32.3°C, 34.24×10^{-3} and 6.7 ml/1; 29.2°C, 35.25×10^{-3} and 5.3 ml/1; 28.2°C, 32.7×10^{-3} and 5.7 ml/1. The mean density of ostracod population during these four months is 226, 341, 283 and 148 respectively. It is inferred that an increase in temperature, salinity and dissolved oxygen content of the bottom water is favourable for a comparative abundance of ostracoda population in the study area.

873. **Hussain, S.M., V. Manivannan and V. Ragothaman** 1997. Sediment-Ostracode relationship in the Gulf of Mannar Off Tuticorin, East coast of India, *J. Napal. Geol. Soc.,* 15: 33-37.

874. **Hussain, S.M., S.P. Mohan and V. Manivannan** 1998. Recent cytherellids, bairdids and cytherids (Ostracoda) from the Gulf of Mannar, off Tuticorin, Southeast Coast of India. *Indian J. Earth Sci.,* 25(1): 17-28.

Address : Department of Geology, University of Madras A.C. College Campus, Chennai 600 025 India.

Abstract : A systematic study of Recent Ostracoda based on 48 bottom sediment samples collected from the inner shelf of Gulf of Mannar, off Tuticorin, Tamil Nadu has been presented in this paper. 3 species belonging to the family Cytherellidae, 5 to Bairdiidae and 5 to Cytheridae are described. Among these, *Cytherella dictyon, Anchistrocheles* sp. *cf. A. mcquadei* and *Neomonoceratina porocostata* are recorded for the first time from the Indian waters. Two new species, *Triebelina tuticorensis* and *Hemicytheridea khoslai* are established. One species, *Cytherelloidea praecipua* Bold, which is revised and placed under the genus Keijcyoidea, is also recorded for the first time from the east coast of India.

875. **Hussain, S.M., S.P. Mohan and V. Manivannan** 2000. Distribution, faunal affinity and zoogeography of recent benthic ostracoda from the Gulf of Mannar, off Tuticorin, Southeast coast of India. *Ongc Bull.,* 37(1): 93-98.

Address : Department of Geology, University of Madras A.C. College Campus, Chennai - 600 025, Tamilnadu, India.

Abstract : Fifty-two Ostracoda species are recorded from inner shelf off Tuticorin, Gulf of Mannar, southeast coast of India. A check-list of the fauna along with their zoogeographic distribution and frequency in the study area is given. The living and total (living + dead) population size is more during summer (April). The maximum living population size attained during any season is found only in the intermediate segment of transect. The increase in temperature, salinity and dissolved oxygen of the bottom waters and higher calcium carbonate content of the sediment favours the abundance of population. The most congenial substrate for the fauna to thrive is sand and siltysand in the present area. It is observed that the fauna has got close affinity with the Ostracoda assemblage of the Indo-Pacific region. The zoogeography and possible migration routes of this tropical, littoral and shallow water benthic fauna are discussed. It is also observed that the south equatorial currents are responsible for the dispersal of the taxa.

876. **Hylleberg, J.** 1992. Marine bivalve culture in India as presented by Dr. Narasimham. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biological Centre*, 10: 90-91.

Address : Institute of Biological Science, Aarhus University, Aarhus, Denmark.

Abstract : A discussion is presented on the culture of bivalve molluscs in India, with particular reference to techniques used at the CMFRI Research Centre at Tuticorin, India. Pearl culture, edible oyster farming and current problems facing the aquaculture sector in India are examined briefly. It is concluded that attempts to make marine mollusc aquaculture economically feasible should have emphasis on extension and marketing.

877. **Hylleberg, J and R.N. Kilburn** 2002. Annotated inventory of molluscs from the Gulf of Mannar and vicinity. *Spec. Publ. Phuket Mar. Biol. Centre*, 26: 19-79.

Address : Institute of Biological Sciences, Aarhus University, Aarhus Denmark; E-mail: hylleberg@biology.aau.dk

Abstract : Some 866 valid species in 116 families of molluscs from the eastern coast of India stretching from Chennai (formerly Madras) to west of Cape Comorin (India) were recorded. The following number of species were counted: Polyplacophora (8), Gastropoda (584), Bivalvia (266), Scaphopoda (7), and Cephalopoda (1). Records of synonyms and obvious misidentifications are listed and indexed together with diverging classification adopted by different authors. Most species have been obtained from Palk Bay and the Indian side of the Gulf of Mannar. Selected literature records, photographs of species of Littorinidae, Oliva, Conidae, and material identified by resource persons of the Tropical Marine Mollusc Programme (TMMP) are included in the inventory. We have recorded 866 valid species in 116 families of molluscs from the eastern coast of India stretching from Chennai (formerly Madras) to west of Cape Comorin.

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878. **Iacol, P.G.** 1973. Sea cucumbers. *Seafood Export J.*, 5(11): 21-24.

Abstract : The author suggests that transplantation of spawn of larger and commercially important seacucumber from the Laccadives and the Andamans to the Gulf of Mannar, the annual production of *Beche-de-mer* can be increased substancially.

879. **Immanuel, G., A. Palavesam and M. Peter Marian** 1997. Formulation and analysis of artificial feed from fishery wastes. *J. Freshwater Biol.*, 9(2): 86-90.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : In order to utilize the available fishery wastes in Kanyakumari district, five different types of pellet feeds were formulated with 40% protein (isoprotein) and supplemented with different levels of fish, *Odonus niger*, liver oil [0% - control (c)], 1% (F1), 2% (F2), 3% (F3) and 4% (F4) diets. The proximate composition of the five diets were analyzed. The protein content ranged between 40.20 and 40.80%. The lipid level was also varied depending on the levels of supplementation in the diets (14.8% to 22.30%). The water stability of these pellet diets was also studied and the percentage leaching of the diets during 6h period was the highest in the control diet (16%); whereas it was in between 13.2% and 15.4% in other diets.

880. **Immanuel, G., A. Palavesam and M. Peter Marian** 2000. Studies on the waste generation potential from Cephalopods landings in coastal areas of Kanyakumari district, Tamil Nadu. *Indian J. Environ. Ecoplan.*, 3(2): 271-282.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : Total landing of cephalopods *i.e.*, cuttlefish and squid were estimated in six major landing stations of Kanyakumari district (Kanyakumari, Manakkudy, Muttom, Colachel, Enayam Puthenthurai and Marthandam) for a period of consecutive three years (1991 – 1993). During this period, cuttlefish and squid productions were averaged to 1,219.55 and 1,050.75 t year^{-1}. From the total cephalopods production, certain percentage of body parts are discarded as wastes in the surveyed areas (tentacles, wings, skins and viscera). During this period (1991 – 1993) about 25 and 29% of body parts from cuttlefish and squid accounted as wastes, respectively. The total wastes averaged to 304.88 t year^{-1} from cuttlefish and 304.72 t year^{-1} from squid. These waste materials can be utilized as one of the ingredients for the aquafeed production.

881. **Immanuel, G., M. Peter Marian and A. Palavesam** 2001. Effects of feeding lipid enriched Artemia nauplii on survival, growth, tissue fatty acids and stress resistance of post larvae *Penaeus indicus*. *Asian Fish. Sci.*, 14 : 377-388.

Address : DDepartment of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

882. **Immanuel, G., V. Menenthira, A. Palavesam and M. Peter Marian** 2002. Physico-chemical properties and fatty acid profile of trash fish, *Odonus niger*, liver oil, *Indian J. Fish.*, 49(3): 667.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

883. **Immanuel, G., V. Menenthira, S. Beena and A. Palavesam** 2003. Effect of probionts on the growth, food utilization and biochemical changes in pearl spot *Etroplus suratensis* (Bloch). *Indian J. Fish.*, 50(2): 273-278.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : To evaluate the efficiency of different probionts (Lactobacillus and Yeast) on *Etroplus suratensis*, three different pelleted diets were formulated with 30% protein and in which two diets were supplemented with probionts such as 2% Lactobacillus (diet A) and 2% yeast (diet B) and a diet (C) without probiont was used as control. The water stability of these diets was studied as a function of exposure duration. The leaching percentage during 6 hrs period did not vary much between experimental diets (17.60 to 18.70%). The specific growth rate of *E. suratensis* revealed that the control diet fed fish have the lowest value of 2.93% against the highest values

of 3.62 to 3.82% in probionts supplemented diets fed fishes. The gross production efficiency was also higher in probionts supplemented diet fed groups than control groups.

884. **Immanuel, G., V. Menenthira, P. Prema and A. Palavesam** 2003. Influence of probionts on the gut microbial diversity in pearl spot, *Etroplus suratensis* (Bloch). *Indian J. Fish.*, 50(4): 499-508.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : Qualitative and quantitative aspects of bacterial population in the gut of *Etroplus suratensis* collected from wild, following one day starvation and also in fishes fed with probionts supplemented diets such as *Lactobacillus acidophilus* (Feed A) and Yeast - *Saccharomyces cervisiae* (Feed B) were studied. The total aerobic heterotrophic bacterial counts in gut contents of wild and one day starved fish were 31.0 x 10^6 and 22.6 x 10^6 CFU / ml. Similarly in fishes fed with probionts supplemented diets and control diet (Feed C) cultured for 15 and 30 days, the bacterial counts registered were 26.40 x 10^6, 22.9 x 10^6 and 29.9 x 10^6 CFU / ml and 28.2 x 10^6, 27.6 x 10^6 and 22.3 x 10^6 CFU/ml during 15th and 30th days of experiment in fish fed with *L. acidophilus*, Yeast, *S. cervisiae* and control diets respectively. Totally eleven bacterial genera were identified in all the gut samples and among these, *Pseudomonas, Bacillus, Micrococcus* and *Alcaligenes* were dominant during 30th day of the experiment.

885. **Immanuel, G., V. Menenthira, S. Beena and A. Palavesam** 2003. Influence of dietary lipid on survival, growth and moulting strategies of *Penaeus indicus* (Milne Edwards) post larvae. *J. Aqua. Trop.*, 18(1): 45-60.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : A study was undertaken to find out the influence of dietary lipid level on survival, moulting, growth and bioenergetic parameters in postlarvae of *Penaeus indicus*. To begin with, four experimental pellet diets (F1 through F4) having 40% crude protein with 1, 2, 3 and 4% lipid were prepared. A diet with same protein level, but devoid of lipid was also prepared and used as the control (C). The shrimps larvae were fed on control and experimental diets to satiation for a period of 30 days. The survival of *P. indicus* was 100% when fed on control (C), F1 and F2 diets against 90% for those groups fed on F3 and F4 diets. The moulting rate was high (7.6) in F1 diet fed shrimps; whereas it was low (5.4) in control diet fed individuals. Similarly, the average inter moult period was also high (5.0 days) in *P. indicus* fed with control diet (C) and lower (3.9 days) in F1 diet fed shrimps. The biochemical composition such as protein content was high (56.2%) in F1 diet fed shrimps; whereas, it was low (51.4%) in control die fed shrimps and in F2, F3 and F4 diet fed groups it was 54.8, 53.3 and 53.8% respectively. The lipid content of the different diet fed shrimps varied from 5.2 to 7.0%. The Specific Growth Rate of control diet fed *P. indicus* was low (8.50%) and it was high (11.46%)for those shrimps received F1 diet. The consumption rate of control diet fed *P. indicus* was 123.36 mg/g/day and it reduced to a range of 64.49 ± 0.692 mg/g/day to 85.54 ± 1.139 mg/g/day in experimental diet fed groups. The absorption efficiency ranged between 79.04% and 89.04% in control and experimental diets fed groups. The gross production efficiency was low in control diet fed shrimps (13.01%) and it was high (25.28%) in F1 diet fed individuals.

886. **Immanuel, G., V.C. Vincy Bai, V. Sivaram, A. Palavesam and M. Peter Marian** 2004. Effect of butanolic extracts from terrestrial herbs and seaweeds on the survival, growth and pathogen (*Vibrio parahaemolyticus*) load on shrimp *Penaeus indicus* juveniles. *Aquaculture*, 236: 53-65.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : Emergence of microbial disease in aquaculture industries implies serious financial lose. Usage of commercial antibiotics for disease treatment produces undesirable side effects. Certain ayurvedic herbal compounds are having potent effect on growth and survival as well as antimicrobial properties of aquatic organisms. In this study, six types of antimicrobial compounds were extracted using n-butanol from terrestrial plants such as *Ricinus communis* (T1), *Phyllanthus niruri* (T2), *Leucus aspera* (T3), *Monihot esculenta* (T4) and seaweeds *Ulva lactuca* (T5) and *Sargassum wightii* (T6). The yield of extractable matter was between 10.20% and 17.50%. The antimicrobial activity of these extracts was tested against shrimp pathogen *Vibrio parahaemolyticus* by giving due consideration to zone of inhibition. Powder form of these extracts was bioencapsulated in *Artemia* and fed to *Penaeus indicus* juveniles reared in individual tanks inoculated with shrimp pathogen *V. parahaemolyticus* at the rate of 10^7 CFU ml^{-1}. *P. indicus* juveniles reared in *V. parahaemolyticus* uninoculated water and fed with unenriched *Artemia* (C1) exhibited maximum survival (86.10%), specific growth rate (SGR, 2.87%) and less bacterial load

(0.43 and 0.52 x 103 CFU g^{-1} in muscle and hepatopancreas tissues). The shrimps reared in *V. parahaemolyticus* inoculated medium and fed with unenriched Artemia (C2) showed the lowest survival (24.44%), specific growth rate (1.11%) and more bacterial load (3.71 and 3.86 x 105 CFU g^{-1} in muscle and hepatopancreas tissues). The shrimps fed with herbal and seaweed diets enriched *Artemia* (T1 – T6) boosted the survival (43.32 – 58.88%), specific growth rate (1.46 – 2.15%) and lowered *V. parahaemolyticus* load (1.36 – 2.03 and 1.47 – 2.16 x 10^5 CFU g^{-1} in muscle and hepatopancreas tissues, respectively) in the culture system. Among the herbal diets screened, *R. communis* (T1) gave better results than the other products. The findings of the present study would be highly useful to produce quality, disease-free shrimps with high production.

887. **Immanuel, G., A. Palavesam, V. Sivaram, M. Michael Babu and M. Peter Marian** 2004. Feeding trash fish, *Odonus niger,* lipid enriched *Artemia* nauplii on growth, stress resistance and HUFA requirements of *Penaeus monodon* postlarvae. *Aquaculture,* 237: 301-313.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : *Artemia franciscana* nauplii (A to E) were enriched with different concentrations of emulsified *Odonus niger* liver oil (0 – 4%). These enriched *Artemia* nauplii were fed to postlarvae (PL2 – PL20) of *Penaeus monodon* and assessed the survival, growth, stress resistance and HUFA requirement. Maximum specific growth rate of 24.55 ± 0.287% was recorded in diet D and the minimum of 22.67 ± 0.237% in diet A fed individuals. Survival of *P. monodon* fed with lipid enriched *Artemia* nauplii was higher than the control diet (A). The salinity stress resistance (0 ppt) of *P. monodon* revealed that the individuals fed with diet D were more stress resistant (50 min) than those that received other diets (40 – 45 min). At high salinity (50 ppt), diets D and E fed individuals survived upto 480 min, whereas in other diets (A, B and C), the larvae survied upto 420 min. In both low and high salinities, a cumulative mortality index (CMI) of 121 ± 0.816 and 91.66 ± 0.942 was recoded for diet A fed groups and it was reduced by 15.14 ± 0.930% and 21.44 ± 0.450% for those fed diet D. The fatty acid profile of the *Artemia* nauplii enriched with selected concentrations (0 – 4%) of *O. niger* liver oil was varied remarkably. The PUFA showed an increasing trend in enriched *Artemia* nauplii ranging from 32.41% (by weight) in control (A) to 46.16% (by weight) in 3% (D) lipid. Similarly, the PUFA of *P. monodon* postlarvae (PL2 – PL20) fed with the lipid enriched *Artemia* nauplii were increased from 29.72% (by weight) in control (A) to 44.13% (by weight) in postlarvae received 3% (D) lipid enriched *Artemia* nauplii. The overall performance of growth enhancement, stress tolerance and fatty acid profile of *P. monodon* revealed that *P. monodon* postlarvae fed with D (3% lipid) were more efficient than the other groups.

888. **Immanuel, G., A. Palavesam, B. Vengadesh and M. Peter Marian** 2004. Rearing of brine shrimp, *Artemia parthenogenetica* using rice bran supplemented with fermented yeast. *Indian J. Fish.*, 51(4): 451-459.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : The suitability of rearing *Artemia parthenogenetica* (KKT 1) fed with rice bran supplemented with fermented yeast at 80 ppt salinity was studied. Feeding experiments were conducted to determine the survival, growth and reproductive traits of *A. parthenogenetica* using different combinations of rice bran: yeast (1:1, 1:2, 1:3 and 1:4) with yeast fermented either in coconut water (yeast CW) or in boiled rice water (Yeast - BRW). A combination of rice bran and yeast - CW in the ratio 1:4 supported maximum survival of 88%, whereas 1:1 combination of rice bran with yeast - BRW supported maximum survival of 64.3%. Better growth was obtained in 1:2 combination of rice bran and Yeast - CW (10.0 ± 0.3 mm), but it was in 1:4 combination of rice bran and Yeast BRW (8.4 ± 0.2 mm). The ratio 1:4 of rice bran and yeast derived from the two sources supported maximum life span of 37 to 38 days as well as more fecundity. This study revealed that the different combinations of rice bran and yeast influenced the life history traits of *A. parthenogenetica.*

889. **Immanuel, G., P. Iyapparaj, R. Ramasubburayan, A. Palavesam and M. Peter Marian** 2005. Screening of medicinal plant extracts for eco-friendly antimicrofouling compounds. *J. Biol. Res.*, 4: 181-188.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : The diversified biofouling organisms cause damage to fishing vessels including accessory materials in marine environment. Their occurrence and diversity are influenced by environmental variables. In the harbouor environment, their growth is favoured by pollutants from anthropogenic activities, a fact deserving critical investigation. The site selected for the present study is Chinnamuttom fisheries harbour in southeast coast of

India. Four different substrata (panels), i.e. wood, FRP, stainless steel and carbon steel were selected and exposed to seawater of fisheries harbour for 72h. From these panels, the biofilm was scrapped out at an interval of 24h for a period of 72h. From these panels, the biofilm was scrapped out at an interval of 24 h for a period of 72h and then the total viable count (TVC) of the biofilm was enumerated. It showed a gradual increase of TVC with increase in time. Among the tested substrata, stainless steel showed the highest (30.0- 85.30 x 10^4 CFU ml^{-1}) bacterial load against the lowest (16.0 – 39.0 x 10^4 CFU ml^{-1}) in carbon steel. In total, eight bacterial species were isolated and identified from all panels, with varying population diversity. The daily variations in physico-chemical parameters of the source showed little fluctuation. Further, the methanolic extracts of 10 selected medicinal plans were screened for antimicrofouling properties against the identified bacterial species. Among the medicinal plants screened, *Phyllanthus niruri* exhibited the highest inhibitory activity against all tested bacterial species (12-14 mm), *Lawsonia innermis* (10-12.5 mm), *Azadirachta indica* (9.5-11.5 mm), and Aloe vera (8.5-10.5 mm) exhibited considerable antimicrofouling property. Plant extracts with their active principle compounds were found to be essential components for the preparation of biofilm repellents.

890. **Immanuel, G., R. Dhanusha, P. Prema and A. Palavesam** 2006. Effect of different growth parameters on endoglucanase enzyme activity by bacteria isolated from coir retting effluents of estuarine environment. *Int. J. Environ. Sci. Tech.,* 3(1): 25-34.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari District, Tamilnadu, India.

Abstract : The cellulolytic enzyme-endoglucanase activity against coir fibre, a major biowaste by bacteria such as *Cellulomonas, Bacillus* and *Micrococcus* spp. isolated from coir retting effluents of estuarine environment was studied. The enzyme assay was carried out by using various concentrations (0.5 – 2%) of substrate of coir powder as a carbohydrate in different pH (5 – 9) and temperature (20 – 50^{0}C). The enzyme activity was minimum in 0.5% substrate concentration at lower pH 5 (0.0087, 0.0143 and 0.0071 U/mL) and at 20^{0}C temperature (0.0151, 0.0154 and 0.0122 U/mL) by the bacterial strains such as *Cellulomonas*, *Bacillus* and *Micrococcus* spp. respectively. Then this level was increased and reached maximum at the neutral pH (0.0172, 0.0165 and 0.0121 U/mL) and 40^{0}C (0.336, 0.0196 and 0.0152 U/mL) by the selected bacterial species. Further increase of pH and temperature, the enzyme activity reduced considerably to 0.0083, 0.0143 and 0.0037 U/mL at pH 9 and 0.0154, 0.0197 and 0.0121 U/ml at 50^{0}C by the tested bacterial strains. The same trend was also obtained in other substrate concentrations such as 1.0, 1.5 and 2.0%, Within the four substrate concentrations, the endoglucanase enzyme activity was more in 1.5% concentration at the tested pH and temperatures. From the overall results, it was observed that, among the three bacterial strains, the enzyme activity was more in *Cellulomonas* sp. followed by Bacillus and *Micrococcus* sp. in varying pH and temperature.

891. **Immanuel, S.** 1995. Training programme for fisher-women on preparation of food from seaweed. An evaluation study. *Mar. Fish. Infor. Serv. T & E. Ser.,* 137: 11-13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweed is one of the important renewable marine living resources. Seaweeds are extensively used in the manufacture of food and medicine and in industries for the extraction of agar agar and sodium alginate. Seaweed receipes for preparing jam, jellies, wafers and pickles are available. With the objectives of extending the methods of preparation of seaweed as food which can help to increase the income generating opportunities to fisherwomen.

892. **Immanuel, S and R. Sathiadhas** 2004. Employment potential of fisherwomen in the collection and post harvest operations of seaweeds in India. *Seaweed Res. Utiln.,* 26(1&2): 209-215.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Seaweeds are the renewable marine resources and they form the primary raw material for the agar and algin industries. They are mostly exploited from the southeast coast of Tamil Nadu from Mandapam to Kanyakumari, Gujarat Coast, Lakshadweep Islands and the Andaman and Nicobar Islands. Even though substantial resources are available in our coastal waters, it is neither harvested to its fullest extent nor much efforts have been put forth. Seaweed collection renders extensive employment to the coastal fisher folk. The estimation of seaweed resources indicate that only a negligible quantity is harvested. At present nearly 5000 women depend on the seaweed industries for their livelihood. If the available resources are harvested to its optimal level, it can provide employment to another 20,000 coastal fisher folk in harvesting sector and an equal number in post harvest activities. Since the domain of seaweed collecting industry is mainly dominated by women, special efforts should

be taken for its optimum exploitation and market expansion through diversified product development and their popularization. This paper deals with the employment potential of fisherwomen in seaweed industries, problems and prospects in the collection and processing segments of seaweeds.

893. **Indra Jasmine, G., C.B.T. Rajagopalasamy and G. Jegatheesan** 1988. Mercury level in the edible oyster, *Crassostrea madrasensis. CMFRI Bulletin*, 42(2): 414-416.

Address : Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu, India.

Abstract : Chemical analysis of the meat of *C. madrasensis* of size range 7.5-15.1 mm and meat weight of 2-2.6 g showed that the level of mercury was less than the accepted standard limit of 0.5 ppm in the edible meat.

894. **Indra Jasmine, G., C.B.T. Rajagopalsamy and P. Jeyachandran** 1989. Total mercury content of Indian squid *Loligo duvauceli* Orbigny from Tuticorin waters, south east coast of India. *Indian J. Mar. Sci.*, 18(3): 219-220.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Mercury content in *Loligo duvauceli* varied from 0.008 to 0.123 ppm wet weight (0.038 ppm to 0.202 ppm dry weight) with a mean value of 0.018 ± 0.002 ppm wet weight (0.076 ± 0.008 ppm dry weight). These levels are well below the FAO/WHO recommend upper limit of 0.5 ppm.

895. **Indra Jasmine, G., S.P. Pillai and S. Athithan** 1993. Effect of feed stimulants on the biochemical composition and growth of Indian white prawn *Penaeus indicus*. *Spec. Publ. Eur. Aquacult. Soc.*, 19: 139.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Dietary supplementation of feeding attractants or stimulants is very significant to elevate feed efficiency in prawns. Crustacea are known to grow through several moulting cycles. A number of compounds have been found to stimulate feeding and growth. Most of them consist of amino acids and Nucleotide monophosphates. DMPT, a sulphur containing volatide compound was found in crustaceans and molluscs and is responsible for the sea smell in various aquatic organisms. Diets supplemented with DMPT and related compounds have been found to accelerate the feeding and growth of various freshwater and marine fish. Glycine betaine is one of the naturally occurring nitrogenous compounds and occurs generally in high concentration in marine invertebrates such as molluscs and crustaceans. It stimulates feeding in fish and crustaceans. In the present study the effect of diet supplemented with DMPT and betaine on the feeding and growth of Indian white prawn Penaeus indicus has been assessed and the results reported. The experiments showed that DMPT and betaine can effectively increase both body weight and molting rate of prawns.

896. **Indra Jasmine, G., A.M.M. Rathinam, K. Rathnakumar and P. Jeyachandram** 1995. Influence of cryoprotectant on the quality of frozen minced threadfin bream *Nemipterus bleekeri* during frozen storage. *FAO Fish Rep.*, 514: 211-224.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Fresh threadfin bream (*Nemipterus bleekeri*) procured from the Tuticorin Fishing Harbour, India, were immediately processed into minced meat and divided into 4 lots. To these lots, cryoprotectants like sorbitol (4% w/w), ascorbic acid (0.1% w/w) and a mixture of sorbitol and ascorbic acid were added. A sample without any treatment was kept as control. All the 4 samples were packed in polyethylene film of 150 gauge in waxed cartons and then frozen in a plate freezer at -40 C for one and a half hours and stored at –20°C + -2°C. Yield rate, physical, biochemical and textural characteristics were assessed fortnightly during frozen storage. Minced meat mixed with a mixture of sorbitol and ascorbic acid showed better quality during frozen storage.

897. **Indraneil Das** 1987. Status and distribution of estuarine turtles in India. *Mar. Fish. Infor. Serv. T & E. Ser.*, 72: 21-22.

Address : Department of Limnology, Bhopal University, Bhopal, India.

Abstract : Distribution and reproductive biology of estuarine turtles of India were discussed. In the east coast sites include the vicinity of Mandapam and are reported as nesting grounds.

898. **Indrasenan, A.** 1960. On the occurrence of the platacid fish *Tripterodon orbis* in Indian waters. *J. Mar. Biol. Assoc. India*, 2(2): 266.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, India.

Abstract : On 20-12-1960 at the fish landing centre at Kunthukal point on Rameswaram Island facing the Gulf

of Mannar two platacid fishes were noticed among specimens of *Drepane punctata* (Linnaeus), and *Ephippus arms* (Bloch). One of these was brought to the Laboratory at the Central Marine Fisheries Research Station, Mandapam Camp and was identified as *Tripteradon arms* Playfair hitherto known from the South African Coast from Natal to Mombasa (Smith, 1949) and Madagascar (Fourmanoir, 1957). The specimen which measures 116 mm. in standard length is a juvenile, the adult of which is known to attain 762 mm and weigh about 20 lbs. Subsequently I have come across two specimens of this species, 101 mm. (locality unknown, probably Gulf of Mannar) and 125 mm. (from Dhanuskodi ; Gulf of Mannar) of standard length, in the reserve collection of Central Marine Fisheries Research Station Museum and a brief description of these three specimens is given.

899. **Ingle, R.W and C.H. Ferando** 1963. On some fresh and brackishwater Crustaceans from Ceylon. *Crustaceana*, 6(2): 101-109.

900. **Irulandy, S.M and J. Sekar** 1988. A report on the inspection of the pearl banks in the Gulf of Mannar during 1981-86. *CMFRI Spec. Publ.,* 40: 23.

Address : Department of State Fisheries, Tamil Nadu, India.

Abstract : The pearl banks of the Tuticorin Division or the Central Division, which are considered to be productive, were inspected during 1981-1986. The inspection was at random owing to inadequate facilities. The physico-chemical condition of the waters and the pearl oyster population and other co-inhabitants of the beds were studied. The data gathered are presented.

901. **Irulandy, S.M and Daniel Sudhandra Dev** 1999. Commercial exploitation of seaweeds by fisherfolk in Gulf of Mannar. Their socioeconomic status and problems. *Seaweed Res. Utiln.,* 21(1&2): 125-127.

Address : Krusadai Marine biological Station, Department of Fisheries, Mandapam-623 518, Tamilnadu, India.

Abstract : Sample survey was undertaken to study the status of commercial exploitation of seaweeds in six places viz., Pamban, Thonithurai, Vedalai, Seeniyappa Dargah, Periyapattanam and Keelakkarai along the Gulf of Mannar Coast. Data were collected on the number of country crafts engaged for the collection of seaweeds and daily income per head. The problems faced by the fisherfolk in the seaweed collection during peak season is discussed. The need for considering relaxation of the existing acts in connection with seaweed collection from Gulf of Mannar area is also discussed. Cultivation of commercially important agarophyte *Gracilaria edulis* in the shallow waters of Gulf of Mannar and Palk Bay is recommended based on the pilot scale experiment conducted at Kurusadai Island to ensure continuous supply of seaweeds to the industries and provide additional income to the fisherfolk.

902. **ISRO/SAC.** 2003. Eco-morphological zonation of selected coral reefs of India using Remotely sensed data- a scientific note. *SAC/RESIPA/MWRG/MSCED/SN/16/ 2003.* 109 pp.

Address : Space Application Center, Ahamedabad, India.

Abstracts : The overexploitation coupled with natural causes have contributed heavily towards the degradation of the coral reefs and related ecosystems. Therefore, need has arose to collect information on the corals and coral reefs in order to manage the reefs in a sustainable way and prevent them from further damage. In the project Applications of Remote Sensing for Coastal Habitat, under the Integrated Coastal and Marine Area Management Programme of the Department of Ocean Development, Government of India, methodologies have been developed to study the ecological as well as morphological zones of a coral reef using satellite data. This report describes the study of zoning of selected Indian reefs for their ecological as well as morphological characteristics. IRS-1C/1D LISS III data of the period 1998-2000 was used to study the reefs. As this was an attempt to establish the methodology, only selected reefs of the four major reef regions, namely, the Gulf of Kachchh, the Gulf of Mannar, the Lakshadweep and the Andaman & Niobar Islands were taken up for the study. The Classification system has been evolved which takes care of both ecological and morphological components of the Indian coral reefs, and can be detected from the remote sensing images. Interpretation key has been generated that helps in identifying and mapping different reef features and is based on optical characteristics along with locational attributes and inherent characteristics of the coral reef system. The analysis was supported with extensive data collection done jointly with the National Institute of Oceanography, Goa, GEER Foundation, Gandhinagar, Zoological Survey of India, Chennai and Central Agricultural Research Institute, Port Blair. Classification accuracy showed improvement on using images belonging to low tide, water column correction and contextual editing. Water column correction helped in identifying the eco-morphological features more clearly. The maps were estimated to have an accuracy of 77-95% at 90% confidence level. The unique features of the Lakshadweep atoll, namely coral knolls and lagoonal patch reefs, have been distinctly delineated for the first time using satellite data. The Malvan reef is a very small reef (less than 1 sq km area) and has been mapped

for the first time using satellite data. The merged data has helped in improving the accuracy by about 6% (from 85% to 91 %). They were reclassified as an atoll. The presence of macro-algae covering large portions of both the KRC and the MRC reefs is indicative of degrading condition of the reef as algae invasion occurs after the death of corals. Eco-morphological zones of a small-uncharted coral head (covering 830 sq m area), about 2 km offshore and northeast to the Tarmugli, were mapped. Among all the reefs present in the Wandoor MNP area, Jolly Buoy is the only reef (1 km long), which has large sandy reef flat making up almost 70-80 % of the reef system and extending from sandy beach on the southern side for about 1 km up to the reef slope. Massive corals of only 50 sq m area along were identified and mapped on this small reef. Although the Gulf of Kachchh reefs have been periodically monitored using RS data, it is for the first time that RS data has helped in mapping the live coral zone of these reefs. Live coral colonies of large sizes and their high percentage are mainly confined to the seaward region of the reef (*i.e*. windward reef front, moat and outer non-aligned coral zone). Eastern region is most degraded as indicated by the absence of algal ridge, non-aligned coral zone and presence of thick mud on reef flat along with matty algae. Overall, the reefs showed decline during 1975-1986 and improvement thereafter. This study is very useful in getting a preliminary knowledge on the locations of diversely rich region on a coral reef .as well as condition of a coral reef system.

903. **Issac Rajendran, A.D and Freda Chandrasekharan** 1969. Report on the survey of Pearl banks off Ramanathapuram coast during 1965. *Madras J. Fish.,* 2: 71-77.

904. **Issac Rajendran, A.D and K. David** 1972. A preliminary underwater survey of the extent of the coral reefs in and around some of the Islands in the Gulf of Mannar. *Proc. I*st *Symp. Corals and Coral Reefs, MBAI.* pp. 231-238.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : A survey using aqua-lung was made to observe the extent of the coral around the Islands along the southeast coast of India. Nineteen Islands were covered during the survey and the eastern side of the Islands appears to have a greater expanse of living coral reefs since the exploitation of coral on commercial lines is done mostly on the western and northern sides, allowing the eastern side to remain unexploited.

905. **Issac Rajendran, A.D., Freda Chandrasekaran and N. Radhakrishnan** 1976. History of the Indian pearl banks of the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 18(3): 549-576.

Address : Department of State Fisheries, Governement of Tamil Nadu, Madras-600 006, Tamilnadu, India.

Abstract : The history of the pearl banks from the year 1904 are traced and presented here with particular emphasis on the role played by the various banks in contributing to pearl fishery and the results of the various fisheries conducted in the area.

906. **Iyengar, M.O.P**. (Mandayam Osur Parthasarathy Iyengar) 1927. Flora of Krusadai Island. *Bull. Madras Govt. Mus. N.S., Nat. Hist. Sec.*, 1(1): 185-188.

907. **Iyengar, M.O.P.** 1933. On the formation of gametes in a *Caulerpa*. *J. Indian Bot. Soc.*, XII : 325.

908. **Iyengar, M.O.P.** 1938. On the structure and life-history of *Pseudovalonia forbesii* (Harv.) Iyengar (Valonia Forbesii Harv.). *J. Indian Bot. Soc.*, 17: 191-194.

909. **Iyengar, M.O.P.** 1940. On the formation of gametes in *Caulerpa*. *J. Indian Bot. Soc.*, 18: 101-104.

910. **Iyengar, M.O.P and K.R. Ramanathan** 1940. On the production of *Anadyomene stellata* (Wulf.) Ag. *J. Indian Bot. Soc.*, 19: 175-176.

911. **Iyengar, M.O.P. and K.R. Ramanathan** 1941. On the life-history and cytology of *Microdictyon tenuis* (Ag.) Decsne. *J. Indian Bot. Soc.*, 20: 157-159.

912. **Iyer, K.M and V.K. Pillai** 1976. Microbiological investigations in Indian coastal waters and the Indian Ocean. *J. Mar. Biol. Assoc. India*, 18(2): 266-271.

Address : Central Institute of Fisheries Technology, Matsyapuri, Cochin - 682 029, India.

Abstract : The past two decades have witnessed several marine microbiological investigations being carried out

by different workers on the east and west coasts of India. The enumeration of the heterotrophic bacteria of the surface and bottom waters, muds and plankton tows and of certain physiological groups had been carried out off the coast of Madras, in the Palk Bay and the Gulf of Mannar. The nature of the bacterial flora associated with seawater and fishes off Malabar Coast had also been worked out though less exhaustively. The quantitative as well as the generic distribution of bacteria in seawater off Cochin and in fresh fishes caught therein has recently been studied. Marine bacteria producing B12 and certain antibiotics had been isolated from the seawater and marine muds off Bombay Coast. Investigation on marine yeasts was first done in Bombay waters and subsequently studies were made in Vellar Estuary and the near-shore waters of Porto Novo. The distribution of yeasts in the Indian Ocean has been studied recently during the International Indian Ocean Expedition. The occurrence of marine bacteriophages had been reported earlier at Bombay and the recent International Indian Ocean Expedition has met with bacteriophages in the bottom and off East African Coast. Valuable information on the geographical distribution, movement and the biochemical activities of bacteria inhabiting the Indian ocean has been provided by some of the earlier Soviet Oceanic Expeditions.

913. **Iyer, T.S.G and P.R.G. Varma** 1990. *Vibrio cholerae* and seafoods. *Ann. Indust. Fish. Assoc.,* 7: 21-24.

Address : Central Institute of Fisheries Technology, Matsyapury P. O., Cochin - 682 029, India.

Abstract : During the period 1986-88, the Central Institute of Fisheries Technology, Cochin, has carried out a detailed survey on the incidence of *V. cholerae* in fishery products and processing environments. Over 3000 samples comprising fresh and frozen shrimps, lobsters, crabs, squids, cuttlefish, clams, finfishes, water, ice and swabs from contact surfaces collected from the seafood processing units situated at Cochin, Mandapam, Calicut, Quilon, Tuticorin, Vizhinjam, Cape-comorin and Madras were included in the study and *V. cholerae* could be isolated from two samples only.

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914. **Jacob, P.G.** 1973. Corals - Raw material for Industries. *Seafood Export J*., 5(5): 35-37.

Address : Central Marine Fisheries Research institute, Cochin - 682 018, India.

Abstract : The class Anthozoa of phylum coelenterata includes the corals, sea anemones, sea fans and gorgonians. Until the beginning of the 18th centuary corals and their relatives were generally regarded as plants. It was Peysonnel, a Marseilles physician who showed that corals are animals which move and eat. Coral organisms are polyps like the sea anemones. They are relatively short and stout and have a flat oral disc. They lead a colonial life. The calcareous skeleton is secreted as a protective shell by the outer cell layer of the polyp's body. A single completed branch of coral bears a number of polyp organisms. The coral of commerce is actually the calcareous skeleton. Milliporina and Stylasterina are hydrozoan corals belonging to another class of phylum Coelenterata and they are also associated with coral formation. The calcareous secretions of billions of colonial coral polyps form ridges or mounds thrusting up in the sea to the surface.

915. **Jacob, P.G.** 1973. Marine mammals. *Seafood Exp. J*., 5(6): 21-28.

Address : Central Marine Fisheries Research institute, Cochin - 682 018, India.

Abstract : The large scale mortality of about 147 pilot whales, probably of the species *Globicephala melaena* which occurred in the southeast coast of India between Manapad and Kulasekarapattnam fishing villages during the year 1973.

916. **Jacob Jerold Joel and I.P. Ebenezer** 1989. The current trend of the mussel fishery in the Kanyakumari district of Tamil Nadu. *Mar. Fish. Infor. Serv. T & E. Ser.,* 100: 9-13.

Address : Central Marine Fisheries Research Institute, Vizhinjam - 695 521, India.

Abstract : Monthwise mussel landings in Kanyakumari district between 1986-87 and 1987-88 were recorded.

917. **Jacob Jerold Joel and I.P. Ebenezer** 1991. On a bramble shark with 52 embryos. *Mar. Fish. Infor. Serv. T & E. Ser.,* 108: 15.

Address : Central Marine Fisheries Research Institute, Vizhinjam - 695 521, India.

Abstract : On 14-10-1989, Two female specimens of the Bramble shark, *Echinorhinus brucus*, measuring 262 and 220 cm total length and weighing 120 and 80 kg respectively were caught off Thoothoor, a fishing village of Kannyakumari District of Tamilnadu.

918. **Jacob Jerold Joel., I.P. Ebenezer and A. Prosper** 1994. On a whale shark landed at Kovalam, Kanyakumari. *Mar. Fish. Infor. Serv. T & E. Ser.,* 131: 22.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurement (in cm) of a whale shrak landed at Kovalam is discussed.

919. **Jacob Jerold Joel and I.P. Ebenezer** 1996. Present status of trawl fishery at Colachel. *Mar. Fish. Inf. Serv. Tech. Ext. Ser.* 141: 10-17.

Address : Central Marine Fisheries Research Institute, Research Centre, Vizhinjam-695 521, India.

Abstract : The paper gives an account of the trawl landings and some related aspects for a period of 5 years from 1990 to 1994 at Colachel. Craft and gear used, details of operation, effort distribution, catch per effort, trend in catch, catch composition, marketing and revenues realised have been discussed.

920. **Jacob Jerold Joel., I.P. Ebenezer, P.P. Sigamony and A. Prosper** 1996. On the stranding of a young fin whale at Kanyakumari, Tamilnadu. *Mar. Fish. Infor. Serv. T & E. Ser.,* 141: 19.

Address : Central Marine Fisheries Research Institute, Vizhinjam - 695 521, India.

Abstract : This report deals with the size and morphometric measurement of a stranded young fin whale.

921. **Jacob Jerold Joel** 1999. On the rare occurrence of a sawfish at Kanyakumari. *Mar. Fish. Infor. Serv. T & E Ser.,* 161: 19-20.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A large-tooth sawfish *Pristis microdon* Lathem locally known as Aathu iluppa or Kombu suraave got entangled in a bottom-set gillnet operated for lobsters. The morphometric measurements were made and given in a table format.

922. **Jacob Jerold Joel** 1999. On a bottlenose dolphin, washed ashore at Kanyakumari. *Mar. Fish. Infor. Serv. T & E. Ser.,* 163: 14-15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of a washed ashore bottlenose dolphin was detailed.

923. **Jagadis, I.** 2000. Shell industries of Rameswaram Island. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp,* pp. 50-52.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seashore has always been a fascinating and recreational place for young and old. In every seashore, people of diverse age groups can be seen moving around and picking things. What is that they are looking for and collecting! Yes, it is nothing but the 'SHELLS'. Shells are the hard calcareous part, literally the 'HOUSE' of the soft bodied living animals called molluscs. When the animal dies in course of time, the shells are washed ashore and strewned around in the beach.

924. **Jagadis, I., Boby Ignatius, K. Ilangovan, A.C.C. Victor, A. Chellam and V. Rani** 2003. Pearl production in *Pinctada fucata* under two Culture Systems in the Inshore Waters of Mandapam, Gulf of Mannar. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. p. 70.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Pearls are cultured in the inshore waters of Mandapam, Gulf of Mannar under the ICAR Revolving fund project since 1997. Pearl oyster farming is done by two different culture methods namely rack and floating raft. The unit size of the rack and raft is 10 sqm. The rack is erected in the inshore area having an average depth of 3m. The floating raft is constructed using palmyrah rafters of 3.5.m length and floated on four numbers of 200 litre PVC drums and moored at depths above 3m. In both the systems, conventional box type cages (40x40xl0cm) made of 4-5mm thick MS rod and covered with fish net were used as culture containers. The uniform sized oysters (40-45mm), which were nucleated adopting standard implantation techniques, were cultured in the containers. The implanted oysters were maintained under running water system for three days for convalescence. These oysters were stocked at the rate of 80 oysters/cage. In each culture unit (rack/raft) 30 cages were suspended. Postoperative culture was done for a period of 9 months following standard farming protocol. Analysis of pearl production in two years in both the above culture systems showed that the pearls produced by the raft culture system are better in terms of number and quality. The reasons for better rate of pearl production under raft system can be attributed to the depth at which cultured animals inhabited and the low rate of fouling.

925. **Jagadis, I., N. Gopinatha Menon and A. Shanmugavel.** 2004. Observations on the effect of bottom trawling on dislocation of non-edible biota in the Palk Bay and Gulf of Mannar, south east coast of India. *Fishery Survey of India.* pp. 607-624.

Address : Central Marine Fisheries Research Institute, Mandapam Cam,p - 623 520, Tamilnadu India.

Abstract : Observations on the dislocated non-edible biota by bottom trawlers in the Palk Bay and Gulf of Mannar were made during 1995-1998. Data were collected at trawl landing centers, Rameswaram (Palk Bay) and Pamban (Gulf of Mannar). The average composition of non-edible biota of the total trawl discard was 38.1% and 33.9% at Rameswaram and Pamban respectively. The dislocated non-edible biota were classified into three groups i.e., (1) major invertebrates, (2) minor invertebrates (including seaweeds) and (3) non-living forms and their rates of dislocation are presented for both the centers. The annual average rate of dislocation increased gradually from 44.7 to 71.5 kg/unit at Rameswaram whereas at Pamban it varied between 49.5 and 61.5 kg/unit during the observation period. Though the number of boats operated varied greatly between these two centers, the average rate of dislocation for both the centers during the whole period was more or less equal. Among the different groups of organisms dislocated, non-edible crab was dominant at both the centers followed by echinoderms, stomatopods and molluscs at Rameswaram and stomatopods, molluscs and echinoderms at Pamban. Among the minor invertebrates sea weeds and sea pens were represented in higher magnitude compared with other components at Rameswaram; whereas at Pamban, sponges and seaweeds were dominating.

926. **Jagadis, I., Boby Ignatius, D. Kandasami and M.D. Ajmal Khan** 2006. Embryonic and larval development of honeycomb grouper *Epinephelus merra* Bloch. *Aquaculture Res.* (In press).

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Spawning and successful rearing of larvae of honeycomb grouper *Epinephelus merra* Bloch 1793 upto juvenile stage was accomplished at the finfish hatchery of Mandapam Regional Centre of Central Marine Fisheries Research Institute during 2004. The fertilized eggs were free, spherical and buoyant with size ranging from 710 to 730 µm. Complete early embryonic development took place within 24-27 h and hatching occurred. The hatchlings measured 1.5 mm. Mouth opening (115 µm) appeared at 72 h when the larvae were 2.2 mm in size. Pectoral fin developed on the fifth day. Complete metamorphosis took place and by the 60th day the larvae transformed into juveniles (45 mm) and attained skin colouration and honeycomb pattern.

927. **Jagtap, T.G., D.S. Komarpant and R.S. Rodrigues** 2003. Status of a seagrass ecosystem : An ecologically sensitive wetland habitat from India. *The Society of Wetland Scientists; Wetlands.Wilmington NC.*, 23(1):161-170.

Address : National Institute of Oceanography (CSIR), Donapaula, Goa-403004, India; E-mail: tanaji@csnio.ren.nic.in

Abstract : Seagrasses in shallow sheltered regions of estuarine, brackish, and marine environments are of productive and ecological importance. The major seagrass meadows in India exist along the southeast coast (Gulf of Mannar and Palk Bay) and in the lagoons of Islands from Lakshadweep (Arabian sea) and Andaman and Nicobar (Bay of Bengal). The flora comprises 15 species and is dominated by *Cymodocea rotundata, C. serrulata, Thalassia hemprichii, Halodule uninervis, H. pinifolia, Halophila beccarii, H. ovata,* and *H. ovalis*. Distribution occurs from the intertidal zone to a maximum depth of similar to 15 m. Maximum growth and biomass are restricted from the lower littoral zone to the depth of 2-2.5 m. A significant correlation ($r = -0.63$ and -0.71, respectively, $p < 0.05$) was observed between depth and biomass from major seagrass meadows. Greatest species richness and biomass of seagrass occur mainly in open marine sandy habitats. Associated and epiphytic flora mainly consist of marine algae and are dominated by members of the rhodophyceae group. Various fishes, molluscs, crustaceans and echinoderms form the predominant associated fauna. Macrofauna mainly comprised of Oligochaetes (40.17%), Polychaetes (18.96%), Crustaceans (11.36%), and Nematods (18.71%), while meiofaunal groups mainly consisted of Turbellaria (34.17%), Nematoda (37.3%), and Harpacticoida (10.11%). In India, seagrass habitat, although categorized under ecologically sensitive coastal areas, is largely ignored from the educational, research, and management points of views. In spite of being one of the predominant marine macrophytic flora, surprisingly, seagrasses have not been introduced in plant science studies, even at the university level. Unawareness regarding the functions of seagrasses at an educational level and among the common people and coastal zone managers has resulted in enormous damage to them in the recent past. Seagrass habitat is under constantly increasing threat from various anthropogenic activities. Strict implementation of Coastal Zone Regulation (CRZ) act is imperative to check further deterioration of seagrass beds.

928. **James, D.B.** 1965. *Phyllophorus parvipedes* (Holothuroidea), a new record to the Indian seas. *J. Mar. Biol. Assoc. India*, 7(2): 325-327.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Phyllophorus (Phyllophorella) parvipedes* Clark is reported for the first time from the Indian Seas. A detailed description of the same is given.

929. **James, D.B.** 1966. Studies on Indian Echinoderms-2. The Holothurian *Stolus buccalis* with notes on its systematic position. *J. Mar. Biol. Assoc. India,* 8(2): 285-289.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A detailed description of the holothurian, *Stolus buccalis* is given with notes on its systematic position.

930. **James, D.B.** 1970. Studies on Indian Echinoderms-4 on the brittle stars *Amphioplus gravelyi* and *Amphioplus depressus* from the Indian coasts. *J. Mar. Biol. Assoc. India*, 12(1&2): 139-145.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Gravely (1927) in his account on the echinoderms of Krusadai Island in the Gulf of Mannar reported the occurrence of a brittle-star *Ophiophragmus felictus* (Koehler). Under synonymy for this species he included *Amphiura relicta* Koehler. *Amphiura relicta* is currently regarded as a synonym of *Amphioplus depressus* (Ljungman). A re-examination of the specimens of Dr. F. H. Gravely at the Madras Museum revealed that they are not *A. depressus* but belong to an undescribed species of *Amphioplus.* They are named here as *Amphioplus gravelyi* after Dr. F. H. Gravely who collected the specimens. The types are present in the reference collections of the Madras Government Museum.

931. **James, D.B.** 1973. Studies on Indian Echinoderms-5. New and little known starfishes from the Indian seas. *J. Mar. Biol. Assoc. India*, 15(2): 556-559.

Address : Central Marine Fisheries Research Institute, Research Centre, Port Blair, Andamans, India.

Abstract : A starfish collected from the Laccadives showing intermediate characters between the genera *Ferdina* Gray and *Neoferdina* Livingstone is described as a new genus and new species, *Paraferdina laccadivensis*. *Halityle regularis* Fisher which was collected off Mandapam at a depth of 275 m is a new record for the Indian Ocean and a detailed description of the same is given. Another starfish *Nardoa* (Andora) *faouzii* Macan which is mentioned, is a new record for the Indian Seas.

932. **James, D.B.** 1973. *Beche-de-mer* resources of India. *Proc. Symp. Living Resources Seas around India, CMFRI*, pp.706-711.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Beche-de-mer* or the cured holothurian is considered a delicacy in some of the South-East Asian countries. The entire quantity of about 30,000 kg produced annually at present in the country is exported since it is not consumed locally. *Holothuria scabra* is the species almost exclusively used in this country for this purpose. It is comparatively large growing to about 300 mm in length and weighing over half a kilogram in fresh condition. The holothurians are collected by divers in 2 to 6 fathoms depth of waters from February to September, the peak season being in June to August. They are also brought in appreciable numbers in trawls. Along the Indian coasts holothurians occur in large numbers in the Gulf of Kutch and along the southeast coast. The holothurians are more abundant in the Palk Bay than in the Gulf of Mannar. In the Laccadive Islands and the Andaman group of Islands which have coral reefs and lagoons the large sized species of holothurians like *Thelenota ananas, Holothuria marmorata* and *Actinopyga mauritiana* are well suited for this purpose. With proper exploitation of the totally unexploited grounds, the annual production of *Beche-de-mer* can be increased substantially.

933. **James, D.B.** 1976. Studies on Indian echinoderm-6. Redescription of two little known Holothurians with a note on an early juvenile of *Holothuria scabra* from the Indian seas. *J. Mar. Biol. Assoc. India*, 18(1): 55-61.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A detailed description of two little known holothurians viz., *Havelockia versicolor* (Semper) and *Pseudocolochirus violaceus* (Theel) are given with notes on their synonymy. Notes on early juvenile of *Holothuria scabra* Jager is also given at the end of the paper.

934. **James, D.B.** 1982. Studies on Indian echinoderms- 11. On *Protankyra tuticorenensis* sp. nov. and other apodous holothurians from the Indian seas. *J. Mar. Biol. Assoc. India*, 24(1&2): 92-105.

Address : Central Marine Fisheries Research Institute, Madras - 600 015, Tamilnadu, India.

Abstract : Ten species of apodous holothurians belonging to nine genera are described in detail with keys to various taxa. *Protankyra tuticorensis*, a new species collected from Tuticorin (Gulf of Mannar) is described here. *Anapta gracilis* Semper and the genus *Labidoplax* are recorded here for the first time from the Bay of Bengal. Notes on the habits of various species are given for the first time. Remarks on the zoogeography are also given at the end of the paper.

935. **James, D.B.** 1982. Ecology of intertidal echinoderms of the Indian seas. *J. Mar. Biol. Assoc. India*, 24(1&2): 124-129.

Address : Central Marine Fisheries Research Institute, Madras - 600 105, Tamilnadu, India.

Abstract : Echinoderms are common and conspicuous organisms of the intertidal region. Their body structure is modified to live on different substrata such as rocky shores, sandy beaches, muddy flats, algal beds and coral reefs. Their concentration in the coral reefs is maximum. The author during the past twenty years has collected and studied echinoderms from various places along the Indian Coast and also from the coral reefs of the Gulf of Mannar and Palk Bay, Andaman and Nicobar Islands and the Lakshadweep Islands. More than one hundred species belonging to all the five classes have been collected from the intertidal region of India. In this paper their adaptations, habits and their distribution in the intertidal region are discussed.

936. **James, D.B.** 1983. Sea cucumber and sea urchin resources. *CMFRI Bulletin*, 34: 85-93.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

937. **James, D.B.** 1983. Research on Indian Echinoderms- A review. *J. Mar. Biol. Assoc. India*, 25(1&2): 91-108.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In the present paper, research work so far done on Indian Echinoderms is reviewed. Various aspects such as history, taxonomy, anatomy, reproductive physiology, development and larval forms, ecology, animal associations, parasites, utility, distribution and zoogeography, toxicology and bibliography are reviewed in detail. Corrections to misidentifications in earlier papers have been made wherever possible and presented in this paper.

938. **James, D.B.** 1985. Echinoderm fauna of the proposed National Marine Park in the Gulf of Mannar. *Proc. Symp. Endangered Marine Animals and Marine Park*, MBAI, 1: 403-406.

939. **James, D.B.** 1986. Quality improvement in *Beche-de mer*, *Seafood Export J*., 18(3): 5-10.

Address : Central Marine Fisheries Research institute, Cochin - 682 018, India.

Abstract : *Beche-de-mer* or Trepang is the commercial name given to processed sea cucumbers. During the last ten years *Beche-de-mer* prices have jumped from a meagre US $ 2.95 for 17 pc/kg in 1974 to US $ 16.00 in 1985 in the Singapore market. There is an urgent need to improve the quality of the product to satisfy the export market.

940. **James, D.B.** 1986. Zoogeography of shallow water echinoderms of Indian seas. ***In***: *Recent Advances in Marine Biology.* (*Ed*.) P.S.B.R. James, Today & Tommorrow Prints & Publishers, New Delhi, pp. 569-591.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The study of zoogeography of echinoderms is important to know the changes in shoreline or relation of landmasses to each other. Very little is known about the zoogeography of echinoderms of Indian Seas. In the present paper the zoogeography of echinoderms from Lakshadweep and Maldives, Gulf of Mannar and Palk Bay along the southeast coast of India, Sri Lanka and Andaman and Nicobar Islands is discussed. Of particular interest is the distribution of echinoderms of Gulf of Mannar and Palk Bay along the southeast coast of India and Sri Lanka. Despite the geographical proximity between the two regions the faunal composition is different. Reasons for this anomaly are indicated. At the end of the paper distributional Tables for all regions are given.

941. **James, D.B.** 1986. Holothurian toxin as a poison to eradicate undesirable organisms from fish farms. *Symp. Ser. Mar. Biol. Assoc. India*, 1339-1341.

Address : Central Marine Fisheries Research Institute, Cochin-682 031, India.

Abstract : Eradication of predators and undesirable organisms from fish ponds and farms is an important operation in any culture practice. Hitherto various chemicals and extracts from plants are being used for this purpose. For the first time, a toxin extracted from the holothurian, *Holothuria atra*, was tried with success. When used in limited water volume eradication was thorough and complete. Not only fishes but other organisms such as molluscs, crustaceans and polychaetes were found to be affected by the toxin. Experiments conducted in a rock pool at Port Blair (Andamans) and in a tidal pool at Mandapam camp are discussed in detail.

942. **James, D.B.** 1988. Research, conservation and management of edible holothurians and their impact on the *Beche-de-mer* industry. *CMFRI Spec. Publ.*, 40: 97-98.

Address : Central Marine Fisheries Research Institute, Madras, Tamilnadu, India.

Abstract : Very little research has been done on the edible holothurians from India. Although more than 70 species of holothurians are known from the shallow waters of India only about 10 species are found to be economically important. At present one species, *Holothuria* (Metriatyla) *scabra*, is almost exclusively used in the Gulf of Mannar and Palk Bay and also Andamans for the preparation of *Beche-de-mer*. There are already indications of fishing pressure affecting the stocks.

943. **James, D.B., M.E. Rajapandian, B.K. Baskar and C.P. Gopinathan** 1988. Successful induced spawning and rearing of the holothurian *Holothuria* (Metriatyla) *scabra* Jaeger at Tuticorin. *Mar. Fish. Inf. Serv. Tech. Ext. Ser.*, 87: 30-33.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Details are given of experiments conducted on the artificial breeding and production of *Beche-de-mer* (*Holothuria scabra*) seed for culture and propagation. Thermal stimulation proved to be successful; procedures involved are outlined and development of the larvae is described.

944. **James, D.B.** 1989. *Beche-de-mer* its resources, fishery and industry. *Mar. Fish. Infor. Serv. T & E. Ser.,* 92: 1-30.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A field key was given to indentify the commercially important holothurians, taking into account the important and conspicuous external characters and live colour.

945. **James, D.B., R. Marichamy and A.D. Gandhi** 1990. Experiments on the culture of *Penaeus monodon* in the Salt Pan Area at Tuticorin. *Proc. 2nd Indian Fish. Forum,* dated 27th to 31st May'90. pp. 47-49.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper embodies the results of growth and production of *Penaeus monodon* cultured during 1988-89 in the salt pan area at Tuticorin. The overall growth rate of the hatchery produced seeds stocked in ponds varied from 25.1 mm/5.85 g to 35.2 mm/9.8g per month and the best growth was associated with low stocking density. The post-larvae attained marketable size of 32 g in about 140 days. Supplementary feed consisted of 7-9 ingredients with protein value of 38%. The conversion ratio varied from 1:5 to 1:1.91.

946. **James, D.B., A.D. Gandhi and R. Palaniswamy** 1993. Sea ranching of sea cucumbers. *Mar. Fish Infor. Ser. T & E Ser.,* 124: 15-17.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Sea ranching is resorted to when natural populations in the sea have been depleted due to over fishing. Sea cucumbers being defenceless animals offer no resistance at the time of capture and are indiscriminately fished out. They also do not make any attempts to move away like fish or prawns. This has resulted in large scale capture of sea cucumbers including small and immature forms.

947. **James, D.B.** 1994. Hatchery techniques and culture of the seacucumber *Holothuria scabra*. *CMFRI Spl. Publ.,* 57: 1-40.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In India the *Beche-de-mer* industry is very ancient one. Till recently the whole fishery was supported only by a single species namely *Holothuria scabra.* As a result of this the natural populations dwindled down alarmingly. In order to enrich the natural populations a Research Project was taken up by the Central Marine Fisheries Research Institute at Tuticorin Research Centre in 1987 on the hatchery and culture of sea-cucumbers. Break-through was achieved in 1988 in inducing *Holothuria scabra* to spawn in the laboratory for the first time by thermal stimulation and producing seeds. Since then several spawnings have taken place and seeds produced. In 1992 the Marine Products Export Development Authority, Cochin has sanctioned a Research Project for six lakhs rupees for three years on intensive seed production and sea-ranching of sea-cucumbers. This has given a further impetus to the work. This Special Publication is a practical guide for seed production in the hatchery and culture of *Holothuria scabra* which is the most valuable species processed in India at present. It is well illustrated with colour photographs.

948. **James, D.B.** 1994. Holothurian resources from India and their exploitation. *CMFRI Bulletin,* 46: 27-31.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In the seas around India nearly 200 species of holothurians are known, of which about 75 species are from the shallow waters within 20 m depth. Of these, about 15 species are of commercial value. At present processing is restricted only to the Gulf of Mannar and Palk Bay on the mainland. Here *Holothuria* (*Metriatyla*) *scabra* is mainly used. The other species exploited are *Holothuria* (*Thelothuria*) *spinifera* and *Bohadschia marmorata. Holothuria* (*Halodeima*) *atra* which occurs in large numbers can also be tried. At present there is no exploitation in the Lakshadweep. In Lakshadweep, *Holothuria* (*Microthele*) *nobilis* which yields first grade *beche-de-mer* occurs in abundance followed by *Bohadschia argus* and *Stichopus choloronotus.* Exploitation is stopped in Andaman and Nicobar Islands. *Holothuria* (*Metriatyla*) *scabra* and species of *Actinopyga* are important from the Andaman and Nicobar Islands.

949. **James, D.B.** 1994. Systematics, Biology, Ecology and zoogeography of Holothurians; Zoogeography and systematics of holothurians used for *Beche-de-mer* in India. *CMFRI Bulletin,* 46: 34-36.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Although holothurians have wide range of distribution in general, they are restricted to certain regions and also- have localised distribution in some cases. *Holothuria (Metriatyla) scabra* is distributed in the Gulf of

Mannar and Palk Bay and also at Andaman and Nicobar Islands, but not represented in the Lakshadweep. *Holothuria (Theelothuria) spinifera* has a localised distribution in the Gulf of Mannar and Palk Bay. *Holothuria (Microthele) nobilis* is abundant in the Lakshadweep, but absent in the Gulf of Mannar and Palk Bay. Species of *Actinopyga* occur in the Lakshadweep and the Andaman and Nicobar Islands, but not on the Indian side of the Gulf of Mannar and Palk Bay. Brief notes on the taxonomy of commercially important holothurians are given.

950. **James, D.B.** 1994. Ecology of commercially important holothurians of India. *CMFRI Bulletin*, 46: 37-38.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A knowledge of the ecology of holothurians is important for proper exploitation of the resource. Species like *Holothuria (Metriatyla) scabra, Holothuria (Thelothuria) spinifera* are distributed on sandy beds with algae in shallow waters. Species of *Actinopyga* live among coral reefs, while species like *Holothuria (Microthele) nobilis, Bohadschia argus, Stichopus choloronotus* occur in the lagoons. Details on the concentrations of holothurians in different zones are described in detail.

951. **James, D.B., M.E. Rajapandian, C.P. Gopinathan and B.K. Baskar** 1994. Break- through in induced breeding and rearing of the larvae and juveniles of *Holothuria scabra* at Tuticorin. *CMFRI Bulletin*, 46: 66-70.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Holothuria* (Metriatyla) *scabra* the most valuable sea-cucumber at present from India, has been successfully induced to breed for the first time. The larvae have been reared through various stages till settlement by feeding with micro-algae. Details of various stages of larvae are given. The feeding and rearing of juveniles also are presented in this paper.

952. **James, D.B and B.K. Baskar** 1994. Present status of the *Beche-de-mer* industry in the Palk Bay and the Gulf of Mannar. *CMFRI Bulletin*, 46: 85-90.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A survey was conducted to study the present status of the *beche-de-mer* from Adirampatnam to Cape Comorin. At present processing of holothurians is carried out from Rameswaram to Sethubhavachatram in Palk Bay and from Pamban to Tuticorin in the Gulf of Mannar. In the Palk Bay, Rameswaram and Thirupalakudi are the most important centres and in the Gulf of Mannar, Kilakarai, Periapatnam and Tuticorin are important centres. Mostly *Holothuria (Metriatyla) scabra* is processed. Very small quantities of *Holothuria (Theelothuria) spinifera* and *Bohadschia marmorata* are also processed. The exploitation is more on the Palk Bay than in the Gulf of Mannar. In most of the places there are indications of overfishing. At present the resource remains untapped from a vast stretch in the Gulf of Mannar from Kilakarai to Tuticorin. The present day catch and effort from various processing centres are presented.

953. **James, D.B. and P.S.B.R. James** 1994. A handbook of Indian Sea cucumber. *CMFRI Spl. Publ.*, 59: 1-49.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The present Hand-Book provides keys and good colour photographs to identify commercially important sea-cucumbers in the field itself without resorting to laboratory examination. Some brief descriptions and information are given for each species regarding its characters, habits and distribution in the seas around India. Methods of processing and precautions to be taken during processing to enhance the value of the processed material are listed. For those who are interested to cook and taste *Beche-de-mer* some good recipes are given. This will be very useful for our exporters.

954. **James, D.B.** 1995. Sea urchin Culture. *Handbook of Aquafarming, MPEDA, Kochi.* pp. 25-32.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This part of the handbook deals with sea urchin culture techniques.

955. **James, D.B.** 1995. Seacucumber culture *Handbook of Aquafarming, MPEDA, Kochi,* pp. 33-47.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This part of the hand book deals with sea cucumber culture techniques.

956. **James, D.B and M. Badrudeen** 1995. Deep-water red fish, a new resource for the Indian *Beche-de-mer* industry. *Mar. Fish. Infor. Serv. T & E. Ser.,* 137: 6-8.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In 1989 for the first time *Actinopyga echinites* known as deep-water red fish was collected and four tons wre processed at keelakarai. This is considered as one of the new resources for the Indian *Bechde-mer* industry.

957. **James, D.B.** 1996. Culture of seacucumber. *CMFRI Bulletin,* 48: 120-126.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The seacucumbers are entirely marine and distributed from the Arctic to the Antarctic region. They are distributed right from the supralittoral zone to the hadal zone. They inhabit a wide variety of habitats viz. rocky, muddy, sandy and coral. Most of them live among corals. They are well distributed on the reefs of the Indo-West Pacific region. Good concentration of them is found in the Philippines. Species belonging to the families Holothuridae and Stichopodidae alone are used for processing since they grow to a large size and the body wall is also thick.

958. **James, D.B.** 1996. Conservation of sea cucumbers. pp.80-88. ***In***: *Marine biodiversity : Conservation and management,* (eds) N.G. Menon and C.S.G. Pillai, CMFRI. 205 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Over the years there is a fall in the landings of the seacucumbers all over the Gulf of Mannar and Palk Bay along with fall in the size of the specimens collected. The catch per unit of effort has also significantly fallen in the recent years. All these factors point to over exploitation of the sea cucumbers and need for their conservation.

959. **James, D.B and M. Badrudeen** 1997. Observations on the landings of the seacucumber *Holothuria spinifera* at Rameswaram by 'Chanku madi'. *Mar. Fish. Infor. Serv. T & E Ser.,* 149: 6-8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seacucumber industry in India was chiefly depending on one species *Holothuria scabra* locally known as Vella attai. In addition to this another species *H. spinifera* locally known as Raja attai or China attai occurs in large quantities in some areas and are processed for export. In this paper, the collection and processing methods of this seacucumber are discussed.

960. **James, D.B.** 1998. Ecological significance of echinoderms. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve.* 1998, pp. 118-128.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : While collecting data on lobsters at Kayalpatnam fish landing center, one specimen of *Holothuria fuscogilva* was obtained from the bottom-set gill net at 10 m depth on 10-10-96. The specimen's morphometric measurements are discussed.

961. **James, D.B.** 1998. A note on the growth of the juveniles of *Holothuria scabra* in concrete ring. *Mar. Fish. Infor. Serv. T & E Ser.,* 154: 16.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The growth rates of the juveniles of *Holothuria scabra* at Tuticorin is discussed.

962. **James, D.B.** 1998. On the occurrence of the gastropod parasite *Prostilifer* sp. on the holothurian, *Holathuria scabra* Jaeger at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 157: 26.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The section of the skin of holothurian showed a cavity where the parasite was lodged is discussed.

963. **James, D.B.** 1998. On a little known Holothurian *Stichopus vastus* Sluiter with notes on other species of *Stichopus* from the seas around India. *Mar. Fish. Infor. Serv. T & E Ser.,* 158: 12-15.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The genus *Stichopus* was established by Brandit in 1835 with the type species *S.chloronotus*. *Stichopus*

vastus was described by Sluiter (1888) from Batavita is taxonomically compared with the above one.

964. **James, D.B.** 1998. Holothuria (microthele) *Fuscogilva cherbonnier*, a new record from India with a note on its export potential and processing. *Mar. Fish. Infor. Serv. T & E. Ser.,* 158: 15-16.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The export potential value of *Holothuria fuscogilva* is discussed.

965. **James, D.B and G. Ruparani** 1999. New resource for the Indian *Beche-de-mer* industry and its management. *Proc. Fourth Indian Fisheries Forum,* 24-28 November 1996, Kochi, Kerala. (*eds*.) M.M. Joseph, N.R. Menon, N.U. Nair. Mangalore, India Asian Fisheries Society, Indian Branch. pp. 385-388.

Address : Central Marine Fisheries Research Institute, Cochin- 682018, India.

Abstract : Seacucumber processing was introduced to India by the Chinese more than one thousand years back. All these years only *Holothuria scabra, H. spinifera,* and *Bohadschia marmorata* were processed. In recent years the price of *Beche-de-mer* shot up in the international market like Hong Kong and Singapore. Therefore the processors started looking for new resources. *Actinopyga echinites* was discovered in 1990 off Vedalai in the Gulf of Mannar and *A. miliaris* in 1991 off Tuticorin, Tamil Nadu, India. Since then these two species are also collected from other localities in the Gulf of Mannar. The new resources were quickly overexploited and within two years they are already in need of conservation and management. In the Lakshadweep in 1994 for the first time *Holothuria nobilis, Thelenota ananas, H. atra, Actinopyga mauritiana* and *Stichopus chloronotus* were porcessed. At present the exploitation of the sea cucumbers is regulated as a measure of conservation. There is still ban on the collection of sea cucumbers in the Andaman and Nicobar Islands. Full details of the new resources, their exploitation and management are presented in the paper.

966. **James, D.B.** 1999. Abnormal asteroids from the seas around India. *Mar. Fish. Infor. Serv. T & E. Ser.,* 159:21-22.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphology of various genus from asteroids such as *Pentaceraster, Linckia* and *Protoreaster* are discussed.

967. **James, D.B.** 1999. *Holothuria* (Thymiosycia) *arenicola* Semper: A rare holothurian from the Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 161: 15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : On a regular and routine trip for the collection of holothurians for the hatchery purpose a single specimen of *Holothuria arenicola* Semper of 200 mm in length was collected. The morphometric and anatomic observations are made and discussed.

968. **James, D.B.** 2000. Seacucumber. ***In***: *Marine Fisheries Research and management,* (eds) V.N. Pillai and N.G. Menon, CMFRI, Kochi, pp.124-151.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Sea cucumbers are a group of economically important echinoderms with a wide range of distribution in coral to mangrove habitats. Out of 200 species known from Indian seas, 75 are from shallow seas; while only a dozen of them belonging to Holothuridae and Stichopodia are large with thick body wall and hence commercially important. They occur in exploitable concentration in the Gulf of Mannar, Palk Bay, Lakshadweep and Andaman & Nicobar Islands. The paper presents family, genera and species key to identification along with the description and distribution of important species. The paper also reviews their ecology, animal association, parasites, biotoxicity, collection, handling and processing for *Beche-de-mer*, conservation and management and hatchery and culture in Indian situation.

969. **James, D.B.** 2000. The enigmatic echinoderms. *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI,* pp.19-23.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Echinoderms, being common and conspicuous organisms of the seashore, have attracted the attention of the naturalists since ancient times. Many of the present day living species were named by Linnaeus and Lamarck. They are known for their beauty, more so for their striking symmetry.

970. **James, D.B., A. Chellam and P.S. Asha** 2001. The early development of the starfish *Pentaceraster regulus* (Muller and Troschel) from Tuticorin. *Mar. Infor. Serv., T&E Ser.,* 167: 12-13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Although more than 20 species of star fishes are known from the Gulf of Mannar except for the observations on the development of the star fish *Asterina burtoni* Gray no development of any starfish has been studied from the region. The starfish *Pentaceraster regulus* (Muller and Troschel) is a widely distributed and common species in the Gulf of Mannar and Palk Bay in shallow waters.

971. **James, D.B.** 2004. Culture possibilities of seacucumbers in India. *Proc. National Seminar on New Frontiers in Marine Bioscience Research, January 22-23, 2004.* pp. 97-104.

Address : 37 Sadasiva Metha Street, Metha Nagar, Chennai- 600 029, Tamilnadu, India.

Abstract : In the world there are about 1400 species of sea cucumbers and of these about 30 species are consumed in various ways. In the seas around India about 200 species are distributed and of these about a dozen species are of commerical importance. The Chinese introduced the sea cucumber industry to India more than 1000 years back. Seacucumbers are defenseless animals and get quickly over-exploited from any place. The sea cucumber population in the Gulf of Mannar and Palk Bay dwindled alarmingly due to continuous exploitation over the years. The only way to make use of this valuable product and earn foreign exchange for the country is to produce the seed and farm them to marketable size. India produced the seed of the most valuable species *Holothuria scabra* in 1988 at Tuticorin by thermal stimulation. Following the same techniques other countries like Australia, Indonesia, New Caledonia, Maldives, Solomon Islands and Vietnam have produced the seed of this species and are farming them. In China the techniques for farming are perfected for the temperate species *Apostichopus japonicus*. The same methods can be applied with suitable modifications. The seed of *Holothuria scabra* is found to grow well in the prawn farms subsisting on the excess feed settling at the bottom of the farm without affecting the prawn farming operations. The results obtained so far are very encouraging and the seed is expected to reach marketable size at the end of one year.

972. **James, D.B.** 2005. Seacucumber resources of India and their potential for culture. *Proc. Ocean life food and Med. Expo.,* Aquaculture Foundation of India, Chennai. p. 90.

Address : Principal Scientist (Retd.), 37, Sadasiva Metha Street, Metha Nagar, Chennai- 600 029, Tamilnadu, India.

Abstract : In the world there are about 1400 species of seacucumber and in the seas around India about 200 species are known, most of them from deep waters. About 30 species are of commercial importance in the world and in India 15 species are processed. They are consumed in fresh, chilled, frozen, dried or processed form. In India species beloging to the genera *Holothuria. Thelenota, Actinopyga, Stichopus* and *Bohadschia* are used in the processing. *Holothuria scabra* is the most valuble species in India. It is distributed in the Gulf of Mannar and Palk Bay and also in the Andaman and Nicobar Islands. The seed of *Holothuria scabra* was produced *for* the first time in 1988 at the Tuticorin Research Centre of the Central Marine Fisheries Research Institute. The seeds so produced on a number of occasions were grown under different conditions at different places. When they were grown in prawn farm the growth rate was found to be three times faster. It is expected to reach marketable size at the end of one year. In China due to disease problem many prawn farms were closed and later converted into seacucumber farms. We too can do the same thing in India with advantage.

973. **James, P.S.B.R.** 1959. *Eupleurogrammus intermedius* (Trichiuridae: Pisces) a new record from Indian waters. *J. Mar. Biol. Assoc. India,* 1(2): 139-142.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The occurrence of a fourth species of ribbon fish *E. intermedius* in Indian waters is reported. A Key for field identification of the four species is given.

974. **James, P.S.B.R.** 1960. Instances of excessive thickening of certain bones in the Ribbon fish, *Trichiurus leptures*. *J. Mar. Biol. Assoc. India,* 2(2): 253-258.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Excess ossification of the supraoccipital bone, interhaemal and interneural spines of *Trichiurus lepturus* is described. Of the four species of ribbon fishes from Indian waters, it appears to occur only in this species, in both sexes and from all localities. The theory of homogeneity of the species, *T. lepturus* in Atlantic and Indo-Pacific is supported by the present observations.

975. **James, P.S.B.R.** 1961. Comparative osteology of the ribbon fishes of the family Trichiuridae from Indian waters, with remarks on their phylogeny. *J. Mar. Biol. Assoc. India*, 3(1&2): 215-248.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Comparative osteology of the four Indian species of ribbon fishes, *Trichiurus lepturus, Lepturacanthus savala, Eupleurogrammus intermedius* and *Eupleurogrammus muticus* is described. The elongation of the bones, especially those of the preorbital region of the skull in all the four species illustrates the extremely predaceous habits of the members of this family. The pre orbital region of the skull of *L. savala* shows a maximum elongation, and that of *E. muticus* minimum. This feature and the arrangement of teeth and gill rakers indicates *L. savala* as extremely carnivorous and *E. muticus* less predaceous of the four species. This view is corroborated by the studies on food of these fishes, to be published elsewhere. The study, while substantiates the affinity between them, draws a distinction between two groups, one represented by *T. lepturus* and *L. savala* and the other by *Eupleurogrammus.* The basic skull pattern in the four species is comparable to other genera of the family. The convergence or divergence between the four species, as evidenced by the structure of the skull and other parts of the skeleton may be explained as a result of function.

976. **James, P.S.B.R.** 1962. Observations on shoals of the javanese cownose ray *Rhinoptera javanica* from the Gulf of Mannar, with additional notes on the species. *J. Mar. Biol. Assoc. India*, 4(2): 217-223.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Four species of *Rhinoptera* were recorded from Indian waters (Misra, 1951) of which *R. javanica* appears to be the common species in the Gulf of Mannar. The natural distribution of this species from India, Ceylon, Malay Peninsula, Siam, China and Malay Archipelago (Misra, 1947) has been extended by definite records to western Indian Ocean (South Africa) by Smith (1961). In this context it may be mentioned that *R. javanica* has been reported from east Atlantic as well (Fowler, 1946), but as pointed out by Bigelow and Schroeder (1953) comparisons of Atlantic and Indian Ocean material is lacking and in the absence of which, with our present knowledge, it will be desirable to consider the range of distribution of the species as Indian Ocean and western Pacific. In view of the economic importance both as a food fish as well as a predator on pearl oysters and due to lack of detailed synonymies for the species from this region, available references to the species from the Indo-Pacific are given below.

977. **James, P.S.B.R.** 1964. Some observation on the fishery of *Chorinemus lysan* Forskal of the Rameswaram Island with notes on its biology. *Indian J. Fish*., 11(1): 268- 276.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Several species of carangids are known to occur in the Palk Bay and Gulf of Mannar in the vicinity of Mandapam of which *Selaroids leptolepis, Selaro kalla, Caranx sexfaseiatus, C. carangus, C. ignobilis, Carangoids armatus, Atropus atropus, Megalaspis cordyla* and *Chorinemus lysan* are the most common species and important from the fishery point of view.

978. **James, P.S.B.R and C. Adolph** 1965. Observations on trawl Fishing in the Palk Bay and Gulf of Mannar in the vicinity of Mandapam. *Indian J. Fish*., 12(1&2): 530-545.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The fishing methods along the southeast coast of India with special reference to the Palk Bay and Gulf of Mannar in the vicinity of Mandapam include the operation of drift gill nets and bottom-set gill nets from plank-built boats, boat seines or bag nets from catamarans, shore seines, hooks and lines and traps, depending on the type of fish available at a particular locality. Operation of trawl nets from mechanized vessels in this area on a commercial scale is comparatively recent. Though a few small mechanized boats have been conducting trawling operations especially off Rameswaram for the past few years, no systematic survey of the fishing grounds has been carried out nor are the biological data for the commercially important fishes that could be caught in these net available. During the course of their work on the biology of silver-bellies and prawns of this area, the authors had opportunity to make some general observations on the catches landed by the Indo-Norwegian Project medium boats and since such observations are lacking for this area till date, the information gathered during the year 1964 is given in this paper. Although quantitative data are also presented in this account to indicate the general trend, special attention has been paid to the qualitative analyses of the catches through an year since the chief aim of the paper is to provide information on the availability of various species of fish and prawns that could be commercially exploited.

979. **James, P.S.B.R.** 1966. Notes on the biology and fishery of the butterfly Ray, *Gymnura poecilura* from the Palk Bay and Gulf of Mannar, *Indian J. Fish.*, 13(1&2): 150-157.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Observation on the biology and fishery of the butterfly ray, *Gymnura poecilura* (Shaw) from the Palk Bay and Gulf of Mannar including details of description, size, proportional measurements, developmental stages, habits, colour and numerical abundance are given.

980. **James, P.S.B.R.** 1967. *Leiognathus leucisus* (Gunther) and *Leiognathus smithursti* (Ramsay & Ogilby) (Family Leiognathidae: Pisces) - Two New Records from Indian seas. *J. Mar. Biol. Assoc. India*, 9(2): 300-302.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Two species, *Leiognathus leuciscus* (Gunther) and *L. smithursti* (Ramsay & Ogilby) of the family Leiognathidae are reported for the first time from Indian seas with brief descriptions. With the inclusion of these two new records, 16 species of this family (genera *Leiognathus, Seclilor* and *Gazza)* are now known from the Indian seas.

981. **James, P.S.B.R.** 1967. Comments on the four new species of ribbon fishes (Family Trichiuridae), recently reported from India. *J. Mar. Biol. Assoc. India*, 9(2): 327-338.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Based on an examination of holotypes, paratypes, other material collected earlier by the author, published details and data on certain types of trichiurids in British Museum, Paris Museum and Leiden Museum, the four new species of ribbonfishes (Family-Trichiuridae) recently reported from India were commented upon. Of these, the two new species *Trichiurus russelli* and *Lepturacanthus serratus* described by Dutt and Thankam (1966, issued 20-7-'67) from Waltair are synonymised with *Trichiurus pantului* and *Trichiurus gangeticus* reported earlier by Gupta (1966, issued 25-2-'67) from the Hooghly estuarine system, of which *T. pantului* is considered a synonym of *Trichiurus lepturus* Linnaeus. Further, *T. pantului* agrees with *T. lajar* Bleeker *(=T. lepturus).* The other species, *T. gangeticus*, which should correctly be designated as *Lepturacanthus gangeticus* (Gupta) because of its greater affinity to genus *Lepturacanthus* than to *Trichiurus*, might prove to be distinct, especially based on its meristic counts and serrations in pectoral spine, if, particularly, the combination of characters of other species it exhibits, the serrations in the dorsal, anal and pelvic spines of young stages of other species of ribbon fishes which are similar to those in its pectoral spine.

982. **James, P.S.B.R and M. Badrudeen** 1968. On certain anomalies in the fishes of the family Leiognathidae. *J. Mar. Biol. Assoc. India*, 10(1): 107-113.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Instances of anomalies are quite common in fishes and were reported by earlier authors in a number of families of fishes, involving different parts of the body. Dawson (1964) gave a valuable bibliography on the subject. Some recent accounts on anomalies in fishes from India are those of Kapoor and Sarkar (1955), Sarkar and Kapoor (1956), Sarkar and Kaushik (1958), Tandon (1959), James (1960), Kaushik (1960), Luther (1962), Chhapgar (1964), Bensam (1965), Bapat and Radhakrishnan (1967) and Rangarajan (1967). During the course of study of the biology and fishery of the fishes of the family Leiognathidae from the Palk Bay and Gulf of Mannar, the authors came across seventeen specimens of seven different species of this family showing certain anomalies. These pertain to the body profile, fins, eye and colour. A brief description of these anomalies is given in this paper. The specimens were deposited in the Reference Collection Museum at Central Marine Fisheries Research Institute (Five specimens of *Leiognathus dussumieri-Reg.* No. F. 98/594A; Three specimens *ofL.brevirostris-Reg.* No. F. 98/283 B; *Two* specimens of *L. bindus-Reg.* No. F. 98/280 B; Four specimens of *Leiognathus-Reg.* No. F. 98/593 A; one specimen of *L.fasciatus-Reg.* No. F. 98/279 B; One specimen of *L. leuciscus-Reg.* No. F. 98/569 A; and one specimen of *L. lincoalus-Reg.* No. F. 98/595 A).

983. **James, P.S.B.R.** 1969. The marine biological association of India- A decade of service to science. *Proc. Symp. Corals and Coral Reefs, MBAI, Souvenir.* pp. 1-4.

984. **James, P.S.B.R.** 1970. Further observations on shoals of the Javanese cownose ray *Rhinoptera javanica* from the Gulf of Mannar with a note on the teeth structure in the species. *J. Mar. Biol. Assoc. India*, 12(1&2) : 151-157.

Address : Central Marine Fisheries Research Station, Kochi, India.

Abstract : Recent large scale incursions of shoals of the Javanese cownose ray, *Rhinoptera javanica* Muller & Henle into the coastal waters of Gulf of Mannar in the vicinity of Mandapam and their capture are reported. The number of fish captured on different occasions ranged from a few to four thousand, consisting of adult fish in breeding condition, maximum size recorded being 158 cm. disc width. There is evidence that females mature and produce young at a size of about 128 cm. disc width, although the minimum size at maturity is not known. Females appear to grow to a larger size than males and dominate the catches on such occasions. A few measurements of 32 adult fish selected at random from a shoal and of three intra-uterine embryos collected on the occasion are given.

985. **James, P.S.B.R.** 1970. *Micrognathus brevirostris* (Family, Syngnathidae: Pisces) - A new record from the Indian seas with observations on its early development. *J. Mar. Biol. Assoc. India,* 12(1&2): 158-162.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Micrognathus brevirostris* (Riippell) (Family Syngnathidae : Pisces) is reported for the first time from the Indian seas. It is also the first record of the genus from this region. A detailed description of the species and some observations on its early development are given.

986. **James, P.S.B.R.** 1971. On the occurrence of a blue-green alga on fishes of the family Leiognathidae. *J. Mar. Biol. Assoc. India,* 13(1): 133-135.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This note records the occurrence and association of the blue-green alga, chroococcaceae on the fishes of the family Leiognathidae, especially on *Leiognathus dussumieri, L. brevirostris, L. splendens, L. lineolatus* and *L. berbis* from the Palk Bay and the Gulf of Mannar.

987. **James, P.S.B.R.** 1972. On a bloom of *Trichodesmium thiebauth bautii* Gomont in the Gulf of Mannar at Mandapam. *Indian J. Fish.,* 19(1&2): 205-207.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A bloom of the blue-green alga, *Trichodesmium thiebautii,* was observed during the last week of May 1968 in the Gulf of Mannar along the Mandapam Coast. The algae was found in abundance in various stages of disintegration in the glass tanks of the sea-water aquarium of the Central Marine Fisheries Research Institute, Mandapam Camp, which caused mortality of fishes kept for experimental purposes. However, no fish mortality was reported from the sea.

988. **James, P.S.B.R.** 1973. The ribbon fish resources of India. *Proc. Symp. Living Resources of seas around India.* pp. 434-438.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Ribbonfishes constitute one of the important commercial fisheries of India, the annual catches fluctuating about 29,000 m.tons and forming 3.8% of the total marine fish landings (average for 1958-67). They are caught almost all along the Indian coast and form an exclusive fishery of considerable magnitude at a number of places, especially in the southern peninsular region. The states of Andhra Pradesh, Madras and Kerala account for the greater percentage of annual catches. A limited fishery exists in Hooghly-Matlah estuaries. Though the catches are constituted by more than one species at several places, it is certain, that the bulk of the catches are contributed to by *Trichiurus lepturus,* which moves in great shoals and appears to migrate from east to west around cape during August to October when it is caught in large quanitites. On such occasisons, the fishery is supported by spent fishes, about 50 to 75 cm, which could be caught to any extent possible without being detrimental to future stocks as such fish would have spawned at least once. The other three species, *Lepturacanthus savala, Eupleurogrammus muticus* and *E. intermedius,* though comparatively not very important, yet form the fishery singly or cojointly at some places. The usual gear for these fishes are the shore seines and the boat seines. Catches could be substantially improved in the southern region between Idinthakarai and Vizhingam if the information of appearance of shoals between August and October is promptly passed on to the fishing centers in between and they are effectively fished at this time.

989. **James, P.S.B.R.** 1973. The fishery potential of silverbellies. *Proc. Symp. Living Resources of seas around India.* pp .439-444.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In recent years, the catches of silver-bellies from the seas around India have shown a steep rise from 15,274 m.tons in 1950 to 43,823 m. tons in 1967, at present forming 5.08% of total marine fish production and offer scope for further development. While they are caught all along the Indian coast, a significant fishery exists only in the southern states. It is essentially a round the year coastal fishery, its range not exceeding about 30 meters in depth. Although the fish school together at the bottom, perhaps with the exception of one or two species which seem to live in, or at least migrate to surface waters, they do not seem to migrate long distances. The peak season for the fishery varies with the dominant species at a place which in tern is dependant on the type of bottom to a large extent. As many as 17 species are now known to be available in the seas around India, but from the fishery point of view, seven species mainly *Leiognathus jonesi, L. splendens, L. bindus, L. dussumieri, L. equulus, Secutor insidiator and Gazaminuta* seem to be important, of which *L. splendens* is widely distributed along the Indian coast. As most of the species are small and appear to be short lived, and since the present method of explitation leaves enough brood for replenishing the stocks, it is desirable to catch fish of all sizes for the best utilization of the resource. The best and most suitable gear for these fishes are the trawl nets, followed by boat seines and shore seines. Unexploited sheltered coastal areas with muddy or coral sandy bottom are likely to be the new grounds for these fishes forming further supplies of food, fish meal and fertilizer.

990. **James, P.S.B.R.** 1973. Sharks, Rays and Skates as a potential fishery resource off the east coast of India. *Proc. Symp. Living Resources Seas around India.* pp. 483-494.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The sharks, rays and skates form one of the important commercial fisheries of India, the average annual landings for 10 years (1958-67) being 33,442 m. tons. Of this, 15,537 m. tons are landed along the east coast and 17,605 m. tons along the west coast and the rest at Andaman and Nicobar and Laccadive groups of islands. Reports indicate that the Indian Ocean offers valuable fishing grounds for these fishes, especially for the larger varieties, which can substantially augment the supplies of food, liver-oils, fins and shagreen. Along the east coast, good fishery for elasmobranchs exists along the coasts of Orissa, Andhra Pradesh, Madras State and in Andaman Islands. These fishes are caught almost round the year, the sharks on hook and line and in drift gill nets at depths varying from 16 to 100 metres and majority of rays and skates in trawl nets, drift and bottom set gill nets and shore seines at depths ranging from 4 to 100 metres. The common species of sharks include the blacktip finned sharks of the genus *Carcharhinus*, species of *Scoliodon*, the hammer-head sharks, *Sphyrna* spp., the tiger shark, *Galeocerdo cuvieri* and the zebra shark, *Stegostoma fasciatum.* The whale shark, *Rhincodon typus*, is occasionally landed. Rays of commercial importance are the cownose ray, *Rhinoptera javanica* shoals of which make frequent incursions into coastal waters of Gulf of Mannar, the butterfly ray, *Gymmura poecilura*, *Himantura* spp., *Amphotistius zugei, Pastinachus sephell* and the devil ray, *Mobula diaboilis.* The common skates include *Rhinobatus djiddensis* and *Rhinobatus granulatus* and the saw-fishes of the genus Pristis. From the present trend, it would appear that the catches of elasmobranchs off the east coast could be substantially increased by extending fishing operations to deeper waters especially in the Gulf of Mannar and by the use of stronger nets from mechanised vessels. Fruitful results may also be expected along the east coast, including Andaman Islands by exploratory surveys to chart potentially rich grounds for these fishes.

991. **James, P.S.B.R.** 1974. An osteological study of the dugong, *Dugong dugon* from India. *Marine Biology,* 27: 173-184.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An osteological study of the dugong (sea cow) *Dugong dugon* (Muller) from Gulf of Mannar, India, based on complete skeletons of an adult male and a juvenile female indicated certain morphological variations with age. It has also revealed a close osteological similarity between the dugongs from India and the Red Sea. Based on a statistical analysis, regression equations for certain typical skull measurements have been calculated; these equations, characteristic of the dugong from India, could be used for comparing dugongs of different regions. The author states that an osteological study of the dugong from the Indian region has so far not been reported.

992. **James, P.S.B.R. and M. Badrudeen** 1975. Biology and fishery of *Leiognathus brevirostris* (Valenciennes) from the Palk Bay and the Gulf of Mannar. *Indian J. Mar. Sci.,* 4(1): 50-59.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Age and growth, reproduction, food and feeding habits, and fishery of *L.brevirostris* from the Palk Bay and the Gulf of Mannar are described, based on material collected from commercial catches landed by different fishing gear during 1969. Life span of the species is (approx) 2 yr, attaining a size of (approx) 60 and 120 mm at the end of 1st and 2nd yr respectively. Female fish mature at (approx) 63 mm and the male at 68 mm when they are just about 1 yr old. Females produce a maximum number of 16,243 eggs. The species spawns throughout the year with intense spawning in may/June and Oct/Nov. Individual fish appear to spawn twice in a year. Diatoms, copepods, lucifer, nematodes and polychaetes form important food of the species. The commercial fishery is based on 1 and < 2 yr old fish, the dominant size range being 62 to 105 mm. Fishing grounds are confined up to 12 m in the Palk Bay and 25 m in the Gulf of Mannar. Females appear to be caught in greater numbers than males. Since the species is short lived and breeds at the end of 1st yr, the present methods of exploitation appear to leave enough brood for replenishment of the stock and ensure maximum utilization of the resource.

993. **James, P.S.B.R and R. Soundararajan** 1979. On a sperm whale *Physeter macrocephalus* Linnaeus stranded at Krusadai Island in the Gulf of Mannar, with an up-to-date list and diagnostic features of whales stranded along the Indian coast. *J. Mar. Biol. Assoc. India*, 21(1&2): 17-40.

Address: Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract: A male sperm whale *P. macrocephalus* Linnaeus was beached on the southern side of Krusadai Island (Gulf of Mannar) on 30th April 1980. Since it is of a very rare instance and since only meagre information is available on sperm whales from the seas around India, a detailed description on the stranded whale is given in this paper. In addition, another instance of stranding of a sperm whale, evidently a male, at Manauli Island in 1979 is also briefly mentioned. An up-to-date list of stranding of whales of different species along the Indian coast from 1748 and their diagnostic features to facilitate identification have also been included. A proforma for taking measurements and collecting other details on stranded whales along the Indian coast has been suggested.

994. **James, P.S.B.R.** 1980. Problems and prospects of marine finfish culture in Tamil Nadu. *Key note address delivered at the seminar on coastal and Inland fisheries culture in Tamilnadu, Fisheries College, Tuticorin, 25 April 1980.*

995. **James, P.S.B.R.** 1980. Some observations on the ray *Himantura marginatus* (Blyth) from the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 22(1&2): 161-164.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : A detailed description of *Himantura marginatus* (Blyth) based on two large specimens from the Gulf of Mannar is given.

996. **James, P.S.B.R.** 1981. Exploited and potential capture fishery resources in the inshore waters of India. Seminar on the Role of Small-Scale Fisheries and Coastal Aquaculture in Integrated Rural Development, Madras (India), 6 Dec 1978. *Proc. Seminar on the role of small-scale fisheries and coastal aquaculture in integrated rural development*, 6-9 December-1978, Madras. Central Marine Fisheries Research Inst., Cochin, India. *CMFRI Bulletin*, 30A : 72-82.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This paper deals with the present status of exploited capture fishery resources and the potential stocks in the inshore waters of India. The nature and distribution, production trends, species composition and seasonal abundance of these resources are analysed for the period 1961 to 1976, delineating the productive areas and the promising fisheries. Certain highly productive areas have been found off the coasts of Kerala, Maharashtra and Gujarat. Recent catch trends indicate that promising fisheries may be those of elasmobranchs, anchovies, catfishes, silver bellies, ribbonfishes and perches. Attention is also drawn to the existence of under exploited and potential fisheries resources which include white baits, horse mackerels, ribbon fishes, catfishes, silver bellies, pomfrets, seer fishes, tunas and related fishes and molluscs. Non-conventional resources like those of cuttle fishes, squids and some fishes can be exploited for stepping up production. Exploitation of ancillary marine resources like those of sea cucumbers, sea urchins, sponges, corals and seaweeds from the inshore waters also offer scope for further development.

997. **James, P.S.B.R and M. Badrudeen** 1981. Biology and fishery of silverbelly *Leiognathus dussumieri* (Valenciennes) from Gulf of Mannar. *Indian J. Fish*., 28(1&2): 154-182.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Length-weight relationship of male and female *L. dussumieri* was found to be different. Within females, the immature, maturing, mature and spent-recovering females differ from one another in the length-weight relationship. Males weigh comparatively less than females. Among the females, immature, maturing and Spent-recovering females weigh more than mature females. This species mainly spawns during April-May and November-December, Minimum size of maturity for males were found to be 78 mm and for females 83 mm. Generally, females predominate over males in the commercial catches. The counts of mature ova ranged from 805 to 41,683 per female. The fecundity-length relationship has been studied by three different formulae and it was found that fecundity is better related to direct cube of length.

998. **James, P.S.B.R and R. Soundararajan** 1981. An osteological study on the sperm whale *Physeter macrocephalus* Linnaeus from Indian Ocean. *Indian J. Fish*., 28(1&2): 217-232.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The skeleton of a male sperm whale, *Physeter macrocephalus* Linnaeus (8.1 m) which was stranded on the southern side of Krusadai Island (Gulf of Mannar) on 30th April 1980, is described in detail. The salient features are a through-shaped asymmertrical skull, long "V" shaped mandible, a vertebral column consisting of seven cervical vertebrae (six of them fused, the first free), eleven thoracic vertebrae with only ten ribs, eight lumbar vertebrae and 23 caudal vertebrae with ten chevron bones attached between 3rd and 4th caudal vertebrae and fairly large forelimbs. The osteological features in which the present material differs from other on record from elsewhere are mentioned.

999. **James, P.S.B.R., V.S. Rengaswamy, A. Raju, G. Mohanraj and V. Gandhi** 1983. Induced spawning and larval rearing of the grey mullet *Liza macrolepis* (Smith). *Indian J. Fish.,* 30(2): 185-202.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper deals with the results of experiments on induced spawning and larval rearing of *Liza macrolepis* during the years 1981 and 1982 at Mandapam. Major carp pituitary glands and chorionic gonadotropin were used for hypophysation. The effective dosages varied between 600 and 1200 mg and 110,000 and 340,000 I.U. per kg body weight of the fish in the case of major carp pituitary gland and chorionic gonadotropin, respectively. In the combination of both, the dose required was 1200 mg and 12,000 to 15,000 I.U. The size of fully mature egg ranged from 0.70 to 0.74 mm and that of fertilized egg from 0.74 to 0.78 mm. The newly hatched larva measured 1.43 mm. Mouth formation was observed at 42 h after hatching when the larvae were 2.36 mm. High mortality occurred on the third day. The larvae could be reared for seven days, when they attained a size of 2.47 mm. The larval development is described in detail.

1000. **James, P.S.B.R.** 1984. A review of marine finfish culture in India its problems and prospects. *Proc. Symp. Coastal Aquaculture,* 3: 718-731.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Details of various ecosystem, utilised for finfish culture, the species of fishes used, mono-and polyculture system adopted, the low cost technology developed for culture of various species of fishes in pens, cages and net impoundments and coastal fish farms development are given. The culture works in India mainly concerned with milkfish, mullets, Indian sand-whiting and prawns in mono-or polyculture systems in seawater ponds. These and other species like rabbit fishes and groupers are cultured in pens, cages and net impoundments. Details of development of coastal fish farm, with simple methods of construction, lining of ponds by polythene film to prevent bund erosion and retention of water against seepage and turfing of bunds are dealt with. The paper also outlines the constraints experienced in culture of finfishes under various systems and the prospects of further development of finfish culture in India.

1001. **James, P.S.B.R., A. Raju and V.S. Rengaswamy** 1984. Further observations on polyculture of finfishes and prawns in saltwater ponds and in a net-pen at Mandapam. *Indian J. Fish.*, 31(1): 31-46.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Polyculture experiments were carried out with milkfish, mullets, Sillago and prawns in salt water ponds and in a netpen in the coastal waters of Palk Bay at Mandapam, during the period 1979-82. The growth of mullet and Sillago was better in the netpen than in the pond, whereas milkfish showed better growth in the pond. Significant differences in production from fertilized and unfertilized ponds have not been noticed, the result of which is attributed to poor soil conditions of the farm. Mullets sharply reacted to low levels of oxygen in ponds.

1002. **James, P.S.B.R., R. Soundararajan and J. Xavier Rodrigo** 1984. A study of the seed resource of the Indian sand whiting *Sillago sihama* (Forskal) in the Palk Bay. *Indian J. Fish.*, 31(3): 313-324.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The fry and fingerlings of the Indian sand whiting, *Sillago sihama* (Forskal), which can serve as seed, have been found to occur in the coastal waters of the Palk Bay throughout the year, with at least three months of peak abundance, January, May and October. From the year-round availability of these it appears that *S. sihama* breeds throughout the year, probably with three peak periods, namely, May-June, August-September and November-December. These were observed to be more during day than in night, and more during the receding and low tides than during the incoming tides. The overall abundance was the highest during full moon period. While a direct relationship of the abundance of the fry and fingerlings could be noticed with the increase in temperature and dissolved-oxygen content, no such relationship was seen with changes in the salinity of seawater.

1003. **James, P.S.B.R.** 1985. On the conservation and management of marine mammals of India. *Proc. Symp. Endangered Marine Animals and Marine Park, MBAI*, 1: 61-64.

Address : Indian Council of Agriculture Research, New Delhi, India.

Abstract : Increasing attention is being paid the world over for affording protection to, and conservation of marine mammals. They are the most vulnerable group of sea animals, excepting the sea turtles. Public awareness needs to be created to remove the prejudices towards marine mammals. There is need for their protection in modem times through regulations, up-dating existing legislations, collection of scientific data, establishment of sanctuaries, extending of financial and other support and inter-governmental and regional cooperation. The status of the dugong in the seas around India is cited as a case in particular for conservation and management through appropriate regulatory measures, intensified scientific study, establishment of sanctuaries *in-situ* and regional cooperation.

1004. **James, P.S.B.R., V.S. Rengaswamy, A. Raju and G. Mohanraj** 1985. Studies on diurnal variations in the occurrence of grey mullet seed at Mandapam. *Symp. Ser. Mar. Biol. Assoc. India*, 6: 765-775.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : In order to study the diurnal variations in the occurrence of mullet seed, collections were made during Aug. 1978 to Jul. 1979 and also Aug. 1979 to Oct. 1979 at Theedai near Mandapam along the Palk Bay. The data indicate that the seed of the grey mullet *Liza vaigiensis* dominate the collections with *L. macrolepis* and *Valamugil seheli* occurring in fewer numbers, occasionally. Other species of fishes which occurred along with mullets include *Therapon* sp., *Hemirhamphus* sp., *Chanos chanos, Allanetta* sp., *Sillago sihama, Tachysurus thalassinus, Nematalosa nasus, Leiognathus brevirostris, gobids, belonids, Gerres* sp., *Megalops* sp., and *Plotosus* sp. Prawns were represented by *Penaeus indicus* and *Metapenaeus burkenrodi*.

1005. **James, P.S.B.R., G. Mohanraj, V.S. Rengaswamy and A. Raju** 1985. Preliminary experiments on the culture of grey mullets at Mandapam. *Symp. Ser. Mar. Biol. Assoc. India*, 6: 791-796.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of experiments on the culture of grey mullets *Valamugil seheli, Liza vaigiensis* and *L. macrolepis* in monoculture and polyculture systems in seawater ponds and a pen erected in coastal waters at Mandapam are detailed. In a monoculture experiment, *L. vaigiensis* was stocked at the rate of 1,125/225 m^2. In polyculture experiments, mullets (*V. seheli*) and *L. macrolepis, Chanos chanos* and prawns (*Penaeus indicus*) were stocked at the rate of 100 and 600, 1000 and 300/450 m^2 respectively in one pond and mullets (*V. seheli*) *C. chanos* and *Sillago sihama* at the rate of 750 nos. each in another pond. Mullets (*V. seheli*) and *C. chanos* were also stocked in a pen (81 sq. m) erected in coastal waters of the Palk Bay at the rate of 500 nos. each. The stocks were fed with artificial feed composed of equal proportions of rice bran and groundnut oil cake in the form of paste.

1006. **James, P.S.B.R., R. Soundararajan and J. Xavier Rodrigo** 1985. Preliminary studies on culture of fin-fishes in cages in the coastal waters of Palk Bay at Mandapam. *Symp. Ser. Mar. Biol. Assoc. India*, 6: 910-915.

Address : Indian Council of Agriculture Research, Krishi Bharan, New Delhi-110 001, India.

Abstract : An examination was made of the possibilities of culturing a few species of economically important marine fishes in suitable low cost cages suspended in coastal waters. The results of a preliminary study on culture of rabbit fishes (*Siganus* spp.), groupers (*Epinephelus* spp.) and whiting *Sillago sihama* in cages fabricated with

different materials and suitability of cages are given. Among the 5 cages used, the one fabricated with palmyra leaf stalks was the cheapest but the 2 cages fabricated with nylon nettings were durable. Data on growth and stocking density are presented for each cage type.

1007. **James, P.S.B.R., V. Gandhi, G. Mohanraj, A. Raju and V.S. Rengaswamy** 1985**.** Monoculture of grey mullets in coastal saltwater ponds at Mandapam. *Indian J. Fish.,* 32(2): 174-184.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The paper gives the results of a set of six monoculture experiments attempted on mullets, *Liza vaigiensis* and *Valamugil seheli* fed on artificial diet composed of rice bran and groundnut oilcake in equal proportions at a rate of 5-10% body weight. The experiments were conducted in saltwater ponds at Mandapam, Tamil Nadu, India and covered in all a period of three years. *L. vaigiensis* stocked at an estimated density of 50,000/ha yielded at the rate of 569 kg/ha/year with the survival estimated at 72.9%. *V. seheli*, which was dealt with in all the subsequent five experiments, with stocking densities varied from 22,000 to 40,000/ha, has given a yield varying from 59 kg/ha/315 days to 782 kg/ha/265 days, with survival rates varying from 18.3 to 81.2%.

1008. **James, P.S.B.R.** 1985. Comparative osteology of the fishes of the family Leiognathidae, Part I: Osteology. *Indian J. Fish.,* 32(3): 309-358.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper deals with the comparative, osteology of 17 species of the three genera, *Secutor* and *Gazza*, in the family Leiognathidae. While giving a detailed description of the osteology of *L. iullesi*, representing the genus the osteological features of the other two genera are compared. The distinctive features of the various species are listed. The relationships among the genera and the species are discussed and osteological keys to the genera and the species arc provided. The results of the study indicate that within the genus *Leiognathus*, the species constitute four groups: the first represented by *L. smithursti*, *L. splendens*, *L. jonesi* and *L. dussumieri*; second by *L. fasciatus* and *L. equulus*; third by *L. leuciscus*, *L. berbis*, and *L. lineolatus*; *and* fourth by *L. daura*, *L. blochi* and *L. brevirostris.* The species *L. bindus* stands apart from all the other species of *Leiognathus* and shows affinity to genus *Secutor* on one hand and genus *Gazza* on the other and incidentally exhibits certain specialised characters like the upwardly directed protrusible mouth of the former and the development of prominent teeth of the latter. The species of Secutor and Gazza remain distinct within the respective genera and from species or the genus *Leiognathus.*

1009. **James, P.S.B.R.** 1986. Biology and Fishery of *Leiognathus jonesi* James from the Palk Bay and Gulf of Mannar. pp. 29-101. ***In***: *Recent Advances in Marine Biology,* (*ed*.) P.S.B.R. James, Today and Tomorrow's New Delhi, 591 pp.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The paper deals with various aspects of the biology and fishery of the silverbelly, *Leiognathus jonesi* James from Palk Bay and Gulf of Mannar, in the vicinity of Mandapam. The length-weight relationship of indeterminates ($W = 0.0000008276\ L^{3.723}$ was found to be significantly different from that of sexed fish ($W = 0.000006279\ L^{3.2167}$ indicating that the rate of increase in weight of the former is much higher than that in the latter. The relative condition of females was found to be lower in March and April compared to other months. The species spawns almost throughout the year, the females attaining maturity at 65 mm and males at 70 mm T.L. Females generally dominate in the commercial catches. The counts of mature ova ranged from 686 to 39,806 per female. For the fecundity-length relationship the formula $Y = bX^3$ was found better correlated than other formulae for samples from all places. The most important items of food of the species include *Pleurosigma, Triceratium, Coscinodiscus,* nematodes, copepods and foraminiferans. No significant variations in the food of fish from different places or in different years from the same place have been found. The feeding habits of the fish also do not change with age. The feeding intensity has been found to be more or less uniform in different months. The fish attains a length of about 60, 90,103 and 115 mm T.L at the end of first, second, third and fourth years respectively. The lifespan of the species was found to be more than four years. Maximum length recorded in the present study was 152 mm. The species contributes to the bulk of the catches of silver-bellies from the area, trawl nets accounting for the greatest proportion of the catches at depths varying from 12 to 20 m. Fish 24 to 75 mm length (zero and one year old*)* dominate the commercial catches. Catch per unit of effort during daytime was found to be higher than that at night. The proportion of smaller size groups was greater in the night catches than in the day catches and vice-versa. Operation of pelagic, subsurface and mid water trawls at night can increase the total catch.

1010. **James, P.S.B.R.** 1986. Finfish culture. *Proc. Symp. Coastal Aquaculture*, 4: 1450-1455.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The total yield from wild stocks of marine species is still increasing but at a progressively reduced rate. With the declaration of the Exclusive Economic Zones and consequent realignment of marine fishing activities all over the world, a greater awareness has been created for production of aquatic food, particularly animal protein food. Aquaculture is an age old practice in some countries but in others, it is of a very recent origin. It has developed from small-scale fish farming to large aquaculture industries. The evolution of modern aquaculture involves improvements to environment, large scale fish farming and sophisticated systems of intensive culture for various organisms.

1011. **James, P.S.B.R.** 1986. On an anomaly in the cheliped of the portunid crab, *Portunus pelagicus*. *J. Mar. Biol. Assoc. India*, 8(1): 218-220.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Portunus pelagicus* is the dominant species and contributes substantially to the crab fishery along the Palk Bay and Gulf of Mannar coasts in the vicinity of Mandapam. On 23rd February 1966, a male specimen of this species with the carapace measuring 59 mm in length and 132 mm. in breadth which had two additional dactyli on the left cheliped was collected from the gill net (Nandu valai) catches from Gulf of Mannar landed near the jetty of the Central Marine Fisheries Research Institute. Such an anomalous condition of the cheliped which appears to be rare has not been reported hitherto in this species and therefore a brief description is given below. The right cheliped of the specimen was unfortunately broken before collection.

1012. **James, P.S.B.R., K.A. Narasimham, P.T. Meenakshisunderam and Y. Appana Sastri** 1986. Present status of Ribbon fish fishery in India. *CMFRI Spl. Publ.*, 24: 1-49.

1013. **James, P.S.B.R and M. Badrudeen** 1986. Studies on the maturation and spawning of the fishes of the family Leiognathidae from the seas around India. *Indian J. Fish*., 33(1): 1-26.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper deals with the maturation, spawning habits, spawning seasons and fecundity of 17 species of leiognathids from the seas around India. Most of the species appear to spawn over a prolonged period (*Leiognathidae fasciatus, L. jonesi, L. bindus, L. daura, L. leuciscus, L. blochii, L. brevirostris, L. berbis , L. lineolatus, S. ruconius, S. insidiator, G. minuta* and *G. achlamys*); a few spawn continuously over a short period (*L. equulus* and *L. smithursti*); *L. splendens* spawns in batches in quick succession over a short period; and *L. dussumieri* spawns twice in a year for a short time in two distinct periods. Four species *L. fasciatus, L. bindus, L. daura* and *L. berbis* spawn fractionally. Except for *L. brevirostris* , which spawns almost throughout the year, the species spawn mostly during March-April and November-December periods. Fecundity was found to increase with length at a higher rate in *G. minuta, L. bindus* and *S. insidiator* at a lower rate in *L. berbis, L. brevirostris, L. daura* and *S. ruconius*. But it was found to decrease with length in *L. leuciscus* and *L. splendens*.

1014. **James, P.S.B.R., V.S.K. Chennuhotla and J. Xavier Rodrigo** 1986. Studies on the fauna associated with the cultured seaweed *Gracilaria edulis*. *Proc. Symp. Coastal Aquaculture, held at Cochin, from January 12 to 18, 1980. Part 4: Culture of other organisms, environmental studies, training, extension and legal aspects*, 6: 1193-1198.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : To study the fauna associated with the cultured seaweed *Gracilaria edulis* in coastal waters of the Palk Bay and the Gulf of Mannar and to assess the damage, if any, caused by any of the organisms, samples of all animals associated with the cultured seaweeds were collected from the seaweed culture sites. Crabs were found to be more numerous than all other groups. Analysis of the stomach contents of the fishes revealed that of the 16 species of fishes encountered, only *Siganus javus* was found to feed voraciously on the seaweed. The crabs represented by *Thalamita crenata* and *T. integra* though not found to feed on the seaweed, could cause extensive damage to growing parts of the seaweed by merely clipping them with their chelipeds as they crawl about amongst the seaweeds. However, greater part of the damage to the cultured seaweed during the period appears to be caused by wind and wave action when the sea becomes rough. Observations indicated damage to growing tips of the seaweed during April to August. This period coincides with the period when the direction of the wind changes from east-west to south-north direction.

1015. **James, P.S.B.R and R.S. Lal Mohan** 1987. The marine mammals of India. *Mar. Fish. Infor. Serv. T & E. Ser.*, 71: 1-13.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The taxonomy of order Cetacea is discussed.

1016. **James, P.S.B.R and R. Marichamy** 1987. Status of sea bass (*Lates calcarifer*) culture in India. *Proc. Int. Workshop on Management of Wild and Cultured Sea Bass/Barramundi (Lates calcarifer), Darwin (Australia)*, 24-30 Sep 1986. 20: 74-79.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results are presented of studies conducted regarding culture of *Lates calcarifer* in a coastal pond at Tuticorin, India. The biology, age and growth, food and feeding habits, migration, spawning, and early life history of the species are discussed. Methods of culture used are detailed.

1017. **James, P.S.B.R., M. Srinath and A.A. Jayaprakash** 1987. Stock assessment of tunas in the seas around India. *Expert Consult.on Stock Assessment of Tunas in the Indian Ocean,Colombo (SriLanka),4 Dec 1986*.pp.353-366.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Data collected on catch, effort, size ranges and other biological information during the period 1982-83 to 1985-86 on the commercially important species of tunas at five centres along the Indian coast and the Lakshadweep Islands have been analysed. The effect of fishing on the stocks of *Euthynnus affinis, Auxis thazard* and *Katsuwonus pelamis* along with the estimates of standing and average annual stocks are highlighted. It was found that in the case of *E. affinis*, except at Mangalore and Vizhinjam, at all the other centres, namely, Calicut, Cochin and Tuticorin there is likely to be increase in yield with increase in fishing effort. In the case of *A. thazard* it was found there may not be significant increase in yield at Cochin with increase in effort. However, at Tuticorin, increased effort may result in higher yields of *A. thazard*. At Minicoy, there is scope for getting increased catches of *K. pelamis* with increase in effort.

1018. **James, P.S.B.R., K. Alagarswamy, K.V. Narayana Rao, M.S. Rajagopalan, K. Alagaraja and E. Mukundan** 1987. Potential marine fishery resources of India. *CMFRI Spl. Publ.*, 30: 44-74.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : As the marine fish production of our country from the presently exploited grounds has remained rather stagnant for more than a decade now, it is imperative that the potential resources of various species and areas as indicated in this account should be properly tapped by extending our fishing effort to middle and outer shelf, continental slope and oceanic region of the EEZ with concurrent development of infrastructure facilities. This would hopefully help in bridging the gap between the potential resources and present production.

1019. **James, P.S.B.R.** 1988. Development of molluscan Fisheries in India. *CMFRI Bulletin*, 42(1): 6-10.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Molluscan fisheries resources are constituted by the edible and non-edible species. The former excluding the cephalopods, comprise mainly the bivalves and the latter a variety of bivalves and gastropods. Development of the edible resources is linked with popularisation and acceptability of the meat as an item of food and the marketing of the meat or the products in the domestic and export sectors. The non-edible species contribute greatly to industrial raw material in the form of extensive sub-fossil deposits in the estuarine, brackishwater and coastal areas. Others of this kind support a lucrative ornamental shell and cultured pearl trades. Production of various bivalves through simple indigenous culture techniques opened up avenues for development of these resources through training, transfer of technology and commercialisation of the methods. Monitoring of the harvesting of molluscan resources assumes greater importance with reference to rational exploitation and conservation. Dredging operations for sub-fossil deposits cause destruction of spat and change in ecological characteristics of the beds. Transplantation of seed available in nature and sea-ranching of hatchery produced seed of bivalves and gastropods need special attention for augmenting natural productivity. A review of the existing laws and conservative measures would contribute to rational exploitation of the molluscan resources of the country.

1020. **James, P.S.B.R and A.A. Jayaprakash** 1988. Current knowledge of the distribution, behaviour and abundance of tunas with suggestions for the development of tuna fishery in the Indian EEZ. *Proc. Indian Fish. Forum*,

Mangalore (India), 4 Dec 1987. pp. 211-219.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, Kerala, India.

Abstract : The paper outlines the status of the tuna fishery in the Indian EEZ and the annual and seasonal fluctuations in the catches in the maritime states. A brief account of the catch, effort, CPUE, species and size composition and distribution pattern of tunas caught by multiple gears at selected centres like Mangalore, Calicut, Cochin Vizhinjam, Tuticorin and Minicoy along with some aspects of behaviour of tunas is given. The results of the recent tuna long line fishery operations by vessels of Fishery Survey of India (FSI) and Central Institute of Fisheries Nautical and Engineering Training (CIFNET) are discussed. The available information on environmental features of the tuna fishing grounds is reviewed to highlight the gaps in knowledge. The effect of fishing on the stocks of *Euthynnus affinis, Auxis thazard* and *Katsuwonus pelamis* is examined along with the estimates of standing and average annual stocks. Suggestions for the development of tuna fishing in the Indian EEZ are indicated.

1021. **James, P.S.B.R.** 1988. Growth profile of marine fisheries in India. *CMFRI Spec. Publ.,* 40: 4-5.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : An outline is made of the growth and changes that have taken place in the marine fisheries of India over the past 4 decades. The trends in marine fish landings, the progressive changes that have taken place in the craft and gear employed to catch the fish, the progress made by the fish processing and marketing industry, including the phenomenal growth of the export for marine products, are reviewed.

1022. **James, P.S.B.R and M.S. Rajagopalan** 1988. Decadewise research contribution of Central Marine Fisheries Research Institute concomitant with development of marine fisheries in India. *CMFRI Spec. Publ.,* 40: 6-7.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Central Marine Fisheries Research Institute was established in 1947 under the Government of India, Ministry of Agriculture. In the formative years, the Institute directed its research toward getting a clear overall picture of the fishery resources of the country through an inventory survey of the production of commercially important fisheries and production means. The limited objectives with which the Institute was started were re-oriented and enlarged through the years to cope up with the development needs in the marine fisheries sector. The Institute is now playing a vital role in the exploitation and utilization of the vast potential of the EEZ of India and for augmenting production through open sea farming.

1023. **James, P.S.B.R., K.N. Kurup, C.P. Ramamirtham, D.S. Rao, G. Subbaraju and V.K. Pillai** 1988. Distribution and abundance of oil sardine and mackerel in relation to environmental characteristics in the Indian coastal waters. *CMFRI Spec. Publ.,* 40: 8-10.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Pelagic resources play a key role in the overall marine fish production in India. Marine fish production from the Indian seas has shown considerable increase during the past four decades. The bulk of the resource caught is constituted by oil sardine (*Sardinella longiceps*) and mackerel (*Rastrelliger kanagurta*), but these species showed characteristic wide fluctuations in abundance as well as distribution compared to other fishery resources.

1024. **James, P.S.B.R and M.S. Muthu** 1988. Mariculture in India. *CMFRI Spec. Publ.,* 40: 42-43.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Good progress has been made in developing viable technologies for cultivating marine food organisms such as penaeid prawns, milkfish, mullet, edible oysters, mussels, clams, pearl oysters and seaweeds. The progress that has been made in all these areas connected with mariculture in the country is reviewed and the problems and constraints are evaluated and strategies to overcome some of them are suggested.

1025. **James, P.S.B.R and K. Alagarswami** 1988. Strategies for marine fisheries development in India. *CMFRI Spec. Publ.,* 40: 80.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Four decades of planned development of marine fisheries in India has raised the production level from about 0.5 to 1.6 million tonnes per annum. An analysis is made of the cause and effect of some of the

important aspects of marine fishery development in the maritime states and Union Territories. Resource research at various periods of time has come out with tentative recommendations on strategies that may be adopted in development of particular fisheries. Taking into consideration the present scenario of research and development, strategy options are indicated for management and development of the marine fisheries of the country.

1026. **James, P.S.B.R and P. Parameswaran Pillai** 1988. Strategies for tuna fisheries development and management in the Indian Exclusive Economic Zone. *CMFRI Spec. Publ.,* 40: 95.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A retrospect of national tuna fishery in India is presented, and strategies and perspectives for the development and management of tuna fisheries, chiefly through augmentation and melioration in the (1) traditional small-scale sector; (2) medium commercial fishery sector; and, (3) large-scale commercial fishery sector are presented with substantiating data and information. The prime need of tapping the skipjack tuna resource from the oceanic sector of the EEZ of India and strategies involved in the augmentation of skipjack production by planned development of the small scale fishery sector around the oceanic Islands are discussed. The prospects of acquisition and utilisation of the vessel capacity, equipments and expertise of the developed nations in the operational sector of large scale commercial tuna fishery for yellow fin and big eye from the EEZ, and other policy options for tuna fishery development in the oceanic waters are reviewed.

1027. **James, P.S.B.R., K.C. George and G. Pillai** 1988. Research in marine fisheries management and development-capture and culture fisheries. *CMFRI Spec. Publ.,* 40: 104-105.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The research contributions of the Central Marine Fisheries Research Institute for the management and development of marine capture and culture fisheries of the country during the past 4 decades are discussed.

1028. **James, P.S.B.R., T. Jacob, K.C. George, V. Narayana Pillai, K.J. Mathew and M.S. Rajagopalan** 1988. National strategy for exploitation and utilization of the potential marine fishery resources - A proposal. *CMFRI Spec. Publ.,* 40: 105-107.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Research and exploratory fishing efforts during the last 4 decades in the traditional fishing zones and beyond, generated information on the potentials of the various exploited, under exploited as well as unexploited fish resources of the Exclusive Economic Zone of the country. Past studies indicate that whereas increase in catches from the traditionally exploited resources like oil sardine, mackerel, bombayduck and prawns is expected to be marginal, the increase possible from additional efforts to exploit varieties like small tunas, whitebaits, horse mackerel, catfish, ribbonfish and threadfin bream is likely to be considerable.

1029. **James, P.S.B.R., A. Noble and M.M. Thomas** 1988. Post-graduate education, training and extension at Central Marine Fisheries Research Institute, Cochin. *CMFRI Spec. Publ.,* 40: 107.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In view of the increasing demand for trained personnel to meet the requirements of mariculture and brackish water culture activities in the country, the Central Marine Fisheries Research Institute took steps to develop a post-graduate education program in mariculture. Through this programme a number of post-graduates have been educated in the subject during the past 7 years. The students were given both theoretical and practical instructions in different aspects of mariculture including basic subjects like physiology, nutrition, genetics and pathology.

1030. **James, P.S.B.R.** 1990. Progress of research on sea ranching at the CMFRI. *Mar. Fish. Infor. Serv. T & E Ser.,* 105: 1-5.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Natural populations of marine animals may decline in their productivity over a period of time due to continuous and heavy exploitation of the resources or due to natural causes or a combination of both. Such a situation would warrant control of fishing activities to safeguard their productivity. Alternatively, the productivity of such marine animals can be maintained and increased to some extent through the process of sea ranching. Sea ranching involves controlled breeding of marine animals, large-scale production of their seed and release into the coastal waters, lagoons and brackish water areas depending on the type of animals under question.

1031. **James, P.S.B.R and K. Alagarswami** 1990. Strategies for marine fisheries development in India. *CMFRI Bulletin,* 44(3): 511-525.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Four decades of planned development of marine fisheries in India has raised the production level from about 0.5 to 1.6 million tons per annum. This growth in tonnage is not commensurate with the effort that has been expended over the period in terms of planning, research and development. Stagnation in production has been witnessed during the last decade. The deep-sea fishing programme is yet to yield any tangible result by way of a quantum jump in production, and its contribution has been marginal, not able to influence the overall production trend. However, marked changes have taken place in the pattern of exploitation and resources during the span of 40 years. The paper analyses the cause and effect of some of the important aspects of marine fishery development in the maritime States and Union Territories. Resource research at various periods of time has come out with tentative recommendations on strategies that may be adopted in development of particular fisheries. These have, wily nelly, not been given a try, perhaps due to several constraints. Taking into consideration the present scenario of research and development, strategy options are indicated for management and development of the marine fisheries of the country.

1032. **James, P.S.B.R and M. Badrudeen** 1990. A new species of silverbelly *Leiognathus striatus* (Family Leiognathidae: Pisces) from the Gulf of Mannar, India and redescription of *Leiognathus fasciatus* (Lacepede). *J. Mar. Biol. Assoc. India,* 32(1&2): 217-226.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A new species of silverbelly *Leiognathus striatus* (Leiognathidae: Pisces) from the Gulf of Mannar is described and compared with *Leiognathus fasciatus* (Lacepede) and *Leiognathus smithursti* (Ramsay and Ogilby) with which the new species resembles. A redescription of *L. fasciatus* (Lacepede) is also given since the original description lacks in many details.

1033. **James, P.S.B.R and V. Narayana Pillai** 1990. Fishable concentrations of fishes and crustaceans in the offshore and deep sea areas of the Indian exclusive economic zone based on observations made onboard FORV Sagar Sampada. *Proc. First workshop Scient. Result. FORV Sagar Sampada,* 5-7 June, 1989. pp. 201-213.

1034. **James, P.S.B.R., M. Badrudeen and V. Edwin Joseph** 1992. Annotated bibliography of the Silverbellies (Pisces: Family Leiognathidae). *CMFRI Spl. Publ.,* 50: 1-220.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This bibliography contains selected research articles and publications on silverbellies.

1035. **James, P.S.B.R., K.A. Narasimham and K.S. Rao** 1993. Prospects for development of oyster culture in India. *Mar. Fish. Infor. Serv. T & E Ser.,* 125: 1-3.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The suggestions for development of Oyster culture is given in this article.

1036. **James, P.S.B.R.** 1994. Endangered, Vulnerable and Rare Marine Fishes and Animals. *Threatened Fishes of India. Natcon Publ.,* 4: 271-295.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : With intensification of fishing in the inshore regions of the Indian Seas for increasing marine fish production through several innovations, a number of fisheries resources have come to be exploited at optimum levels. The demand for fish and fish products both for internal consumption and for export, has been the main reason for this situation. Among finfishes, the Whale Shark *Rhiniodon typus* of Gujarat, the catfishes of the genus *Tachysurus* off Karnataka and the Whitefish *Lactarius lactarius* along the southwest coast of India have been reduced in abundance. The once existing fisheries for "Dara" *Polynemus indicus, P. heptadactylus,* "Karkara" *Pomadasys hasta,* "Koth" *Otolithoides brunneus,* "Ghol" *Protonibea diacanthus,* "Wam" *Congresox talabanoides, Muraenesox cinereus,* all of the Gujarat - Maharashtra coast and for *Platycephalus maculipinna* along the southeast and southwest coasts have become nonexistant at present. The other marine animals which are causing concern because of habitat damage or declining populations arc the corals in the Gulf of Mannar, Palk Bay, Gulf of Kutch and the Lakshadweep and Andaman-Nicobar Island systems; the gorgonids in the Gulf of Mannar, the molluscan top shells Trochus and Turbo in Andaman-Nicobar Islands; the sacred chank and the pearl oyster *Pinctada fucata* along the south-east coast; the spiny lobsters; *Panulirus* spp., off southeast and

southwest coasts and the deep sea lobsters off southeast and southwest coasts; the robber crab *Birqus latro* in Andaman Islands; the Sea cucumber in the Gulf of Mannar, Palk Bay and the two Island systems; the king crab *Tachypleus gigas* of the West Bengal- Orissa coasts; the sea turtles *Chelonia, Eretmochelys*, etc and the Sea Cow *Dugong dugon* in the Gulf of Mannar and Palk Bay. The two marine ecosystems of coral reefs and the mangroves, which harbour a wide variety of finfishes, crustaceans and molluscs of commercial value along different parts of the coast and the Islands have reached a vulnerable stage. Besides, the ceaseless bottom trawling operations within about 50 m depth from the coast as well as pollution of coastal waters in certain places have been damaging the habitats, thus leading to various ecological problems. Suggestions are offered for the conservation and rational exploitation of marine resources through stricter enforcement of existing laws, setting up of sancturies and preserves, diversification of fishing, declaration of closed seasons for fishing and extension education for coastal human population.

1037. **James, P.S.B.R and D.B. James** 1994. Management of *Beche-de-mer* industry in India. *CMFRI Bulletin*, 46: 17-22.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstraact : Strategies for the management of the *Beche-de-mer* industry in India are the extension of fishing to new areas, processing of more valuable species, collection of biological information to regulate exploitation, restriction on size for capture, imposition of closed seasons, farming and sea-ranching and developing the industry in an organized manner which are discussed in detail in this paper.

1038. **James, P.S.B.R and D.B. James** 1994. Conservation and management of seacucumber resources of India. *CMFRI Bulletin*, 46: 23-26.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Conservation measures such as size regulation, closed seasons, sea ranching for seacucumbers are described in detail. The management policies for seacucumbers are also outlined.

1039. **James, P.S.B.R., S. Lazarus and G. Arumugam** 1994. The present status of Major Perch fisheries in India. *CMFRI Bulletin*, 47: 1-9.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The fisheries belonging to Families Serranidae, Lutjanidae and Lethrinidae are popularly known as Rock cods, Snappers and Pig-face breams respectively and are collectively termed as 'Major Perches', They form about 12% of the perch catch with an annual landing of 10,336 tonnes constituted by rock-cods (41.3%), snappers (35.4%) and pig-face breams (23.3%). Bulk of the catch comes from Tamil Nadu (42.4%), Maharashtra (18.9%) and Kerala (14.8%). Gujarat and Andhra Pradesh support respectively 9.5% and 9.3% of the catch. The remaining catch is shared by Karnataka, Orissa, Pondicherry and Goa. Lethrinids do not form appreciable fishery in the northern States and in the southern States there exists a multispecies fishery for all the three major perch groups. Trawl net accounts for 42% of the catch and the rest of the quantity is contributed by 'other mechanised' and non-mechanised units equally. The peak fishery season is from October to April. The results of the studies particularly on fisheries and fishing grounds carried out during various exploratory surveys and other cruises are discussed in this account.

1040. **James, P.S.B.R and B.K. Baskar** 1995. Studies on the biology, Ecology and Fishery of the seacucumber, *Holothuria scabra* from southeast coast of India. *CMFRI Spl. Publ.*, 61: 13-17.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Seacucumbers or Holothurians are the most important groups among the echinoderms which belong to the family Holothuriidae. Among the holothurians, *Holothuria scabra* is commonly available in the Gulf of Mannar, Palk Bay, Andaman and Nicobar Islands and they are used for the preparation of *Beche-de-mer. Beche-de-mer* is the product of the degutted, dried or smoked holothurian rich in protein content. This product is exported to Singapore, Hongkong and other Southeast Asian countries for use as an item of food. Annually India is earning a foreign exchange of about 20 lakhs rupees by exporting this product. Thus there is a good scope to develop the processing industry and to step up the production of *Beche-de-mer* in this country.

1041. **James, P.S.B.R and K.A. Narasimham** 1995. Molluscs. *Handbook on Aquafarming, MPEDA, Kochi*.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This part of the hand book deals with molluscan culture techniques.

1042. **James, P.S.B.R.** 1996. Sea farming - Key for diversification and enhancement of seafood exports from India. *Seafood Export J.*, 27(1): 5-11.

1043. **James, P.S.B.R.** 1996. Technologies and potential for sea farming in India. Part 2. *Aquacult. Mag.* 22(3): 30-43.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Milkfish (*Chanos chanos*) and mullets (*Mugil* spp.) were mostly cultured experimentally in saltwater ponds at Mandapam (southeast coast). Polyculture of *Chanos*, *Valamugil seheli*, *Liza macrolepis* and the white prawn, *Penaeus indicus* gave a production of 1,364.40-1,864.50 kg/ha. Mixed culture of *V. seheli* and *Chanos* yielded 1,422.2-1,600 kg/ha. Monoculture of *V. seheli* or *Chanos* did not yield a production of more than 358.20 kg/ha. At Tuticorin (southeast coast), an estimated production of 499-739 kg/ha/yr of milkfish, mullets and shrimp was obtained in polyculture. *Chanos* L. *macrolepis* and the mud crab, *Scylla serrata* gave production of 1,644 kg/ha/yr at the same place. In the derelict salt-pans, 857.47 kg/ha of milkfish were harvested in 14 months. Pen culture in a hyper saline lagoon at Mandapam was attempted for *Chanos*.

1044. **James, P.S.B.R.** 2000. Diatoms to whales: My research and field experiences in the Gulf of Mannar and Palk Bay in the vicinity of Mandapam, along the southeast coast of India. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp,* pp. 10-17.

Address : Kamaraj Road, Bangalore-42, India.

Abstract : I am exhilarated and immensely thrilled to narrate my research and field experiences in the Gulf of Mannar and Palk Bay in the 1960s, 1970s and 1980s for publication in the souvenir on the occasion of the Golden Jubilee Celebrations of the Recreation Club, CMFRI, Mandapam Camp which I also served as Secretary and President for some years in the past.

1045. **James, R.** 1990. Individual and combined effects of heavy metals on behaviour and respiratory responses of *Oreochromis mossambicus*. *Indian J. Fish.*, 37(2): 139-143.

Address : V.O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Sublethal effects of copper, zinc and cadmium on behavior and respiratory responses of *Oreochromis mossambicus* were studied individually and in combinations. Animals exposed to Cu + Zn and Cu + Cd combinations exhibited the strange phenomenon of behavioural changes than the animals exposed to copper or zinc or cadmium individually. The rates of oxygen consumption and opercular movements were increased when the fish were exposed to chosen metals individually and in combinations on first day while it was declined on 15th day. The results are discussed in the light of recent literature.

1046. **James, R., K. Sampath, V. Sivakumar and S. Manthiramoorthy** 1991. Individual and combined effects of heavy metals on survival and biochemistry of *Oreochromis mossambicus*. *Indian J. Fish.*, 38(1): 49-54.

Address : Tamil Nadu Agricultural University, Coimbatore, Tamilnadu, India.

Abstract : Toxic effects of copper, zinc and cadmium studied in *Oreochromis mossombicus* showed their LC_{50} at 96 hr as 2.0, 4.0 and 17.0 ppm respectively. Copper was most toxic followed by zinc and cadmium. Combination of Zn+Cd was less toxic than the combinalions of Cu+Cd and Cu+Zn. A significant decrease in protein, carbohydrate and lipid were observed in muscles, liver, gills and the whole body of *O. mossambicus* exposed to metals individually and combined except copper. Combinations of Cu+Cd, Cu+Zn and Zn+Cd markedly reduced the protein, carbohydrate and lipid in all tissues tested.

1047. **James, R., K. Sampath and G. Devakiamma** 1993. Accumulation and depuration of mercury in a catfish *Heteropneustes fossilis* (Pisces: Heteropneustidae) exposed to sublethal doses of the element. *Asian Fish. Sci.*, 6(2): 183-191.

Address : Department of Zoology, V.O. Chidambaram College, Tuticorin-628 008, Tamil Nadu, India.

Abstract : The accumulation and depuration of mercury in exposed *Heteropneustes fossilis* to two sublethal levels of the element have been studied as a function of time. Exposure produced a time- and dose-dependent increase in the concentrations of mercury in all tested tissues. Animals exposed to both concentrations accumulated significant amounts of mercury, levels in the tissues decreasing in the following order: liver > gill > muscle > intestine. On transfer of the fish to uncontaminated water after 9 days of exposure, the mercury concentrations

in tissues gradually declined. All tissues of catfish exposed to 0.01 or 0.03 ppm mercury recorded complete depuration of accumulated mercury over 37-123 days; individuals exposed to 0.03 ppm mercury took twice the time for excretion of the element as those exposed to 0.01 ppm.

1048. **James, R., K. Sampath and M. Narayanan** 1993. Effect of sublethal concentrations of ammonia on food intake and growth in *Mystus vittatus*. *J. Environ. Biol.,* 14(3): 243-248.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu India.

Abstract : Effect of sublethal concentrations of ammonia on food intake and growth were studied in *Mystus vittatus*. Rates of feeding, absorption and conversion showed a gradual decrease with increase in the concentration of ammonia. Not only the rates but also the gross and net efficiencies of conversion decreased gradually.

1049. **James, R and K. Sampath** 1994. Combined toxic effects of carbaryl and methyl parathion on survival, growth, and respiratory metabolism in *Heteropneustes fossilis* (Bloch). *Acta. Hydrobiol. Cracow.,* 36(3): 399-408.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, India.

Abstract : The 96 h LC_{50} values of carbaryl, methyl parathion individually and equitoxic of both were 19.99, 10.00, and 16.68 ppm respectively. Animals exposed to sublethal levels of carbaryl and methyl parathion individually and in combination significantly reduced the rates of feeding, absorption, and conversion and increased oxygen consumption and surfacing frequency. Methyl parathion was more toxic than carbaryl in individual concentration and in combination produced synergistic and antagonistic effects.

1050. **James, R., K. Sampath and S. Alagurathinam** 1994. Accumulation and prediction of lead elimination in *Oreochromis mossambicus* as a function of body size. *Acta Hydrobiol.,* 36(1): 115-124.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu India.

Abstract : Lead accumulation in the gill, liver, and muscle of *O. mossambicus* was time and dose dependent but decreased with body size. During recovery, the large size group eliminated the metal faster than the small sized one. Animals exposed to higher concentration of metal needed longer time for recovery.

1051. **James, R and K. Sampath** 1995. Sublethal effects of mixtures of copper and ammonia on selected biochemical and physiological parameters in the catfish *Heteropneustes fossilis* (Bloch). *Bull. Environ. Contam. Toxicol.,* 55(2): 187-194.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu India.

Abstract : Individual and combined effects of ammonia and copper on selected biochemical and physiological processes in the catfish, *Heteropneustes fossilis*, were examined.

1052. **James, R., K. Sampath, V. Sivakumar, S. Babu and P. Shanmuganandam** 1995. Toxic effects of copper and mercury on food intake, growth and proximate chemical composition in *Heteropneustes fossilis*. *J. Environ. Poll.,* 16(1): 1-6.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu India.

Abstract : *Heteropneustes fossilis* exposed to copper (750 ppb) and mercury (60 ppb) individually showed significant decrease in food consumption and growth. Animals exposed to copper + mercury (56 ppb) consumed and grew at the rate of 31.2 and 4.8 mg/g/day as against 37.8 and 11.4 mg/g/day in the control animals. The efficiency with which the food was converted into flesh also showed significant reduction. Exposure of animals to the media containing both copper and mercury produced about 50 and 40% reduction in the rate and efficiency of conversion compared with the animals exposed to metals individually indicating a synergistic effect of copper and mercury. Similar trend was observed in the biochemical composition also.

1053. **James, R and K. Sampath** 1998. Effects of feed and water quality (hardness) on growth in red swordtail *Xiphophorus helleri* fry. *Indian J. Fish.,* 45(3): 307-313.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu India.

Abstract : The effects of quality and quantity of food and water quality (hardness) on growth parameters such as body length and weight were studied in the fry of ornamental fish, red swordtail, *Xiphophorus helleri*. The fry when fed on *Artemia* nauplii grew faster than fry fed on beef liver, 35 % protein diet (1mm size), egg yolk and pasted maida. *Artemia* nauplii fed group showed 9 fold increase in growth rate compared to fry fed on egg yolk and pasted maida. There was no significant difference ($P<0.05$) in body length and weight of animals subjected

to 3/1 and 2/1 meal frequency; however, they elicited significant difference when compared with 1/1, 1/2 and 1/3 meal frequency. Fry reared in 1,018 ppm water hardness exhibited 6 times more growth in body weight than those reared in the lowest hardness of 76 ppm.

1054. **James, R and K. Sampath** 2002. Effect of different feeds on growth and fecundity in ornamental fish, *Betta splendens* (Regan). *Indian J. Fish.*, 49(3): 279-285.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu, India.

Abstract : Feed intake, conversion and fecundity of an ornamental fish *Betta splendens* were studied as a function of feed types. Fish fed with the mixed diet and liver showed higher feeding rates followed by those fed with *Artemia* sp. Conversion rate and efficiency were maximum in fish fed with earthworm followed by those with *Artemia* sp. Fish fed with pelleted feed did not sexually mature and spawn, whereas, those maintained on other groups spawned thrice during the experimental period. The fecundity of *B. splendens* fed with various types of feed decreased in the following order: *Artermia* sp. > mixed diet > liver > earthworm. The number of eggs laid increased with increase in the number of spawning in all groups. The perecentage hatching of eggs in fish fed with *Artemia* sp., mixed diet and liver did not vary much and it averaged 94.3%. Adult Artemia sp. and mixed diets were found suitable for enhancing reproductive performance in *B. splendens*.

1055. **James, R., K. Sampath and S. Velammal** 2003. Effect of methyl parathion on blood parameters and its recovery in a catfish, *Mystus keletius*. Indian J. Fish., 50(2): 191-197.

Address : Department of Zoology, V. O. Chidambaranar College, Tuticorin-628 008, Tamilnadu, India.

Abstract : Effects of sublethal concentrations (0, 50, 100 or 200 ppb) of methyl parathion (MP) on haematological parameters and their complete recovery were studied in a catfish, *Mystus keletius*. Exposure to sublethal levels of MP elicited time and dose dependent significant decrease in red blood corpuscle (RBC) count, haemoglobin (Hb) content, haematocrit (Ht) value leading to anaemia. Anaemic condition may be due to inhibition of erythropoiesis, destruction of matured erythrocytes and haemodilution. Total Leucocyte Count (TLC) and Erythrocyte Sedimentation Rate (ESR), on the other hand, exhibited time and dose dependent increase. The increase in TLC was due to the increase in the population of lymphocytes, neutrophils and basophils, however, thrombocyte population showed a gradual decline. During recovery treatments, the trends were reversed. Extrapolation of recovery showed that, on an average, the blood parameters (RBC, Hb or TLC) of fish exposed to 50, 100 or 200 ppb took 44, 40 or 39 days respectively for complete recovery.

1056. **Jameson, J.D., A. Murugan and P. Natarajan** 1982. Studies on the distribution pattern and morphometry of *Scylla serrata* (Forskal) along Tuticorin coast. *Seafood Export J.*, 14(4): 17-20.

Address : Fisheries College and Research Centre, Tuticorin, 628-003, Tamilnadu, India.

Abstract : This paper deals with the distribution pattern of the edible mud crab *Scylla serrata* in the coastal and estuarine regions of Tuticorin. Their occurrence and abundance were assessed from catches obtained for a period of one year through drag nets and indigenously made crab traps. Morphometric measurements were made and their relationships with reference to carapace width, live weight and sex ratio have been discussed.

1057. **Jamila Patterson, V. Deepak Samuel, J.K. Patterson Edward and Dan Wilhelmsson** 2006. Improving living conditions for Reef dependant fisher families in Tuticorin, Gulf of Mannar, Southeast coast of India. pp. 252-262. ***In***: *Coral reef degradation in the Indian Ocean.* CORDIO, Sweden. 285 pp.

Address : Sugandhi Devadason Marine Research Institute, 44 Beach Road, Tuticorin, Tamilnadu, India.

Abstract : The Tuticorin Coast is the most environmentally stressed coastal area in the Gulf of Mannar (Patterson, 2002). Population increases, lack of other employment opportunities, and low literacy levels force local villagers to depend mainly on the marine resources that can be harvested from around the four coral reef fringed islands off the coast. As most of the fishermen do not have adequate financial support for large vessels, they are restricted to reef areas that are easily accessible with small boats. Strained by decreasing fish catches, they are often compelled to use more effective and also destructive fishing methods, which reduce the productivity of the reefs even further. Overfishing and the use of destructive fishing methods have been prevalent for many years. Coral mining has been practiced for the past several decades, and many poor fishermen are involved in this illegal practice for their daily livelihood (Patterson, 2002). The number of boats involved in mining varies with the fishing season. Although this practice is now considerably less common, it still persists. Cyanide fishing is used to catch reef fishes and the use of various types of destructive fishing nets such as beach seine nets and trawl nets are causing harm to the benthic environment in Tuticorin.

1058. **Jayachandran, P., G. Sukumaran and G. Jeyasekaran** 1988. Utilisation of the edible oyster, *Crassostrea madrasensis* - Preparation of certain value added products. *CMFRI Bulletin*, 42(2): 387-390.

Address : Department of Fishery Technology, Fisheries College, Tuticorin, Tamilnadu, India.

Abstract : A variety of new products have been developed with the edible oyster. *Crassostrea madrasensis* and comparative study of their storage characteristics is reported. Of the different types of products developed oyster soup, Oyster nectar, oyster curry and oyster pickle will have export potential, as these items are popular in western countries. In addition to the above mentioned products. oysters canned in brine, oil etc., have been prepared and it is hoped that there will be a good market for these products among people especially in urban areas. The products can either be canned or frozen and preserved for reasonable storage period.

1059. **Jayakumar, K.** 2005. Studies on corals of Gulf of Mannar: Monitoring Bio-Physical status and reef fishes. Madurai Kamaraj University, *Ph.D. Thesis*. 219 pp.

Address: Centre for Marine and Coastal Studies, School of Energy Environment and Natural Resources, Madurai Kamaraj University, Madurai – 625 021, Tamilnadu, India.

Abstract: The worldwide decline of coral reefs calls for an urgent reassessment of current management practices in the Marine Protected Areas such as the Gulf of Mannar Marine Biosphere Reserve. In this study, extensive underwater surveys on the corals and reef fishes were carried out for a period of 7 years from 1996 to 2002 in the Gulf of Mannar. Stress was given to assess the diversity of corals and their associated ornamental fishes, their distribution, Bio-Physical Status, and the impacts caused by coral bleaching phenomena and subsequent recovery and water quality of the reef areas in the Gulf of Mannar. The present study recorded 62 species of corals divided among 24 genera and 10 families around the 21 islands (of the four groups of islands) in the Gulf of Mannar. Acroporidae was found to be the dominant coral family followed by Faviidae. The present investigation brought out information on the less studied reef associated ornamental fishes, which can contribute to export fishery. The major reef fish families recorded during the present study were Chaetodontidae, Pomacentridae, Labridae, Acanthuridae, Apogonidae, Holocentridae, Lethrinidae, Mullidae, Carangiidae and Tetraodontidae in the 21 islands of the Gulf of Mannar. Salinity values obtained during the present study fluctuated between 26.67 ppt and 36.45 ppt in the surface water in all the study sites. The minimum values were recorded during the Post-monsoon season and the maximum values were observed during the summer season. The low concentration of dissolved oxygen was observed during the pre-monsoon season and the highest concentration was recorded during the post-monsoon season. The highest dissolved oxygen value of 5.59 ppm was recorded at Manoliputti island in January 1997 and the minimum concentration of dissolved oxygen was 3.18 ppm as observed at Upputhanni island. The maximum concentrations of phosphate, viz., 0.28 $mg.l^{-1}$ and 0.23 $mg.l^{-1}$, were recorded around Vaan and Appa islands in Tuticorin group and Keezhakkarai group respectively during the monsoon period. The values of dissolved silicate fluctuated from 1.14 to 26.58 $mg.l^{-1}$ in all the four representative islands in the Gulf of Mannar. The lowest concentration of dissolved nitrate was recorded as 0.52 $\mu g. l^{-1}$ during summer and the highest concentration of 3.65 $\mu g. l^{-1}$ was found during monsoon season. Low nitrite concentration was recorded as 0.01 $\mu g. l^{-1}$ during summer and pre-monsoon seasons and the maximum concentration of 0.28 $\mu g. l^{-1}$ was recorded during monsoon and post-monsoon. The maximum gross primary productivity was estimated as 177 mg C/m^3/hour and the minimum was 20 mg C/m^3/hour. The volume of zooplankton estimated in the Gulf of Mannar during the present study ranged from 1.9 ml/l to 8.4ml/l. The long-term bio-physical monitoring of corals around the 21 islands in the Gulf of Mannar undertaken during 1996 to 2002 provided an opportunity to study both the 1998 and 2002 events of bleaching. A comparison therefore has been made between these events with reference to their impacts on the reefs. The live coral covers of the four groups of islands were similar with only slight variations and the maximum percentage covers of live corals occurred during the pre-bleaching period of 1996 (66%). This scenario changed after the 1998 coral bleaching that caused a reduction in the overall mean percentage of live coral cover. The present study revealed 53% coral bleaching in the Gulf of Mannar during 1998 and 31% during 2002. In acute cases, the above coral genus had suffered severe mortality, which was noticed during the post-bleaching surveys in the year 1999 and recorded under the life form category (recently) dead coral with algae. As much as 7% of overall coral mortality due to the bleaching phenomenon was recorded in the Gulf of Mannar during the 1998 bleaching and such mortality recorded was 2% in the 2002 bleaching. The live coral cover slowly increased during the subsequent post-bleaching period of 1999 and the same pace continued till the year 2001 in all the four groups of islands indicating good recovery. However, it decreased again to a low level mainly because of the recurrence of bleaching in 2002. Sea surface water temperature was high during the summer season (33.4°C June 1998 in Appa island) and low (25°C January 2000 Vaan island) during the Post-monsoon season corresponding with the atmospheric temperature. Reef corals are very sensitive to sea surface water temperatures outside their normal range. Elevation of temperature of 1°C above the long-term monthly summer average is enough to cause coral bleaching in many dominant coral species.

1060. **Jayamani, K.** 2002. Status of organic load in coastal waters of chosen sites in the Gulf of Mannar and Palk Bay. *M.Phil., dissertation* submitted to Madurai Kamaraj University. 140 pp.
Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai-625 021, India.
Abstract : Maintaining the quality of coastal water is the most important one for man since it is directly or indirectly linked to his life. Coastal waters of Gulf of Mannar become polluted due to the activities in ports and harbors, sewage discharge from human settlements along the coast and industrial effluents. Disposal of wastewater and industrial effluents into the oceans will increase the organic pollutant load in the coastal environment. The present investigation monitored the organic pollution load in coastal waters of Rameswaram, Tuticorin and Pudhmadam. Physico-chemical and microbial analyses were done to determine the water quality. Seawater samples were collected from the southeast coast of India from six stations at periodic intervals and analysed. Samples were collected at fortnightly intervals from different areas to assess the coastal water quality in the southeast coast of India. The physico-chemical parameters such as Temperature, pH, Salinity, Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, Total Organic Carbon and Total kjeldahl nitrogen were estimated. Microbial analysis was done using standard methods. For statistical analysis of the physico-chemical parameters and microbial analysis, ANOVA was done to see variations if any from the control station. Regression analysis was done to see the relationship between physico-chemical parameters and the organic load and microbial population.

1061. **Jayanth, K., G. Jeyasekaran and R. Jeya Shakila** 2001. Biocontrol of fish bacterial pathogens by the antagonistic bacteria isolated from the coastal waters of Gulf of Mannar, *Bull. Eur. Assoc. Fish. Pathol. Weymouth,* 21(1):12-18.

Address : Fisheries College & Research Institute, Tamilnadu Veterinary and Animal Sciences University Tuticorin 628008, Tamilnadu, India.

Abstract : Marine bacteria were isolated from seawater, sediment, seaweeds, bivalves and submerged substrates of Tuticorin Bay of Gulf of Mannar, India. Marine pigmented bacteria were screened for antagonistic activity. Of the 166-pigmented bacterial strains isolated, 62 showed antibacterial activity against the gram-positive indicator organisms viz., *Micrococcus*, *Lactobacillus* and *Arthrobacter*. Alteromonas was found to be the dominant antagonistic marine bacteria and it exhibited a wide antibacterial spectrum against various fish/shrimp bacterial pathogens viz. *Aeromonas hydrophila, A. sobria, Vibrio alginolyticus, V. harveyi* and *V. fischeri*. The other dominant antagonistic marine bacteria were *Flavobacterium*, which exhibited greater inhibitory activity against *A. sobria*. One strain of Alteromonas (A8) showed greater antagonism against fish and shrimp bacterial pathogens when compared to other strains, and it could be used as biocontrol agent in the aquaculture industry.

1062. **Jayanth, K., G. Jeyasekaran, R. Jeya Shakila and S.A. Shanmugham** 2002. Isolation of marine bacteria inhibitory to shrimp bacterial pathogens. *Indian J. Fish.*, 49(3): 235-239.

Address : Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tuticorin-628 008, Tamilnadu, India.

Abstract : Pigmented bacteria from seawater, sediment, seaweeds, bivalves and submerged substrates from Tuticorin coast were screened for the antagonistic activity. Of the 166 strains isolated, 15 showed inhibitory activity against shrimp bacterial pathogens. *Alteromonas* was the antagonistic marine bacteria and it exhibited a wide antibacterial spectrum against various shrimp bacterial pahtogens viz., *Vibrio harvyi*, *V. fischeri* and *V. alginolyticus*. One strain of *Alteromonas* (A6) showed greater antagonism against the shrimp bacterial pathogens. Results suggest that these antagonistic marine bacteria could be used as biocontrol agents in the shrimp culture systems.

1063. **Jayaprakash, A.A., C. Kasinathan and N. Ramamurthy** 1993. On the conservation and management of marine turtles. *Mar. Fish. Infor. Serv. T & E. Ser.,* 123: 21-23.

Address : Central Marine Fisheries Research Institute, Mandapm Camp - 623 520, Tamilnadu, India.

Abstract : An account of management of marine turtles maintained in CMFRI Mandapam aquarium is given in this report.

1064. **Jayaprakash, A.A.** 2003. Whitebaits. ***In*** : *Status of exploited marine fishery resources of India* (eds.) Mohan Joseph and A.A. Jeyaprakash, CMFRI, Cochin, India. pp. 30-39.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The whitebaits that comprise a group of small pelagic fishes belonging to the genera *Encrasicholina* are widely distributed in the Indo-Pacific region. Altogether ten species have been found to occur in our seas. In

India, this resource contributes on an average to 64,000 t (1991-2000) forming 1.7-5.8% of the total marine fish landings in the country and unlike other anchovies (genera: Thryssa, Setipinna, Coilia and Thrissina), is mostly exploited from the southern maritime states. The landings of whitebaits from the southern states like Andhra Pradesh, Tamil Nadu, Kerala and Karnataka accounted for 75-97% of the total production of whitebait. The studies conducted on this resource by the UNDP/FAO Pelagic Fishery Project along the southwest coast of India from Ratnagiri to Tuticorin; and the investigations carried out by the Central Marine Fisheries Research Institute at various centres along the east and west coasts have indicated its fishery potential and provided valuable information on various biological aspects of the constituent species.

1065. **Jayaraju, N and K.R. Reddi** 1995. Foraminiferal ecosystem in relation to coastal and estuarine sediments of Kovalam-Tuticorin, south India. *J. Geol. Soc. India*, 46(5): 565-573.

Address : Sri Venkateswara University, Tirupati 517 502, Andhrapradesh, India.

Abstract : A total of 180 bottom water and sediment samples each were collected both in monsoon (1990) and premonsoon (1991) periods from coastal and estuarine environments of Kovalam-Kanyakumari-Tuticorin, South India. Fifty four benthic foraminiferal taxa were reported belonging to three suborders-Rotalina, Miliolina and Textularina. The fauna was thus related to ecological ingredients viz., salinity, organic matter, calcium and phosphate. Salinity showed an erratic relation whereas other parameters exhibited slight positive bearing with living crop in both the seasons. The living fauna have limited number of taxa with *Ammonia beccarii* and *Asterorotalia dentata* being dominant in both the seasons. Faunal density, diversity and distribution increases gradually towards Tuticorin. Interplay of ecological parameters coupled with substrate character could be the reason in faunal abundance and diversity along the east coast. The results lead to the conclusion that the type and size of the substrate is more important in regulating the forminiferal density and diversity in the study area than mineralogy of the sediment. Investigations reveal that the monsoon season is more congenial than premonsoon season to the foraminifera. The provenance of the sediment is a metamorphic terrain dominated by Precambrian gneisses, schists and ferruginous quartzites belonging to Peninsular shield.

1066. **Jayaraju, N and K.R. Reddi** 1996. Impact of pollution on coastal zone monitoring with benthic foraminifera of Tuticorin, southeast coast of India. *Indian J. Mar. Sci.*, 25(4): 376-378.

Address : Department of Geology, Sri Venkateswara University, Tirupati-517 502, Andhrapradesh, India.

Abstract : Magnitude of corrosive effect, lower than normal ornamentation sutural thickenings, pores enlargement and widening of apertures in foraminifera were taken as indices of pollution impact on the coastal zone of Tuticorin. Pollution causes reduced diversity with a decrease in foraminiferal population. Moreover, there is a reduction in size followed by test wall thickening Ammonia and Florilus and dispersal and dilution of the pollutants resulting in faunal abundances. The effluents effect presents morphological anomalies like erosion along peripheries, abnormal growth of the end chambers inferred dissolution and consequent destruction of small thin walled biota.

1067. **Jayaraju, N and K.R. Reddi** 1996. Factor analysis of benthic foraminifera from coastal and estuarine sediments of Kovalam-Tuticorin, South India. *J. Geol. Soc. India*, 48(3): 309-318.

Address : Department of Geology, Sri Venkateswara University, Tirupati - 517 502, Andhrapradesh, India.

Abstract : This study investigates the present faunal geographical boundaries and environmental limits of foraminifera in the southeast coast of India. Ninety samples were examined. The raw data of foraminiferal population was analysed with the R-mode factor analysis program. Twelve factor assemblages, explaining 74% of the observed variance emerged from this test. The statistically most important assemblage is *Ammonia beccarii*, *Asterorotalia dentata*. The last assemblage is represented by *Rectobolivina raphana*. These assemblages reflect the hyposaline to hypersaline conditions and sandy to muddy sand substrate environment. The cross plot of the first two factors shows the separation of two groups as lower, which is dominated by Miliolids and seconded by Rotaliids and upper group is predominately represented by Rotaliids. Physico-chemical parameters could be the reason for the separate grouping of the species.

1068. **Jayaraju, N and K.R. Reddi** 1999. Benthic foraminifera - Substrate relationship at the Southernmost Coast of India. *Indian J. Earth Sci.*, 26(1&4): 25-36.

Address : Department of Geology, Sri Venkateswara University, Tirupati-517 502, Andhrapradesh, India.

Abstract : A total of 180 bottom sediment samples were collected in monsoon and premonsoon from Kanniyakumari to Tuticorin. The sediment samples were studied for their sediment - type, species variation and

abundance. The faunal density and diversity were related to nature of substrate in both seasons. The study revealed that the marine benthic foraminifera which live on the sea floor or in the upper most few millimetres/ centimetres of the bottom sediments are governed by the type and texture of bottom sediment and hydrography of the bottom water masses rather than water depth which is virtually a static variable. Grain-size analysis showed that most of the sediments are well sorted to moderately sorted. The texture of the sediment in monsoon and premonsoon is mainly silty sand (44.4%; 35.5%), muddy sand (30%; 22.3%) and sand (25.67%; 42.4%) respectively besides small amounts of shell fragments. Seasonal sediment type variation may be attributed to the estuarine environment where appreciable flood water during monsoon is anticipated. Among 54 taxa recognised only *Ammonia beccarii* and *Asterorotalia dentata* are unaffected by subtle changes wrought in the sediment environment viz., nature and size of the sediment and therefore are ubiquitous and cosmopolitan. The most accommodative substrate for higher foraminiferal crop in both the seasons appears to be silty sand folowed by muddy sand. The fine-grained sediment and weaker currents could be associated with ample populations and luxuriant growth of the microbiota during monsoon.

1069. **Jayaraman, R.** 1954. Seasonal variations in salinity, dissolved oxygen and nutrient salts in the inshore waters of the Gulf of Mannar and Palk Bay near Mandapam (S. India). *Indian J. Fish*., 1(1&2): 345-364.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Data on the seasonal variations is salinity, dissolved oxygen and nutrient salts in the inshore waters of the Gulf of Mannar and Palk Bay between the years 1950-53 have been presented and discussed. Salinity shows a regular seasonal cycle corresponding to the Southwest and Northeast monsoons. Dissolved oxygen content values are steady during most of the year and the surface-bottom differences in the oxygen content are not quite appreciable. The oxygen values are far below the saturation limit. Phosphates are low and do not show much seasonal variation. Nitrates show wider variations due probably to the activity of the denitrifying bacteria. Silicates show the usual inverse relationship with salinity except during the period, June-October in the year 1952. It is suggested that there is a possible association of these conditions with the swarming of Noctiluca observed during the same period.

1070. **Jayaraman, R., P. Selvaraj, R. Senthilathiban and R. Suresh** 1988. Fisheries economics research in India- A review. *CMFRI Spec. Publ.,* 40: 22.

Address : Fisheries College and Research Centre, Tuticorin - 628 008, Tamilnadu, India.

Abstract : India is endowed with abundant fishery resources. The declaration of Exclusive Economic Zone (EEZ) in 1971 provided opportunities as well as challenges in utilising these resources optimally. However, the optimal utilisation of fishery resources calls for the inter-disciplinary R&D efforts. Fisheries economics is an important area of education and research and it is inevitable for the optimal utilisation and management of fishery resources. A review is made of various studies in fisheries economics carried out in India, discussing the aspects covered in these studies critically and suggesting future lines of research.

1071. **Jayaraman, R., J.P. Sai, K.R.R. Babu, V.S. Rao and K. Joshua** 1988. Extension service for prawn culture. *CMFRI Spec. Publ.,* 40: 78.

Address : Marine Products Export Development Authority, Regional Centre (Prawn Farming), Machilipatnam 521 001, Andhrapradesh, India.

Abstract : The technology of prawn culture in India is still traditional, but adoption of semi-intensive prawn culture technology is increasing in several places notably in West Bengal, Kerala, Andhra Pradesh and Orissa. The production from such culture practices is estimated to be 15,000-17,000 tons/year, accounting for about 5% of the total prawn production in India. The technology of scientific prawn culture is now available. Though steps are being taken to motivate and encourage the fishfarmers to take up prawn culture on scientific lines to increase their income, lack of an appropriate and proper extension network is felt to be a major handicap in the field. A review is made of the various extension services available for taking up prawn culture by the fishfarmers, identifying the pitfalls and proposing a working fisheries extension programme for prawn culture in India.

1072. **Jayaraman, R., M. Chinnadurai, S. Narayanan, R. Senthilathiban, R. Suresh, P. Selvaraj and N. Durairaj** 1988. Strategies for production of marine fisheries and market development for Indian marine resources. *CMFRI Spec. Publ.,* 40: 88.

Address : Marine Products Export Development Authority, Regional Centre (Prawn Farming), Machilipatnam 521 001, Andhrapradesh, India.

Abstract : The non-optimal utilization of Indian marine fisheries resources has led to concentration of fishing effort on a few high-unit-value species and negligible harvest and utilization of other species that are abundantly

available. Further, the marine fish production has been showing only gradual increase for the past 15 years. The supply of marine fish fell short of demand by about a million tonnes in 1985. Adoption of appropriate conservation/ management practices for the heavily and indiscriminately exploited capture fisheries, exploitation of other potential marine fisheries, and deepsea fishing are some measures that could step up marine fish production. Further the potential of coastal aquaculture in supplementing marine fish production has not been fully utilized in India.

1073. **Jayaraman, R., P. Selvaraj, J.V. Kumar and R.K. Ramkumar** 1988. An economic analysis of trends in the export of Indian marine products. *CMFRI Spec. Publ.,* 40: 89.

Address : Marine Products Export Development Authority, Regional Centre (Prawn Farming), Machilipatnam 521 001, Andhrapradesh, India.

Abstract : Export of marine products has increased dramatically from Rs. 400 million in 1971 to about Rs. 4000 million in 1985-86. The share of shrimps in the Indian marine products has increased steadily since their introduction to international market in 1971 and is about 60% in terms of quantity and about 83% in terms of value of total marine products exports from India during 1985-86. The development of Indian marine fishing industry is claimed to be largely due to the development of shrimp fisheries as the demand for them seems to be on the increase. Based on the results of the analyses, projections of future exports were made for 1985, 1986, 1987 and 1988. The projections for 1985 were found to agree with those reported figures for 1985 and it is suggested that these models can be used by the policy planners and concerned administrators.

1074. **Jayaraman, R.** 1994. Export of marine products does not affect domestic consumption. *Seafood Export J.,* 25(16): 23-29.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : With the increase in exports of fish products in the last few years from India, at some corners a fear exists that it may affect meeting domestic market needs. Supporting the argument with data on shrimp landings and export, share of marine fish exports in marine fish production, etc., the author wishes to stress that this fear is unfounded and need to be allayed.

1075. **Jayasankar, P.** 1989. Some observations on the biology of the blotched croaker *Nibea maculata* (Schneider, 1801) from Mandapam. *Indian J. Fish.,* 36(4): 299-305.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Some aspects of the biology of *Nibea maculata* from Mandapam waters (Tamil Nadu, India) are studied. Regression coefficients in the length-weight relationships of females and males of *N. maculata* show significant difference between them and both significantly differ from the cubic value. The spawning season is from April to August and the females appear to perform two spawning acts during this period. Relative condition factor is apparently related to the reproductive cycle. Females and males attain first maturity at 185 and 167 mm, respectively. Fecundity show wide fluctuations from 21,584 to 475,043 with high correlation to ovary weight. Overall sex-ratio shows predominance of females.

1076. **Jayasankar, P.** 1990. Some aspects of biology of the white-spotted spine-foot, *Siganus canaliculatus* (Park, 1797) from the Gulf of Mannar. *Indian J. Fish.,* 37(1): 9-14.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The regression coefficients of length-weight relationships of males and females of *Siganus canaliculatus* are not significantly different and therefore a common regression is recommended. The regression coefficient does not significantly depart from 3. The spawning season is from November to February in the Gulf of Mannar. The female attains first maturity at about 177 mm length. Fecundity varies from 33,711 to 284,516 and bears good correlation with ovary weight.

1077. **Jayasankar, P.** 1990. Length-weight relationship and relative condition factor in *Otolithes ruber* (Schneider, 1801) from the Gulf of Mannar and Palk Bay. *Indian J. Fish.,* 37(3): 261-263.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The regression coefficients of length-weight relationship in females and males *Otolithes ruber* showed no significant difference and a common regression is recommended. The regression coefficients depart significantly from 3. Total length-relative condition factor curve showed first major inflexion at 200 mm.

1078. **Jayasankar, P.** 1990. On the record of the largest specimen of the engraved catfish *Tachysurus caelatus*. *Mar. Fish. Infor. Serv. T & E. Ser.*, 103: 17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A large cat fish was landed by a commercial trawler at Rameswaram landing centre. The morphometric characters of the cat fish were discussed in detail.

1079. **Jayasankar, P.** 1991. Sillaginid fishes of Palk Bay and Gulf of Mannar with an account on the maturation and spawning of Indian sand whiting, *Sillago sihama* (Forsskal). *Indian J. Fish*., 38(1): 13-25.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In the Palk Bay and Gulf of Mannar, 6 species of the family Sillaginidae occurred: *Sillago* (Silaginopodys) *chondropus*, *Sillago* (Sillago) *sihama*, *Sillago* (Sillago) *indica, Sillago* (Parasillago*) vincenti*, *Sillago* (Parasillago) *argentifasciata* and *Sillago* (Parasillago) *soringa*. A key to the identification of these species is given and their morphometric and meristic characters tabulated. *S. sihama*, the most dominant sillaginid species in this region, was a prolonged breeder. The spawning season of this species extended from July to February, with peak spawning activity during July to November. Lengths at first maturity of females and males were 179 and 159 mm respectively. Fecundity varied from 6,956 to 48,373 and showed high correlation with length, body weight and ovary weight of the fish. Overall sex ratio indicated predominance of females. Length-related sex ratio showed significant dominance of males till 170 mm and that of females above this length.

1080. **Jayasankar, P.** 1991. Length-weight relationship and relative condition factor in *Sillago sihama* from Mandapam region. *Indian J. Fish.*, 38(3): 183-186.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Sillago sihama* forms about 60% of all sillaginids commercially exploited in the Gulf of Mannar and Palk Bay landing centres of Ramanathapuram district in Tamil Nadu (Jayasankar, 1991). Only a preliminary study on the length-weight relationship and condition factor of *S. sihama* was made by Radhakrishnan (1957) from Mandapam area. Later work (Jayasankar, 1991) showed a marked difference from Radhakrishnan's results on condition factor. This study re-examins the issue.

1081. **Jayasankar, P and M. Bose** 1991. Unusually heavy landings of juvenile cat fishes at Rameswaram. *Mar. Fish. Infor. Serv. T & E. Ser.*, 112: 11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The length frequency distribution of juvanile catfish landings at Rameswaram Coast during 07-12-90 to 12-12-90 by mechanized trawlers are given in detail.

1082. **Jayasankar, P.** 1992. Revival of ribbonfish fishery in Mandapam region. *Mar. Fish. Infor. Serv. T & E. Ser.*, 118: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Ribbonfish landings at Rameswaram Verkottil landing center during 1980-91 are discussed in this report.

1083. **Jayasankar, P and M. Bose** 1992. Observation on catfish landings by pair trawlers at Rameswaram. *Mar. Fish. Infor. Serv. T & E. Ser.*, 118: 17-18.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This paper reveals the detatils of catfish fihery during 1988-92 off Rameswaram region.

1084. **Jayasankar, P and K. Alagarswami** 1993. Studies on the reproduction of Indian sand whiting *Sillago sihama* (Forskal) (Sillaginidae, Percoidei). Mariculture Research under the Postgraduate programme in mariculture. Part-5. (*eds*) K. Rengarajan, A.N. Prathibha, V. Kripa, N. Sridhar and M. Zakhriah. *CMFRI Spec. Publ*., 56 : 77-82.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Some information on the biology notwithstanding, a comprehensive knowledge on maturation and gametogenesis in sillaginids is lacking. Further, their taxonomic status is largely conjuctural. Keeping these lacunae in view, investigations on different aspects of reproduction in *Sillago sihama* along with a systematic study of the family Sillaginidae from the Palk Bay and Gulf of Mannar were taken up for 1) Systematic study of

sand whitings from the Palk Bay and Gulf of Mannar, 2) Histological, histochemical and biochemical studies on gonadal maturation, 3) Preliminary studies on the induced maturation and spawning.

1085. **Jayasankar, P and S. Krishna Pillai** 1994. Observations on the fishery of croakers (Sciaenidae) in the trawling grounds off Rameswaram Island. *Mar. Fish. Infor. Serv., T & E Serv.,* 131: 11-15.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The trawling grounds off Rameswaram Island were observed periodically and the fish landing data were assessed and discussed.

1086. **Jayasankar, P.** 1995. Population dynamics of big-eye croaker *Pennahia macrophthalmus* and blotched croaker *Nibea maculata* (Pisces/ Perciformes/ Sciaenidae) in the trawling grounds off Rameswaram Island, east coast of India. *Indian J. Mar. Sci.,* 24: 153-157.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Growth parameters of *Pennahia macrophthalmus* and *Nibea maculata* were estimated. Estimated lengths on completion of 1, 2 and 3 years were 173,216 and 228 mm for *P. macrophthalmus* and 193,253 and 273 mm for *N. maculata*. Total mortality rates (Z) ranged from 2.7 to 5.8 and from 3.35 to 5.91, while natural mortality (M) ranged from 1.84 to 2.38 and from 1.66 to 2.70 respectively for *P. macrophthalmus* and *N. maculata*. Length and age at first capture were 97 mm, 0.35 y and 124 mm, 0.48 y for the two species, which were less than the corresponding parameters at first maturity in both of them. Highest yield could be obtained when age at first capture was 0.45 in *P. macrophthalmus* and 0.60 in *N. maculata*.

1087. **Jayasankar, P.** 1997. Population parameters of *Pennahia anea* and *Nibea maculata* in the Palk Bay / Gulf of Mannar area, India. *NAGA.,* 29(2) : 46-48.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1088. **Jayasankar, P., M. Anand and J. Anandan** 2000. Bottom trawling - A potential threat to the ecology and benthic communities of Gulf of Mannar. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp. 92-94.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : It is now widely appreciated that an important aspect of protecting fish stocks is the conservation of the habitats and animal communities on which those stocks depend. Over the years, fish catching techniques and devices have undergone remarkable variations, every time improving their efficiency. Trawl net exploits fish and other organisms from the bottom of the seas. Bottom trawls are sometimes referred to as bulldozers mowing down fish and destroying the structure that provides fish stocks with the necessary environment.

1089. **Jayasankar, P., P.C. Thomas, M.P. Paulton and J. Mathew** 2004. Morphometric and genetic analyses of Indian mackerel (*Rastrelliger kanagutra*) from Peninsular India. *Asian Fish. Sci.,* 17(3&4): 201-215.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A holistic approach, combining one phenotypic and two genotypic methods, was adopted to analyze possible population differences in Indian mackerel (*Rastrelliger kanagurta*) from selected centers in the East and West coasts of India. Principal component analysis of truss landmark variables revealed that the area encompassing depth between the origin of anal and origin of second dorsal and caudal peduncle depth has high component loadings. Bivariate scatter plots of principal components showed a great degree of morphometric homogeneity between Indian mackerel populations from Mandapam, Kochi and Karwar. Clustering pattern of polypeptide markers revealed relatively greater population homogeneity among Mandapam fish (58%) than Kochi samples (33%). The three random amplified polymorphic DNA (RAPD) primers used in the present study have generated a total of 59 loci varying in size from 560 to 4500 bp. None of the populations from Mandapam, Kochi and Karwar showed RAPD fragments of fixed frequencies, to be treated as population-specific markers. No significant differences were found among the three populations.

1090. **Jayasree, V and A.H. Parulekar** 1977. The ecology and distribution of alcyonaceans at Mandapam (Palk Bay and Gulf of Mannar) South India, *J. Bomb. Nat. Hist. Soc.*, 94(3): 521-524.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India

1091. **Jayasree, V., C.G. Naik and Prabha Devi** 2004. Effect of soft coral extracts on isolated tissues. *Proceedings of the National Seminar on New Frontiers in Marine Bioscience Research, January 22-23, 2004*. pp. 41-45.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

Abstract : Methanolic extracts of eleven species of soft corals collected from Lakshwadeep Islands in the Arabian Sea and Mandapam in the east coast of India were tested for their antispasmodic, antiarrhythmic and oxytocic activity on guinea pig ileum, atrium and uterus respectively. *Lobophytum schoedei* caused a decrease in nictotine induced concentration. *L. denticulatum* and *Sinularia leptoclados* caused a dose-dependent decrease in all spasmogens tested (acetylcholine, histamine, 5-hydroxytryptamine, nicotine and barium chloride). *Cladiella pachyclados* and *C. kremfi* collected from Kalpeni and Kadamath Islands showed difference in activity. None of the soft corals exhibited any anti-arrhythmic property on guinea pig atrium.

1092. **Jegannath, N.** 1990. Results of demersal resources survey along south west coast and Gulf of Mannar between lat. 7° N. and 10° N. *Resour. Infor. Ser. Fishery Survey of India, Bombay,* 1(2&3): 7-10.

1093. **Jegannatha Rao, M., P.V. David and T. Shanmugaraj** 1998. Community-Based Marine Resources Management in the Gulf of Mannar Biosphere Reserve. *BOBP News, June'98*.

Address : Gulf of Mannar Marine Biosphere Reserve Project, Ramnad, Tamilnadu.

Abstract : The Gulf of Mannar is the first marine biosphere reserve not only in India, but also in Southeast Asia. Designated as national biosphere reserve, the Gulf of Mannar and its 3,600 species of plants and animals constitute a biologically rich coastal region - one of the richest in all of mainland India. Management of the Gulf of Mannar Marine Biosphere Reserve (GOMMBR) is presently being strengthened through a project sponsored by GEF (Global Environment Facility), UNDP and the Government of India. The primary goal of this project is to improve the welfare of local, regional and national communities while restoring the ecological qualities of the area.

1094. **Jesi Selvarani** 2001. Whelk processing industry at Thirespuram- Tuticorin. *Mar. Fish. Infor. Serv., T&E Ser.,*167:11-12.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Tuticorin located on the southeast coast of India with its rocky and reedy grounds in the Gulf of Mannar affords vast opportunities for the exploitation of a variety of finfishes, shellfishes and molluscan resources.

1095. **Jeyabaskaran, R.** 1996. Monograph on invertebrates and vertebrates in Gulf of Mannar, Ministry of Environment and Forests. p. 96.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1096. **Jeyabaskaran, R and S. Ajmalkhan** 1996. Regeneration of coral reefs in artificial substrates of Tuticorin harbour. *Paper presented at National Symposium on Recent Advances in Biological Oceanography, NIO, Goa, India* during May 27-30, 1996.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1097. **Jeyabaskaran, R and S. Ajmalkhan** 1996. Studies on biodiversity and man made perturbations in coral reef ecosystem of Keelakkarai coast, Gulf of Mannar. *Paper presented in the symposium on Coastal Zone management, Berhampur University, Orissa.*

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1098. **Jeyabaskaran, R and P.S. Lyla** 1996. Krusadai Island: Biologists' Paradise. *Seshyiana, ENVIS Newsletter*, 1(3):10.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1099. **Jeyabaskaran, R, D. Asir Ramesh and A.L. Paul Pandian** 1996. Distribution and abundance of molluscan

cryptofauna from Karaichalli Island, Gulf of Mannar, Southeast Coast of India. *Proc. 6th workshop of the Tropical marine mollusc programme*, Annamalai University, 12-20, 1995. pp.215-219.

1100. **Jeyabaskaran, R., P.S. Lyla and S. Ajmalkhan** 1996. Coral: The excellent bone graft material. *Seafood Export J.*, 27(5): 27-28.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1101. **Jeyabaskaran, R., P.S. Lyla and S. Ajmalkhan** 1996. Present status of Coral reefs of Gulf of Mannar Islands. *Seshyiana, ENVIS Newsletter*, 1(3): 11-12.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1102. **Jeyabaskaran, R.** 1997. Studies on biodiversity of brachyuran Crabs of Gulf of Mannar, Southeast coast of India. *Ph.D. Thesis*, Annamalai University, India. 147 pp.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1103. **Jeyabaskaran, R and S. Ajmalkhan** 1998. Biodiversity of crab resources. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*, MSSRF Publ. pp.150-155.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Gulf of Mannar Marine Biosphere Reserve is remarkable for its richness and variety of fauna and the inshore sea bottom forms an ideal habitat for the growth of fishes, which sustain good fishery. The earliest references of pearl fishery of Gulf of Mannar are the Singhalese records. According to the classical Singhalese writer "Mahawanso" pearls had been sent as presents by King Vijaya of Ceylon to his Indian father-in-law during 540-550 B.C. and again in 306 B.C. King Devanarnipiyatissa sent an envoy to India and the presents included eight Ceylon pearls. The pearl fishery and other faunal resources of this are finding a place in the great Tamil epics Shilapadikaram and Manimekalai which were probably written in the first or early second century A.D. Brachyuran crab resources, their diversity and management aspects are discussed in this paper in detail.

1104. **Jeyabaskaran, R and S. Ajmalkhan** 1998. Trapezian crabs: Bio-indicators for coral reef monitoring. *International society for reef studies (ISRS) meeting, Perpignen, France, September,* 11-14 (Abstract).

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1105. **Jeyabaskaran, R., P.S. Lyla and S. Ajmalkhan** 1998. Brachyuran crabs: Bio-indicators for coral reef monitoring and management. *Paper presented at seminar on status and protection of coral reefs (STAPCOR*), March 11-13, Kadamat Island, Lakshadweep.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1106. **Jeyabaskaran, R., S. Ajmalkhan and V. Ramaiyan** 1999. *Brachyuran crabs of Gulf of Mannar- a monograph.* CAS in marine biology, Annamalai University, Tamilnadu, India. 210 pp.

/address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

1107. **Jeyabaskaran, R and K. Venkataraman** 2000. Degradation of coral diversity and its causes in Gulf of Mannar (Southeast coast of India). *Paper presented at IX International Coral reef symposium, Bali, Indonesia on 22-28, October 2000.*

/address : Zoological Survey of India, Santhome, Chennai, Tamilnadu, India.

1108. **Jeyabaskaran, R and K. Venkataraman** 2000. Mass mortality of Trapezian crabs in coral reefs of Gulf of Mannar (south east coast of India). *Paper presented at IX International coral reef symposium, Bali, Indonesia on 22-28, October 2000.*

/address : Zoological Survey of India, Santhome, Chennai, Tamilnadu, India.

1109. **Jeyabaskaran, R., P.S. Lyla and S. Ajmalkhan** 2000. Biodiversity of brachyuran crabs associated with coral *Povana decussata* in Gulf of Mannar. *J. Ecol. Res. Biocon.,* 1 (2): 28-31.

/address : Zoological Survey of India, Santhome, Chennai, Tamilnadu, India.

1110. **Jeyabaskaran, Y., Daniel Sudhandra Dev, I. Nalluchinnappan and N. Radhakrishnan** 1983. On the growth of the pearl oyster *Pinctada fucata* (Gould) under farm conditions at Tuticorin, Gulf of Mannar. *Symp. on Coastal Aquaculture*, Cochin (India), 12-14 Jan 1980. Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part 2: molluscan culture. *MBAI*, Cochin, India. No. 6: 587-589.

Address: Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu, India.

Abstract: The growth of *Pinctada fucata* under farm conditions has been studied. The rate of growth is high during the first three months. The growth rate shows an inverse relationship to temperature, salinity and quantity of foulers settled on the oysters.

1111. **Jeyachandran, P.** 1979. Present situation of fisheries technology in India. Seminar on Fishery Technology Education, Kagoshima (Japan), 11 Jul 1979. Report of the seminar on fishery technology education, July 11 to August 1, 1979. Kagoshima Univ. Japan; Japan Int. Coop. Agency, Tokyo, Japan. pp. 70-82.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A brief report on the status of fisheries technology in India is presented. Information is given on: the assessment and management of fishery resources, the problems of induced breeding and aquaculture, the improvement of fishery techniques and fish processing and the socioeconomic strategy for fisheries development.

1112. **Jeyasekaran, G and K.V. Saralaya** 1991. Studies on the canning of white sardine, *Escualosa thoracata*. *Asian Fish. Sci.,* 4(2): 147-154.

Address : Fisheries College and Research Institute, Tuticorin 628 008, Tamilnadu, India.

Abstract : The suitability for canning of an underutilized, small, low-fat, high-protein pelagic marine fish of the species *Escualosa thoracata*, commonly known as the white sardine, was studied. Physical and chemical characteristics of the fish were examined and a suitable procedure for canning of “natural” and “oil-packed” products was developed. The canned products were highly acceptable in quality, being rated as good or excellent with respect to all the organoleptic attributes studied.

1113. **Jeyasekaran, G., M. Sasi, R. Jeya Shakila and S.A. Shanmugam** 2002. Effect of dry ice in preserving the fresh shrimps (*Penaeus semisulcatus*). *Indian J. Fish.,* 49(4): 397-403.

Address : Fisheries College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The effect of dry ice in preserving the shrimps showed that those packed in 50% dry ice remained in acceptable condition upto 9 days, whereas those packed in 20% dry ice along with 50% water ice resulted in a longer shelf life of 11 days. But, the shrimps packed with water ice (1:1) could remain for only 7 days. When shrimps were rated unacceptable, the TPC, psychrophilic and lactics counts were 10^6, 10^5 and 10^4 cfu/g, respectively, but the TMA-N and TVB-N were within the prescribed limits and Hx reached a maximum of 17.37 mg%. Shrimps preserved in combination of dry ice and water ice were found to have good quality characteristics.

1114. **Jeyasekaran, G., P. Ganesan, K. Maheswari, R. Jeya Shakila and D. Sukumar** 2004. Effect of delayed icing on the microbiological quality of tropical fish: Barracudas (*Sphyraena barracuda*). *J. Food Sci.,* 69(7): M197-M200.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Effect of delayed icing on the bacteriological quality of a commercially important tropical fish, barracuda (*Sphyraena barracuda*), was studied. Fish obtained from the fish-landing center of Tuticorin, India, were immediately brought to the laboratory and divided into 2 lots. One lot was immediately iced (II) and the other lot was left at ambient temperature (32 ± 2°C) for 6 h and then iced (DI). Immediate icing extended the shelf life of barracuda by 6 d. In II fish, the total bacterial count increased from 103 to 106 colony-forming units (CFU)/g; total lactics and total histamine formers appeared on day 7 and 3, respectively, and the total coliforms

were very low. While in DI fish, total bacterial count remained at 106 CFU/g. Total lactics, total histamine formers, and total coliforms were high.

1115. **Jeya Shakila, R., R. Lakshmanan, G. Jeyasekaran** 2002. Incidence of amine forming bacteria in the commercial fish samples of Tuticorin region. *Indian J. Microbiol*., 42(2): 147-150.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Incidence of biogenic amine forming bacteria in the commercial fish samples of Tuticorin region was investigated. The total bacterial load was found to be high in fresh shrimps (9.5×10^6 g^{-1}), which was 2-3 log more than in other fresh fishes, salt dried sciaenids and dried anchovies. The incidence of biogenic amine forming bacteria was high in fresh sardines, fresh tuna, salted sardines and lethrinids and dried anchovies. Histamine forming bacteria were recorded in higher proportion almost in all products tested except in fresh lethrinids, shrimps and dried shrimps, where it was nil. Cadaverine and putrescine forming bacteria were found to be high in fresh sardines, fresh shrimps, salted sardines and dried anchovies.

1116. **Jhingran, A.G and S. Paul** 1988. Planning for fisheries development - search for appropriate policy instruments. *CMFRI Spec. Publ.,* 40: 5.

Address : Central Inland Capture Fisheries Research Institute, Barrackpore - 743 101, West Bengal, India.

Abstract : The Indian fisheries economy for the last several years has been characterised by sluggish growth rates in production (3.5%), inadequate marketing infrastructure, demand and supply imbalances, inter-sectoral conflicts, insignificant contribution of deepsea fishing (1%), lack of diversification in export trade and apathetic entrepreneurship in offshore fishing. Unlike marine fisheries, inland fisheries have registered a higher growth rate of production. Despite imperfections of marketing system, land-based culture fisheries have been favourably placed. Fish Farmers Development Agencies (FFDAs) have brought 150,000 ha under scientific fish farming. Reservoirs (3 million ha) afford opportunities for enhancing inland fish production for augmentation of domestic availabilities. An examination is made of some of these areas so as to have a sound basis for the task of policy formulation for both marine and inland fisheries.

1117. **Job, S.V and K. Ramachandran Nair** 1959. Volume - Density changes in a marine catfish *Plotosus anguillaris* in different salinities. *J. Mar. Biol. Assoc. India,* 1(2): 131-138.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The changes in weight, volume and density of a marine catfish, *Plotosus anguillaris*(Bloch), of average weight of 5gm acclimated to salinities of 12.5, 30.4 and 40% on abrupt transfer to different salinities and within three hours of transfer are recorded. With a few exceptions, the data indicate that there is greater facility for water to enter the fish body than to leave it and the change either in the density or in volume is relatively greater on transfer from high to low salinity than in the opposite direction in a 5 gm fish. Even after prolonged acclimation this species is unable to maintain a volume independent of the environmental salinity. An instrument for measuring the volume of a small fish or other similar organism accurately, is described.

1118. **Joel, D.R., G. Sanjeeviraj, M. Venkataswamy and P. Natarajan** 1985. Prospects for coconut-cum-fish and prawn culture. *Seafood Export J.*, 17(5): 21-25.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Observations made concerning fish culture in a coconut farm in Tirunelveli District, Tamil Nadu in October 1978 are presented. Fish were cultured in trenches dug out between rows of trees; species cultured include*: Channa striatus, Ompok bimaculatus, Lates calcarifer* and *Mugil cephalus.* The aquaculture potential of the aquatic spaces in coconut and banana plantations in the coastal states of India are discussed in detail.

1119. **Joel, D.R., V. Sundararaj and G. Jegatheesan** 1988. Coastal zone management in fisheries development. *CMFRI Spec. Publ.,* 40: 90-91.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The shallow coastal zone and the adjoining regions assume greater significance in fisheries. The resource utilization of this narrow but productive zone is increasingly threatened due to a wide variety of factors as overfishing, dumping of sewage, oil and heavy metal pollution, reclamation of coastal land for agriculture, denudation of mangroves, unauthorised mining of corals for lime-burning, etc. The urgent need for an in depth study of the coastal ecosystem on fertility, productivity, potential and actual yields of fish is indicated for a rational management.

1120. **John, J.A.C., S. Murugadass and M. Peter Marian** 1993. Growth hormone study in aquaculturally important animals: Problems and prospects. *Proceedings of the National seminar on aquaculture development in India: Problems and Pprospects. 27-29 November, 1990*. (eds) P. Natarajan and V. Jayaprakas. Kerala Univ., Thiruvananthapuram, India. pp. 255-262.

Address : Institute of Artemia Research and Training, Madurai Kamaraj University Reserach Centre, Muttom 629 202, Kanyakumari Dist., Tamil Nadu, India.

Abstract : The practice of growth hormone application for food production has led aquacultural scientists to use growth hormone gene in several fish species. But, the expression and germ line transmission of the growth hormone gene has been successful in only a few cases. The success of growth hormone gene introduction, integration and expression varied with animals. The problems related to these aspects in different animal groups and the possible prospects are discussed.

1121. **John, K.R., N. Jayabalan and M.R. George** 1993. Impact of sublethal concentrations of endosulfan on the histology of *Cyprinus carpio* liver and kidney. *Proc. on Aquaculture Development in India- Problems and Prospects, Trivandrum (India), 27-29 Nov, 1990.* (eds) P. Natarajan and V. Jayaprakas, pp. 179-182.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Sublethal effects of the organochlorine insecticide-endosulfan on the histology of liver and kidney of the common carp *Cyprinus carpio* were investigated. 5, 10, 15, 20 and 25% of the 96 h LC_{50} value, 5.199 ppb, were the different sublethal concentrations tried. Extensive vacuolation of the cells, indistinct cell boundaries, loss of polygonal shape of the cells and degenerative necrosis were the histopathological changes observed in the liver. Kidney showed shrinkage of renal tubules and necrosis of the hemopoietic tissue. The alterations in the normal histology progressively increased as the duration of the exposure was extended at different sublethal concentrations. Effect of pesticide influx in the aquatic ecosystems is discussed.

1122. **John, K.R., M. Venkataswamy and V. Sundararaj** 1995. Monoculture, bispecies culture and composite culture of *Macrobrachium rosenbergii* and *M. malcolmsonii*. *J. Aquacult. Trop.*, 10(1): 37-41.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Three types of freshwater prawn culture trials, monoculture, bispecies culture, and composite culture, were carried out in earthen ponds of 500 m^2 and 1000 m^2 for a period of six months with uniform stocking density of 20,000/ha. The prawns and carps were fed at the rate of 3-5% of body weight daily with pelleted feed (25% protein) and conventional groundnut oil cake (GNOC) feed. The freshwater prawns performed better in composite culture ponds than in the other two types of trials.

1123. **Jonathan, M.P and V. Ram Mohan** 2003. Heavy metals in sediments of the inner shelf off the Gulf of Mannar, South East Coast of India. *Marine Poll. Bull.*, 46(2): 263-268.

Address : Department of Geology, School of Earth/Atmospheric Sciences, University of Madras, Chennai - 600 025, India.

Abstract : The Gulf of Mannar, located between India and Sri Lanka, is a shallow embayment of the Bay of Bengal. The gulf, which has been declared a bioreserve is a highly productive area endowed with rich marine fauna including corals.

1124. **Jonathan, M.P., V. Ram Mohan and S. Srinivasalu** 2004. Geochemical variations of major and trace elements in recent sediments, off the Gulf of Mannar, the southeast coast of India. *Environ. Geol*., 45(4) : 466-480.

Address : Department of Geology, School of Earth and Atmospheric Sciences, University of Madras, Chennai - 600 025, India.

Abstract : The Gulf of Mannar along the Tuticorin coast is a coral base of the southeast coast of India. To obtain a preliminary view of its environmental conditions, geochemical distribution of major elements (Si, Al, Fe, Ca, Mg, Na, K, P), trace elements (Mn, Cr, Cu, Ni, Co, Pb, Zn, Cd) and acid leachable elements (Fe, Mn, Cr, Cu, Ni, Co, Pb, Zn, Cd) were analyzed in surface sediment samples from two seasons. Geochemical fractionation confirmed the lithogenic origin of metals, which were mainly associated with the detrital phase. The sediments in the gulf are sandy with abundant calcareous debris, which controls the distribution of total and acid leachable elements. Enrichment factors relative to crust vary by a magnitude of two to three and the presence of trace metals indicates the input of Cr, Pb, Cd, Cu and Zn in both forms through industrial activities. Factor analysis supports the above observation with higher loadings on acid leachable elements and its association with $CaCO_3$. The increase in

concentration of trace metals (Cr, Pb, Cd, Cu, Co, Ni, Zn) along the Gulf of Mannar indicates that the area has been contaminated by the input from riverine sources and the industries nearby. The present study indicates that other sources should be evaluated in the long-term monitoring program.

1125. **Jones, S.** 1950. Observations on the bionomics and fishery of the brown mussel (*Mytilus* sp.) of the Cape region of Peninsular India. *J. Bombay Nat. Hist. Soc.,* 49: 519-528.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Brown Mussel fishing is a regular industry of considerable local importance along the rocky coastal tracts of Southern Travancore and the Tinnevelly District of Madras Province. From Kovalam near Trivandrum up to Cape Comorin, the 'Land's End' of India, along the west coast, and beyond as far as the Tinnevelly District on the east coast, the sea shore consists of frequent stretches of rock with intermittent beaches of sand. Several fishing villages nestle along these beaches and some as at Vizhinjam, Pulluvila, Poovar, Thengapatnam, Midalam, Kolachal, Muttam, Manakudi, Cape Comorin and Leepuram are very large ones, each consisting of hundreds of families carrying on inshore, foreshore and to some extent offshore fishing with country boals and catamarans. The fairly close proximity of the Wadge Bank to this area gives a rich yield of fish to the enterprising fishermen and in comparison to this, the value of the Brown Mussel fished is not great. Despite this, Brown mussel fishery plays an important part in the economy and dietary of quite a large number of people along the coast since, in addition to giving employment with a modest income to several hundreds of people for about 6 to 8 months in the year, thousands are benefited by the availability of a very nutritious and palatable article of diet as an alternative to ordinary fish especially during the months when the latter is scarce.

1126. **Jones, S.** 1958. Notes on the frigate mackerels, *Auxis thazard* (Lacepede) and *A. tapeinosoma* Bleeker, from Indian Waters. *Indian J. Fish.*, 5(1&2): 189-194.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The so-called frigate mackerels of the genus *Auxis* are the smallest of the tunas and could be distinguished from all other genera of the family Thunnidae by the wide interspce (nearly equal to the length of the head) between the first and the second dorsal. Another distinguishing character is the size of the axillary scales (between the ventral fins) which are equal in length to the fins in *Auxis* while in other Thunnidae they are only about one-half in length. In addition to the geno-type, *Auxis thazard* (*Scomber thazard* Lacepede), which is a widely distributed fish found in all the warm seas, a few species have been described which according to some are only synonyms of the above. Recently Wade (1949) has shown that two species, *viz*., *Auxis thazard* and *A. tapeinosoma*, occur in the Philipine waters thereby helping to establish the validity of the second species. It has been possible to obtain recently both the species from the Indian waters and notes on them are given in this article as there are no previous published records of these from India.

1127. **Jones, S.** 1959. An unusual instance of a bird getting trapped by a clam. *J. Mar. Biol. Assoc. India,* 1(1): 97.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : On 29.8.1958 while on a field trip to Manoli Island in the Gulf of Mannar a small bird similar to the common snipe was found trapped by the clam, *Catelysia opima* on a sandy stretch which was exposed being low tide.

1128. **Jones, S.** 1959. Notes on animal associations. I. A porecllanid crab on the sea pen *Pteroeides esperi*. *J. Mar. Biol. Assoc. India,* 1(2): 178-179.

Address: Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Recently while examining a living specimen of the sea pen, *Pteroeides esperi* Herklots, brought up in a shore seine at Vedalai near Mandapam on the Gulf of Mannar, a porcellanid crab, the colour pattern of which resembled that of the host to a remarkable degree, was found sheltering between the pinnules.

1129. **Jones, S.** 1959. On a pair of captive Dugongs (*Dugon dugon*). *J. Mar. Biol. Assoc. India,* 1(2): 198-202.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A male specimen 160 cm. was caught on 2-10-1959 in a turtle net laid about 7 miles from here in the Gulf of Mannar beyond Hare Island and was transferred a couple of days later to an open cement tank with running sea water in the Central Marine Fisheries Research Station, Mandapam Camp. The tank in which it was kept, though a long one, was only a little over a metre wide but the animal managed to curve its body and turn

around and move with ease inside without injuring itself. It became tame in about 3 to 4 days time and began to take food from hand.

1130. **Jones, S.** 1960. Notes on animal associations. 2. The scyphomedusa, *Acromitus flagellatus* and young *Seleroides leptolepis* with the latter forming a vanguard. *J. Mar. Biol. Assoc. India, 2(1)*: 51-52.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Instances of young fishes swimming under the umbrella of jellyfishes and taking refuge in their subgenital cavities and grooves at the base of the mouth arms when alarmed are well known. The fishes associated with medusae are mostly carangids and gadids. Panikkar and Prasad (1952) have described the association between *Rhopilema hispidum* Maas and the young of *Caranx kalla* Cuvier & Valenciennes. The association described in the present article differs from the previous records in that the fish were found to move in advance of the medusa as a vanguard. On 28-4-1960 at about 7.00 a.m., while making underwater observations with the help of mask and snorkel on an interesting case of association between an alpheid and a gobiid fish, which will be described in a subsequent number in this series, my attention was directed to a jellyfish in the neighbourhood by Mr. P. V. Ramachandran Nair, one of my colleagues, who had accompanied me. In association with it were a number of small fish which unlike in other recorded cases remained above the umbrella of the jellyfish and moved in advance in jerks pausing intermittently and in rhythm with the movement of the medusa. The fish kept themselves close to the medusa but not in actual contact with it. Their movements were so well synchronised that it would appear that the fish, which were never seen to turn around or make any special attempt to check the position of the jellyfish, could anticipate the direction in which and the distance to which the latter would move.

1131. **Jones, S and C. Sankaran Kutty** 1960. Notes on animal associations 3. A parthenopid crab *Harrovia albonlineata* on a mariametrid crinoid *Lamprometra* sp. *J. Mar. Biol. Assoc. India*, 2(2): 194-195.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Instances of decapod crustaceans living in association with crinoids are known (Hyman, 1955) and from Indian waters one such example of *Galathea elegans* living in association with *Antedon* has been recorded by Southwell (1909) from Okha in the Gulf of Kutch. The same species of anomuran crab was reported from South Africa by Barnard (1950) as commensal on another crinoid, *Tropiometra carinata.* The brachyuran crab, *Harrovia albo/ineata* Adams & White, has already been recorded to live in association with comatulids by Serene *et al.* (1957-58) in the Gulf of Nhatrang, Vietnam. In this article an association between *H. albo/ineata* and *Lamprometra* sp. is recorded. During one of the diving operations for collection purposes in comparatively shallow water at Vedalai near Mandapam in the Gulf of Mannar, a mariametrid crinoid belonging to the genus *Lamprometra* which was harbouring a female specimen of a parthenopid crab, *H. albolineata* was collected by one of us from a depth of about 2 metres. The crinoid was found attached to sea-grass with the crab at the aboral side close to the aboral cirri. The latter was well camouflaged in the above position and was hardly distinguishable on account of the similarity in the colour pattern of the symbionts.

1132. **Jones, S.** 1962. The scombroid fishery of India: Present and future. *Proc. Symp. Scombroid fishes*, MBAI., 3&4: 994-1000.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Scombroids constitute a significant part of the marine fish landings in India. Only a very brief review is attempted here with the object attention on the potentialities for the development of this resource in the seas around.

1133. **Jones, S and Horacio Rosa** 1962. Synopsis of biological data on the fishes of the genus *Rastrelliger* Jordan and Stark 1908 : With an annotated bibliography. *Proc. Symp. Scombroid fishes, MBAI, III & IV*, 1190-1234.

1134. **Jones, S and E.G. Silas** 1964. A systemic review of the scombroid fishes of India. *Proc. Symp. on Scombroid fishes, MBAI*, 1: 1-106.

1135. **Jones, S.** 1965. The crustacean fishery resources of India. *Proc. Symp. Crustaceana.* MBAI., 4 : 1328-1340.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The crustacean fisheries of India have assumed considerable importance in recent years in the economy of the country. Exports of frozen and canned prawns and frozen lobster tails have been steadily on the increase earning very valuable foreign exchange. The commercially important crustaceans consist of the prawns, lobsters

and crabs caught from the sea and brackish waters. Except the giant freshwater prawn, limited quantities of which are exported in frozen condition, the freshwater crustaceans contribute only to a sustenance fishery of minor importance. The annual marine crustacean landings in India average about 80,000 tonnes of which 97.5% is constituted by prawns. The paper discusses the present condition of the crustacean fisheries of India.

1136. **Jones, S. and S. Mahadevan** 1965. Notes on animal associations. 5. The pea crab *Pinnotheres decannensis* inside the respiratory tree of the sea cucumber, *Holothuria scabra*. *J. Mar. Biol. Assoc. India*, 7(2): 377-380.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The sluggish and comparatively defenseless nature of the holothurians make them convenient hosts to many commensals and parasites. A variety of commensals, from protozoans to fish, have been reported from them of which the most interesting and classical example is the pearl fish, Carapus formerly known under Fierasfer. Holothurians collected from the Gulf of Mannar and Palk Bay in the neighborhood of Mandapam were examined especially for the pearl fish but the only internal commensal of interest found was the pea crab, *Pinnotheres decanensis* Chopra from *Holothuria scabra* Jager. The crab was found to remain inside the lower part of the respiratory tree above the cloaca.

1137. **Jones, S.** 1966. The Dugong or Sea cow - its present status in the seas around India with observations on its behaviour in captivity. *International 2000 year - Book* 7: 215-220.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of two dugongs, *Dugong dugon* at Mandapam camp which were caught in October and December 1959, are discussed in this article.

1138. **Jones, S.** 1967. Two decades of Marine Fisheries Research. *Souvenir 20th Anniversary CMFRI*, pp. 5-21.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The establishment of the Central Marine Fisheries Research Institute early in 1947 took place just before the dawn of independence, a most critical period in the history of our country which brought in its wake the partition, the stress and strains of which affected in one way or the other the entire Nation. However, the Institute continued to grow inevitably at a slow pace, mainly for want of adequate suitable technical personnel. Such difficulties in the early stages of any organisation are only natural even under normal conditions and could ill the more be so in regard to an Institute of this kind as no set up for fisheries research or education existed then in the country from which experienced personnel could be drawn. The scientists required to shoulder the responsibilities were recruited mainly from Universities, Colleges and provincial or state fisheries departments and it necessarily took some time for many of them to get themselves acquainted and oriented to handle the problems that had to be tackled.

1139. **Jones, S and D.B. James** 1968. On a stiliferid gastropod parasitic in the dorsal chamber of *Holothuria atra* Jaegar. *Proc. Symp. on Mollusca, 799-804, MBAI*, 3: 799-804.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Over 1,300 specimens of *Holothuria atra* ranging in size form 78 to 351 mm were examined for internal commensals and parasites, and of these, eight were found to harbour gastropods belonging to the genus Stilifer in their cloacal chamber. Thirteen parasites were collected in all of which three had egg capsules between the shell and the pseudopallium. The parasite which appears to be a new one is described and figured and its early development is given. Unsuccessful attempts to infect fresh holothurians with free-swimming veligers are briefly discussed.

1140. **Jones, S.** 1968. The molluscan fishery resources of India. *Proc. Symp. on Mollusca MBAI*, 3: 906-918.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The present status of the different molluscan fisheries of India and their potentials are discussed in the paper. Molluscs of commercial importance are all essentially marine and broadly come under two major categories, viz., (i) edible and (ii) ornamental. Squids, mussels, Oysters, clams, etc., which are used for human consumption come under the edible molluscan fisheries. Of these, the most widely distributed is the squid fishery. The mussel fishery is of considerable local importance in rocky areas especially along the West Coast. Backwater oysters, clams, etc., form sustenance fisheries of limited importance in some localities. Most of the edible molluscs are consumed by the poor class of people along the coastal areas. Special reference is made

regarding the scope for the development of the mussel fishery in certain parts of India. Under ornamental molluscan fisheries, pearl oyster, chank, window-pane oyster, Trochus, Turbo and a variety of curio shells are included. In addition to the above, dead shells and shell products are used for a variety of purposes including the manufacture of lime and cement.

1141. **Jones, S and K. Alagarswami** 1973. Mussel fishery resources of India. *Proc. Symp. on Living Resources of the Seas around India, Cochin, December 1968, Cochin, India*. CMFRI. pp. 641-647.

Address : Department of Zoology, University College, Trivandrum - 1, India.

Abstract : In the recent years there has been a growing world interest to develop mussel fisheries in various countries which sustain fairly adequate mussel resources. Holland and Spain, the two leading countries in mussel production, have developed simple but effective techniques of mussel farming and together account for approx. 80 per cent of mussels caught in the world. In India, in common with the other molluscan shellfishes, mussel fishery is still in an underdeveloped state, mussels being collected by hand-picking from the exposed rocks or diving in shallow waters. There are 2 spp of mussels, the common green mussel and the brown mussel, both belonging to the genus Mytilus. While the former is widely distributed on the east as well as west coast, the latter has a restricted distribution in the Kanyakumari-Tinnevely coast of the Madras State and the South Kerala Coast. Almost all the rocky stretches, including the breakwaters, piles, etc., laid by man, along the coast from the shoreline to a depth of 6-8 m harbour mussels and the west coast contains more mussel beds than the east coast. Adequate statistics are not available on the mussel landings and their size composition. In this article an attempt is made to assess the extent of presently known mussel resources objectively. The need for obtaining necessary biological data is stressed. Systematic farming of the mussels by collecting the seed and growing them in sheltered areas will increase the production at least fivefold. Enhanced production will also open up scope for mussel canning. The possibilities of developing mussel fishery as an organised industry by a more scientific utilisation of this potential resource are pointed out.

1142. **Jones, S and A. Bastin Fernando** 1973. Present status of the turtle fishery in the Gulf of Mannar and the Palk Bay. *Proc. Symp. on Living Resources of seas around India,* pp. 712-715.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Turtles are caught along the entire coastline of India but except in the Gulf of Mannar and Palk Bay it is a fishery of only a causal nature and hardly of any significance. The main commercial species is the green turtle *Chelonia mydas* while other species occur in stray numbers. A fairly regular fishery of some magnitude exists for the green turtle in the Gulf of Mannar and it is estimated that on an average about 3,000 to 4,000 numbers are landed every year between Pamban and Cape Comorin. In the Palk Bay, the fishery is of a much lower level and about 1,000 turtles are estimated to be landed annually between Rameswaram and Mimisal. The possibilities of increasing the catches in the Gulf of Mannar giving due attention to conservation measures are discussed.

1143. **Jones, S.** 1976. The present status of the dugong, *Dugong dugon* (Muller) in the Indo-Pacific and problems of its conservation. Rome-Italy *FAO*, 47 pp.

Address : FAO Advisory Committee on Marine Resources Research, Rome (Italy).

Abstract : The dugong, *D. dugon* (Muller) is the only existing sirenian in the Indo-Pacific region, being recorded in coastal areas from southeastern Africa along the southern coast of Asia to the western Pacific Islands. There has been considerable depletion of the stocks of this sp throughout its areas of former abundance owing to increasing fishing pressure. This paper concentrates on the state of *D. dugon* on the Indian and Sri Lanka (Ceylon) coasts in the Gulf of Mannar and the Palk Bay where it is reported to have been present in larger numbers than anywhere else in its entire range of distribution. Some areas of former abundance and present remaining local habitat within these 2 bodies of water are given. Fishing for *D. dugon* continues, although catches have diminished considerably in recent years, and specimens are also caught inadvertently in large meshed nets set for other marine species. The meat of the animal is used for human consumption, with demand and price being very high in local areas. While occurring in 'flocks' of many hundreds about a century ago, presently the dugong is rarely seen in this area and it is rare for >1 specimen to be captured at a time. Likewise, the problem appears to be the same in other areas of the dugong's range. Although it has been declared a protected animal by some countries, it is evident that, with the possible exception of Australia, conservation at the national level has been ineffective; it is only a question of time, therefore, before *D. dugon's* complete or near extermination, unless urgent and effective conservation measures are taken at an international level.

Additionally, very little is known of the species' biology and migration in all areas of its range. Systematic investigations on the biology of the species and a general survey of its distribution and abundance in 6 broad zones of the Indo-Pacific region are suggested, with zones established as follows: 1. Red Sea, 2. East Africa and Madagascar, 3. Palk Bay and the Gulf of Mannar, 4. Burma, Andamans and Malaya, 5. Australia and Indonesia, 6. Pacific Islands. Further, the establishment of research centers and sanctuaries in appropriate areas of the Indo-Pacific is suggested, with investigations coordinated by an international agency. In particular, recommendations with regard to the Gulf of Mannar and the Palk Bay are given, calling for joint efforts by the Governments of India and Sri Lanka (Ceylon).

1144. **Jones, S.** 1976. The short-finned pilot whale, *Globicephala macrorhynchus* Gray of the Indian Ocean. Rome-Italy FAO, 35 pp.

Address : FAO Advisory Committee on Marine Resources Research, Rome (Italy).

Abstract : The short-finned pilot whale, *G. macrorhynchus* Gray, 1846 is the only member of that genus known to occur in the Indian Ocean. There is no fishery for this species in these waters. *G. macrorhynchus* does not occur in the coastal waters of the Indian subcontinent, where the only information available on the species is from 2 strandings, 1 consisting of 20 to 'several dozens' of specimens in the Salt Lake near Calcutta in the Gangetic Delta about 175 km up from the sea in July 1850 and the other consisting of {approx} 160 specimens at Manapad between Cape Comorin and Tuticorin in the Gulf of Mannar in Jan 1973. The details of the above strandings and the possible causes for the same are discussed. Features of the morphology and life history of *G. macrorhynchus* are reviewed. The possibility of more than 1 geographical race of this species in the Indian Ocean is indicated and the need for studying this aspect on a global basis is pointed out. Circumstances following the Manapad stranding indicate the need for a more fully organized system able to respond to future similar situations in order to take full advantage of the material for scientific study.

1145. **Jones, S.** 1981. Distribution and status of the *Dugong dugon* (Muller) in the Indian waters. ***In*** : *Dugong*, (ed.) H.Marsh, *Proc. Workshop held at James Cook University,* 8-13 May, 1979. pp. 43-54.

1146. **Joseph, K.C.** 1980. Fisheries extension activities at the fisheries college, Tuticorin. *Seminar on fisheries extension, status reports and background papers:* pp. 1-5.
Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

1147. **Joseph, K.M and M.E. John** 1987. Potential marine fishery resources. *CMFRI Spl. Publ.*, 30: 18-43.

Address : Department of Agriculture, Fisheries Division, Government of India, New Delhi-110 001, India.

Abstract : Among the countries bordering the Indian Ocean, India has strategic advantages in exploitation of marine fish resources with its long coastline of 6100 km and rich and varied fishery resources within 2.02 million sq. km Exclusive Economic Zone. The present marine fish production of 1.85 million tonnes is less than half of the conservative potential estimate of 4.2 million tonnes (George *et al*, 1977). The trends in marine fish landings of past few years indicate that the coastal fisheries viz. oil sardine, mackerel, Bombay duck and penaeid and non-penaeid prawns may not contribute significantly for further increase in marine fish production of our country. Hence, while monitoring the resources for management of these stocks for conservation as well as exploitation up to the sustainable-yield level, we have to be on the look out for new potential resources in our EEZ.

1148. **Josileen Jose., M.R. Arputharaj, A. Ramakrishnan and A.Vairamani** 1996. Larval rearing of the crab, *Portunus pelagicus* (Crustaceae, Portunidae) in hatchery at Mandapam R.C of CMFRI. *Mar. Fish. Infor. Serv. T & E Ser.*, 143: 23-24.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The selection of brood stock, the spawning and larval development and the maintainance of larval feed are discussed in this chapter.

1149. **Josileen Jose.** 2000. Crabs and crab fisheries of the Mandapam area. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp.* pp.68-70.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In our country, crab fishery is mainly contributed by portunid crabs those which belong to three

generae ie., *Scylla, Portunus* and *Charybdis*. They have the typical portunid shape with carapace having 4-9 anterolateral teeth. Chelepeds are longer than all legs and last pair is typically paddle shaped.

1150. **Josileen Jose and N. Gopinatha Menon** 2004. Larval stages of the Blue swimmer crab, *Portunus pelagicus* (Linnaeus, 1758) (Decapoda, Brachyura). *Crustaceana*, 77(7): 785-803.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Larvae of *Portunus pelagicus* (Linnaeus, 1758) were reared in the laboratory on hatching from wild ovigerous females collected from Palk Bay, southeast India. The larval stages included four zoeal stages and one megalopa. The megalopa moulted to the first crab instar. The zoeae and megalopa were very similar to those of other portunids. The duration of each of the first two weak stages was 3-4 days, the following two stages 2-3 days, and the megalopa 3-5 days, reaching the first crab stage in 15-17 days. All zoeal and megalopa stages are described in detail and are documented with illustrations.

1151. **Jude, D., N. Neethiselvan, G. Gopalakrishnan and G. Sugumar** 2002. Gill net selectivity studies for fishing frigate tuna, *Auxis thazard* Lacepede (Perciformes/ Scombridae) in Thoothukkudi (Tuticorin) waters, southeast coast of India. *Indian J. Mar. Sci.*, 31(4): 329-333.

Address : Department of Fishing Technology and Fisheries Engineering, Fisheries College and Research Institute, Tuticorin - 628 008, Tamil Nadu, India; E-mail: drneethi@yahoo.co.in

Abstract : *Auxis thazard* form commercial fishery in Thoothukkudi coastal waters from June to October in big meshed drift gill nets with the mesh size ranging from 60 to 100 mm. The fishery is mainly constituted by the length group 275-500 mm. The present study deals with the estimation of mesh size to capture the commercially significant length group (326-400 mm) of *A. thazard* and its enmeshing pattern in gill nets with two different mesh sizes. The optimum mesh size for the exploitation of the commercial significant size group of *A. thazard* from Thoothukkudi coastal waters is estimated as 84 mm. As the length at first maturity of this species in Thoothukkudi coast varied from 300 to 310 mm, the nets with proposed mesh size would reduce growth and recruitment over fishing of *A. thazard* in this coast and allow for spawning before first capture. Though the big meshed drift gill net fishery of Thoothukkudi coast is multi species oriented, the study emphasises the need to regulate the mesh size of the nets based on the type of fishes that form fishery and fishing seasons. It is recommended to conduct big meshed gill net fishing from June to October with the nets having the mesh size of 84 mm, as *A. thazard* is the major contributor to the big meshed gill net catch during this season. The use of gill nets with the 60 mm-mesh size should be banned during this season, as this would result in capturing of juveniles of *A. thazard* leading to growth overfishing.

1152. **Jyothi Mallia, V., Palaniyappan Muthiah and P.C. Thomas** 2006. Growth of Triploid oyster, *Crassostrea Madrasensis* (Preston). *Aquacul. Res.*, 37(7): 718.

Abstract : The performance of I and II meiotic triploids and control oysters *(Crassostrea madrasensis)* reared at Tuticorin Bay was compared to determine if the improvements in the growth of edible oysters were additive to faster growth in triploids. After a grow-out period of 12 months, both mean whole weights and shell heights were in the order I meiotic triploid>II meiotic triploid>control. Mean whole weights and shell height of different oyster lines were all significantly different ($P<0.05$). On an average, larger morphological traits indicated that growth improvements from triploids were additive, and throughout the study triploid oysters maintained faster growth rate than their diploid siblings. Condition index and adductor muscle diameter of both triploids were higher than those of control.

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1153. **Kagwade, P.V**. 1973. Polynemid fishery resources of India. *Proc. Symp. on Living Resources of seas around India.* pp. 424-433.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The polynemids contributing to fisheries along the Indian coasts are dealt with. The biological behaviour of the concerned species in relation to their fisheries, especially in the northeastern and northwestern parts of the country is discussed. The Bombay and Saurashtra waters are the richest, contributing to about 80% of the polynemid landings of this country. The species forming the bulk of the landings *Polydactylus indicus* (Shaw), one of the two polynemids which grows to over a metre in length, the other being *Eleutheronema tetradactylum* (Shaw). The declining trend in the fishery of *P. indicus* is reflected in the low yields of the total polynemids of this country in recent years.

1154. **Kagwade, P.V.** 1988. Present status of polynemid fishery in India. *CMFRI Spec. Publ.* 40: 14.

Address : Central Marine Fisheries Research Institute, Research Centre, Bombay, India.

Abstract : The polynemid fishery, which is not of a big magnitude, has shown rise and fall in the catches during the last 30 years from 1956 to 1985. Though represented by 9 species, the fishery is supported mainly by *Polydactylus indicus* ("Dara") and to a lesser extent by *Eleuthronema tetradactylum* ("Rawas"), both growing to over a metre in length and weigh more than 18 kg. Because of the dominance of *P. indicus*, fluctuations in its catches are reflected in the total polynemid landings. "Dara" matures above 80 cm in the IV year and is a gonochoristic hermaphrodite in which the ovarian part of ovotestis becomes active alternatively with the testicular part; because of this, the egg-bearing period for an individual is reduced to half. Cessation of trawling in the nursery grounds of "Dara" due to the concentration of fishing effort for prawns in other areas in the late sixties and seventies has helped the fishery to revive in the seventies and eighties and thus to conserve the species.

1155. **Kailasam, M and S. Sivakami** 2004. Effect of thermal effluent discharge on benthic fauna off Tuticorin Bay, southeast coast of India. *Indian J. Mar. Sci.*, 33(2): 194-201.

Address : Central Institute of Brackishwater Aquaculture, No. 75 Santhome High Road, R.A.Puram, Chennai 600 028 India; E-mail: kailu66@hotmail.com

Abstract : Benthic fauna of Tuticorin bay in relation to thermal effluent discharge was studied for a period of two years (March 1990 to April 1992). Station 1st situated closer to thermal effluent discharging site was characterized by high water temperature (surface mean 38.92 ^{o}C, Bottom mean 38.86 ^{o}C), low dissolved oxygen (surface mean 3.79 ± 0.29 ml/l) and high percentage of sand (mean sand 87.96%, mean silt 7.57%, mean clay 4.87 %) with the record of only three benthic species mainly dominated by *Cerithedia fluviatilis*. Occasional record of *Prionopsio* sp. and *Nassa pulla* was also noticed at station 1. Higher water temperature recorded at station 1 had resulted elimination of other benthic species with survival of fewer organisms. Station 4, situated far away from thermal effluent discharging site had better water quality parameters of temperature (surface mean 30.84 ^{o}C), dissolved oxygen (surface mean 4.08 ml/l) and improved sediment particle size composition (mean sand 76.27%, mean silt 16.11%, mean clay 7.68%) with the record of 23 benthic species. Station 1st was recorded with the lowest benthic population density (480-1,084 /m^2) and species diversity (0-0.44) while other stations showed the highest faunal density (2,327-3,452 /m^2 at station 6) and species diversity (2.12-2.54 at station 5). Temperature showed significant negative correlation with species diversity (1%), benthos density (5%) and benthos biomass (1%) at station 1, while in other stations, temperature was positively correlated with species diversity, benthos density and benthic biomass but statistically insignificant. Thermal effluent increased the temperature of receiving waters and thereby affected the benthic population of Tuticorin bay.

1156. **Kajler, M and M. Truve** 1989. Informal credit systems in small-scale fisher-folk communities in Tamil Nadu, India. *Fish. Dev. Ser. Natl. Swed. Board Fish.*, 40, 28 pp.

Address : National Swedish Board of Fisheries, Goteborg (Sweden).

Abstract : The findings are presented for a study conducted to identify the informal credit systems in small scale fisherfolk communities in Tamil Nadu and understand their functioning. The findings are based on interviews made on Orur, Olcottkuppam and Sulerikattukuppam villages and observations made in 6 villages in the Kanyakumari District regarding 2 organized savings and credit systems: Sangams and Sandi Dhans.

1157. **Kaladharan, P., N. Kaliaperumal and J.R. Ramlingam** 1998. Seaweeds - Products, Processing and Utilization. *Mar. Fish. Infor. Serv. T & E. Ser.*, 157: 1-9.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The various marine food products produced from marine seaweeds are discussed in this paper.

1158. **Kaladharan, P and N. Kaliaperumal** 1999. Seaweed Industry in India. *NAGA*, 22(1): 11-14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1159. **Kaladharan, P and R. Gireesh** 2003. Laboratory culture of *Gracilaria* spp. and *Ulva lactuca* in seawater enriched media. *Seaweed Res. Utiln.,* 25(1&2): 139-142.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Thallus bits of *Gracilaria edulis, G. corticata, G. crassa* and *Ulva lactuca* were maintained in three enriched seawater growth media under laboratory conditions. Weekly observation on growth rate of these algae showed that Walne's medium enhanced Daily Growth Rate (DGR) of *Ulva lactuca* (54.42 3.82 mg/ d), *Gracilaria corticata* (58.71 ±3.35 mg/ d) and G. *crassa* (72.42 ± 2.07 mg/ d). *Gracilaria edulis* registered higher growth rate in PES medium (50.42 ± 3.82 mg/ d) than in Warne's and Gamborg media. However, addition of 2 % garden soil extract to Warne's medium promoted the DGR in all the four species considerably (62.28 mg/ d for *Ulva,* 66.71 mg/ d for *Gracilaria corticata,* 77.71 mg/ d for G. *crassa* and 56.29 mg/ d for *G. edulis).* The results are compared with the growth rate of seaweeds achieved elsewhere in *in situ* sea farming being carried out without addition of any nutrients extraneously.

1160. **Kalamani, N., K. Gopakumar and T.S.U. Nair** 1988. Quality characteristics of cured fish of commerce. *Fish. Technol.,* 25(1): 54-57.

Address : Trainners Training Centre, Central Marine Fisheries Research Institute, Narakkal-682 505, Kerala, India.

Abstract : A survey was conducted at the fish curing yards at Shakthikulangara (Quilon), fish market at Vizhinjam, fish curing yards, fish market as well as dry fish godowns in and around Tuticorin. A total of 23 samples of different varieties of fishes collected from the markets and curing yards and 8 samples of anchovies collected from different godowns at Tuticorin were analysed to evaluate the quality and extent of fungal and insect infestation. Samples were analysed for proximate composition and estimated their water activity. About 70% of the 23 samples of different varieties of fish were found to be unfit for consumption and 12.5% of the samples of anchovies were found to be infested with beetle, after 3 weeks of storage after collection from these centres.

1161. **Kaliaperumal, N and M. Umamaheswara Rao** 1975. Growth, fruiting cycle and oospore output in *Turbinaria decurrens* Bory. *Indian J. Fish*., 22(1&2): 225-230.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies on the growth, fruiting cycle and oospore output in *T. decurrens*, carried out for one year from March 1972 to February 1973 are presented in this paper. Young plants of *T. decurrens*, observed in the natural habitats in May and June, grow to maximum size in the period from December to February. Plants with receptacles occur for eleven months from August to June, with large number of fruiting plants in the peak growth season from December to February. Periodicity was not seen in the liberation of oospores and during the fruiting season peak output of spores was observed in November. From this study, it is suggested that the period December-January is suitable for harvesting the crop of *T. decurrens* in the localities around Mandapam.

1162. **Kaliaperumal, N and S. Kalimuthu** 1976. Changes in growth, reproduction, alginic acid and mannitol content of *Turbinaria decurrens* Borry. *Bot. Mar*.,19(3): 157-159.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1163. **Kaliaperumal, N., V.S.K. Chennubhotla and S. Kalimuthu** 1977. Growth, reproduction and liberation of oospores in *Turbinaria ornata* (Turner) J. Agardh. *Indian J. Mar. Sci.,* 6(2): 178-179.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Young plants of *T. ornata* appeared in Aprl and grew to maximum size during October to December. Plants were mostly unbranched between February and June and thereafter branching started reaching maximum during September to November. Reproductive plants were found throughout the year with a peak spore output in November (33,810 oospores/plant). There was no periodicity in the liberation of oospores. *T. ornata* may be harvested during the peak growth period from October to December for the manufacture of alginic acid.

1164. **Kalimuthu, S and M. Najmuddin** 1979. Seaweed Culture in Mandapam. Preliminary Evaluation on Bench-Mark Survey Data. Workshop on Technology Transfer in Coastal Aquaculture, Cochin (India), Mandapam (India), 23 Jul. 1979. *Proc. First workshop on technology transfer in coastal aquaculture*, Cochin, 23-24 July 1979. Mandapam. *CMFRI Spec. Publ.,* 6: 53-55.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A brief status report of seaweed culture in Mandapam is presented. Information on the socioeconomic conditions of the farmers is given, and the progress and constraints of the CMFRI's aquaculture development programme in the area are evaluated.

1165. **Kaliaperumal, N and M. Umamaheswara Rao** 1982. Seasonal Growth and Reproduction of *Gelidiopsis variabilis* (Greville) Schmitz. *J. Exp. Mar. Biol. Ecol*., 61(3): 265-270.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seasonal variations in growth, fruiting, and sporulation of *Gelidiopsis variabilis* (Greville) Schmitz occurring on the Visakhapatnam coast have been described. Only tetrasporophytes and vegetative plants were found in the populations analysed for 2-½ yr and seasonal changes were more marked in the abundance of Tetrasporophytes, formation of Stichidia, and in the spore output, than in the stature of the plants. Maximum development of the plants was observed each year between October and January-February and peak reproductive activity from July to September.

1166. **Kaliaperumal, N and G. Pandian** 1984. Marine algal flora from some localities of south Tamil Nadu coast. *J. Mar. Biol. Assoc. India*, 26(1&2): 159-164.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Marine algae were collected from 6 localities along the South Tamil Nadu coast, India, namely Tuticorin, Manapad, Tiruchendur, Idinthakarai, Kovalam, and Muttam. Maximum number of 56 algal species at Tuticorin and minimum number of 25 species at Muttam were recorded. A total of 98 algae belonging to the groups Chlorophyta, Phaeophyta, Rhodophyta and Cyanophyta were recorded from these 6 places. The red algae occurred in greater number than other algae in all of these places.

1167. **Kaliaperumal, N and S. Kalimuthu** 1986. Tropical cyclones. *Souvenir, 35th Anniversary, Recreation Club of R.C. of CMFRI, Mandapam Camp*, pp. 34-36.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Address : The term 'Cyclone' derived from a Greek word meaning the coil of a snake, is used for tropical revolving storms occurring in the Bay of Bengal and the Arabian Sea. These storms are confined to definite regions of the earth and occur, for the most part, in the tropical portions of the western sides of the great oceans. The term cyclone is applied to all tropical storms although they are known as 'hurricanes' in the Atlantic and Eastern Pacific, as 'typhoons' in the Western Pacific. as 'willy willias' in the Australian Seas and as 'Baguios' in the Philippines.

1168. **Kaliaperumal, N and M. Umamaheswara Rao** 1986. Growth, reproduction and sporulation of marine alga *Gelidium pusillum* (Stackhouse) Le Jolis. *Indian J. Mar. Sci.*, 15(1): 29-32.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seasonal aspects of growth, reproduction and spore output in *Gelidium pusillum* growing (Sept. 1976-Feb. 1979) at Visakhapatnam coast were described. Plants occurred throughout the year with maximum growth in Sept. and Oct. and minimum between Jan. and April. Tetrasporophytes were predominant over the cystocarpic plants and seasonality was not observed in the abundance of these fruiting plants. Under laboratory conditions tetraspore and carpospore shedding was maximum on the 1st day and spore output gradually decreased from 2nd d onwards. Seasonal variations were not observed in the formation of sori and discharge of spores.

1169. **Kaliaperumal, N., V.S.K. Chennubhotla, S. Kalimuthu and J.R. Ramalingam** 1986. Growth, phenology and spore shedding in *Gracilaria arcuata* var. arcuata (Zanardini) Umamaheswara Rao and *G. corticata* var. cylindrica (J. Agardh) Umamaheswara Rao (Rhodophyta). *Indian J. Mar. Sci.*, 15(2): 107-110.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Maximum development of plants occurs in the intertidal region at Kilakarai, southeast coast of India, during March-April and Jan.-Feb. in *Gracilaria arcuata* var. arcuata and from Nov. to Feb. in *G. corticata* var. cylindrica . Tetrasporic plants are abundant almost throughout the year in both algae. Peak shedding of spores occurs during the maximum growth period in *G. arcuata* var. arcuata while seasonal variations are not observed in the discharge of spores in *G. corticata* var. cylindrica . Monthly output of tetraspores and carpospores varies from 43 to 28,291 and from 10 to 40,055 spores g^{-1} fr wt in *G. arcuata* var. arcuata and *G. corticata* var. cylindrica respectively. There is no definite rhythm in diurnal output in these algae.

1170. **Kaliaperumal, N., S. Kalimuthu, J.R. Ramalingam and M. Selvaraj** 1986. Experimental field cultivation of

Acanthophora spicifera in the nearshore area of Gulf of Mannar. *Indian J. Fish.*, 33(4): 476-478.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Results of experimental field cultivation of the red alga *Acanthophora spicifera* (Vahl.) Boergesen, following vegetative-propagation method, are presented. Vegetative fragments 5 cm in length were tied into clusters with polypropylene straw and were fastened to nylon fishing lines. The weight of seed material thus introduced was 4.85 kg. The algae grew rapidly and reached harvestable size of 15.9 cm mean length in 25 days. The weight of fresh harvested plants was 12.85 kg, having had a 2.6 fold increase over the weight of the seed material indicating that the nearshore area of Hare Island in Gulf of Mannar, where the experiment was conducted, is suitable for large-scale cultivation of this seaweed.

1171. **Kaliaperumal, N., V.S.K. Chennubhotla, S. Kalimuthu, J.R. Ramalingam, M. Selvaraj and M. Najmuddin** 1987. Chemical composition of seaweeds. *CMFRI Bulletin,* 41: 31-51.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Considerable work has been done on the chemical aspects of Indian seaweeds during the last three decades, of which those up to 1970 have been reviewed by Umamaheswara Rao (1970). In this chapter the information so far collected on the mineral constituents, carbohydrates and other chemicals is presented.

1172. **Kaliaperumal, N., V.S.K. Chennubhotla and S. Kalimuthu** 1987. Seaweed resources of India. *CMFRI Bulletin,* 41: 51-54.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The surveys carried out in certain areas of the east and west coasts of India clearly show the diversity and abundance of seaweed resources in our country. Intensive surveys for a long period in other areas along the Indian coast would throw much light on the resources occurring in the natural habitat and on the raw material available for expanding the seaweed industry in our country.

1173. **Kaliaperumal, N., S. Kalimuthu and J.R. Ramalingam** 1988. Seasonal variation in growth, alginic acid and mannitol contents in *Cystoseira trinedis and Hormophysa triqueta. Indian J.Bot.*,11(1): 17-21.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1174. **Kaliaperumal, N., S. Kalimuthu and J.R. Ramalingam** 1990. Studies on phycocolloid contents from seaweeds of south Tamil Nadu coast. *Seaweed Res. Utiln.,* 12(1&2): 115-120.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1175. **Kaliaperumal, N., V.S.K. Chennubhotla, S. Kalimuthu, J.R. Ramalingam, and K. Muniyandi** 1990. Environmental factors influencing the growth of *Gracilaria edulis* in culture. *Mar. Fish. Infor. Serv. T & E. Ser.,* 105: 10-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In the CMFRI, culture experiments with *Gracilaria edulis* were conducted in the near shore areas of Gulf of Mannar and Palk Bay.

1176. **Kaliaperumal, N., S. Kalimuthu, K. Muniyandi, J.R. Ramalingam, V.S.K. Chennubhota, K. Rama Rao, P.V. Subba Rao, P.C.C Thomas, S.H. Zaidi and K. Subharamaiah** 1992. Seaweed resources of Tamilnadu coast III. Valinokkam - Kilakkarai. *Seaweed Res.Utiln.,* 15(1&2): 11-14.

Address : Central Marine Fisheries Research Institute, and Central Salt and Marine Chemicals Research Institute, Mandapam - 623 520, Tamilnadu, India.

Abstract : Survey of seaweed resources in deep water was carried out in the area between Valinokkam and Kilakkarai during January 1989 and March, 1990 respectively. In the survey from Valinokkam to Kilakkarai 33 species of marine algae were recorded of which 8 species belong to Chlorophyta, 8 to Phaeophyta and 17 to Rhodophyta. Only one species of seagrass *Halophila ovalis* was recorded. Among the 200 sq km area surveyed, vegetation occurred only in 27.5 sq.km with a total standing crop of 2,962.5 tons (wet wt). The estimates for the dominant species are: *Spatoglossum asperum* - 1,200 tons, *Halymenia floresia* - 2,550 tons and *Hypnea spp.* 710 tons. The *Hypnea spp.* could be exploited for the production of carrageenan by the Indian seaweed industries.

1177. **Kaliaperumal, N., S. Kalimuthu and J.R. Ramalingam** 1992. Studies on the agar content in *Gracilaria arcuata* Var. *arcuata* and *G. corticata* Var. *cylindrica*. *Seaweed Res. Utiln.,* 15(1&2): 191-195.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies on the yield and physical properties of agar was made for one year from March 1982 to February 1983 in *Gracilaria arcuata* var. *arcuta* and *G. corticata* var. *cylindrica* growing in the intertidal belt at Kilakarai. In *G. arcuata* var *arcuata.* the agar content varied from 38.8 to 52.2% and gel strength from 11 to 67 gm/cm^2. In *G. corticata* var. *cylindrica* the yield of agar ranged from 33.1 to 48.6% and gel strength from 12 to 67 gm/cm^2. The yield of agar in *G. corticata* var. *cylindrica* was slightly more from material cooked for 1-3 hrs at 30 lbs than at 10 and 20 lbs pressure. There was no marked variation in the yield and qualities of agar extracted in pH ranging from 5 to 10 in these two species.

1178. **Kaliaperumal, N and S. Kalimuthu** 1993. Need for conservation of economically important seaweeds of Tamil Nadu coast and time-table for their commercial exploitation. *Mar. Fish. Infor. Serv. T & E. Ser.,* 119: 5-12.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This study reveals the time table for commercial harvest of economically important seaweeds from Tamilnadu coast. Moreover, it deals with the occurrence of agar, carrageenan and algin yielding seaweeds in other parts of Indian coasts.

1179. **Kaliaperumal, N., V.S.K. Chennubhotla, S. Kalimuthu, J.R. Ramalingam and K. Muniyandi** 1993. Growth of *Gracilaria edulis* in relation to environmental factors in field cultivation. *Seaweed Res. Utiln.,*16(1&2):167-176.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Field cultivation of *Gracilaria edulis* was carried out in the near shore areas of Gulf of Mannar and Palk Bay near Mandapam to determine the various environmental factors which affect the growth of this agar yielding seaweed. The suitable period for field cultivation of *G. edulis* in Gulf of Mannar is from December to March.

1180. **Kaliaperumal, N.** 1995. Seaweed Culture. *Handbook of Aquafarming, MPEDA, Kochi.* pp 9-24.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : This part of the hand book deals with seaweed culture techniques.

1181. **Kaliaperumal, N., S. Kalimuthu and J.R. Ramalingam** 1995. Economically important seaweeds. *CMFRI Spl. Publn.* 62: 1-35.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : At present the seaweeds exploited from natural seaweed beds are used for agar and sodium alginate only. They can also be used for the production of other phytochemicals such as agarose, carrageenan and also for fertilizer, human food and animal feed. Though many species of seaweeds viz. *Gelidiella acerosa, Gracilaria edulis, Gracilaria crassa, Gracilaria verrucosa, Sargassum* spp. and *Turbinaria* spp. are harvested from the natural seaweed beds, the fishermen involved in their collection are not fully aware of these species and also other economically important seaweeds growing in the vicinity. This handbook attempts to give an illustrated information on 35 species of economically important agar, agaroid, algin yielding and also edible seaweeds which occur commonly and abundantly.

1182. **Kaliaperumal, N., V.S.K. Chennubhotla, S. Kalimuthu, J.R. Ramalingam, S. Krishna Pillai, K.Subbraramaiah, K. Rama Rao and P.V. Subba Rao** 1995. Distribution of seaweeds off Kattapadu, Tiruchendur coast, Tamil Nadu. *Seaweed Res. Utiln.,* 17(1&2): 183-193.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The present paper deals with the distribution of seaweeds and seagrasses during the deep sea survey conducted in the first sector from Kattapadu to Tiruchendur in Tamil Nadu coast between December 1986 and March 1987 covering an area of 650 sq.km. In this survey, 58 species of marine algae were recorded, of which 7 belong to Chlorophyta, 12 to Phaeophyta and 39 to Rhodophyta. Three species of seagrasses viz., *Cymodocea serrulata, Halophila ovalis* and *H. ovata* were also recorded at the depths ranging from 5.5 to 21.5 m. *Halimeda macrolaba, Dictyota bartayresiana, D. Maxima, Gracilaria corticata* var. *corticata, G. edulis, Sarcodia indica, Sarconema filiforme, Solieria robusta, Hypnea esperi* and *H. Valentine* were found to be dominant and widely distributed. Hydrological data were also collected from area surveyed. The atmospheric and bottom water temperature varied from 25.0 to 36.8°C and 26.0 to 31.8°C respectively. The pH ranged from 8.3 to 8.6 and the salinity from 26.39 to 33.43‰. The dissolved oxygen ranged from 3.42 to 6.47 ml/l. The phosphate content varied from 0.05 to 0.15 µg. at/l, silicate from 4.00 to 12.00 µg. at/l, nitrate from 0.25 to 1.00 µg. at/l and nitrite from 1.05 to 3.99 µg. at/l.

1183. **Kaliaperumal, N., S. Kalimuthu, and J.R. Ramalingam** 1996. Effect of repeated harvesting on the growth of

Sargassum spp. and *Turbinaria conoides* occurring in Mandapam area. *Seaweed Res. Utiln.*, 18(1&2): 57-66.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies were made on the effect of repeated harvesting on the growth of *Sargassam cristaefolium, S. ilicifolium, S. polycystum, S. wightii* and *Turbinaria conoides* occurring at Mandapam coast for a period of 2 years during June 1986 to November 1988. The growth of these algin yielding seaweeds depended on the period of harvesting and interval between one harvest and next. The maximum standing crop with plants of maximum stature was found during the period September to January in these brown algae. An interval of 7 months is required for the regrowth of these plants to harvestable size and the suitable season for commercial exploitation of these algae is September to January.

1184. **Kaliaperumal, N., S. Kalimuthu, K. Muniyandi, J.R. Ramalingam, S. Krishna Pillai, V.S.K. Chennubhotla, M.S. Rajagopalan, P.V. Subba Rao, K.Rama Rao, P.C. Thomas, S.H. Zaidi and K. Subbaramaian** 1996. Distribution of marine algae and seagrasses off Valinokkam - Kilakkarai, Tamil nadu coast. *Seaweed Res. Utiln.*, 18(1&2): 73-82.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1185. **Kaliaperumal, N and S. Kalimuthu** 1997. Seaweed potential and its exploitation in India. *Seaweed Res. Utiln.*, 19(1&2): 33-40.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The potential areas in India for luxuriant growth of seaweeds are south Tamil Nadu Coast, Gujarat, Coast, Lakshadweep and Andaman Nicobar Islands. The total standing crop of seaweeds from Intertidal and shallow waters of all maritime states and Lakshadweep Islands was estimated as 91,339 tons (wet wt). The quantity of seaweeds growing in deep waters of Tamil Nadu was estimated as 75,372 tons (wet wt) in an area of 1,863 sq km from Dhanushkodi to Kanyakumari. Data were collected every month from 1978 to 1995 from the seaweed landing centres in Tamil Nadu on the quantity of seaweeds exploited from the natural seaweed beds. During this period the quantity of agar yielding seaweeds *Gelidiella acerosa, Gracilaria edulis, G. crassa* and *G. foliifera* exploited in a year varied from 248 to 1,289 tons (dry wt) algin yielding weaweeds Sargassum spp from 651 to 5,537 tons (dry wt) and all the above seaweeds from 1,177 to 6,420 tons (dry wt), Since several years, agar yielding red algae are over-exploited in Tamil Nadu, India. The need for conservation of commercially important seaweeds of Tamil Nadu and timetable for their commercial exploitation are given. The harvesting of underexploited and unexploited seaweeds from Tamil Nadu and unexploited seaweeds from other parts of Indian coast are suggested.

1186. **Kaliaperumal, N.** 1998. Seaweed resources and biodiversity values. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*, MSSRF Publ. pp. 92-101.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds or marine algae form one of the important marine living resources. They are primitive plants without any true root, stem and leaves. They come under the Division of Thallophyta of Plant Kingdom. Seaweeds belong to four groups of algae namely Chlorophyceae (green algae), Phaeophyceae (brown algae), Rhodophyceae (red algae) and Cyanophyceae (blue-green algae) based on the type of pigments present in them and other morphological and anatomical characters. They occur in the intertidal and subtidal regions of the sea and also in brackish backwater environments. They grow on dead corals, rocks, stones, pebbles, and other substrates and as epiphytes on seagrasses.

1187. **Kaliaperumal, N., V.S.K. Chennubhotla, S. Kalimuthu, J.R. Ramalingam, S. Krishna Pillai, K. Muniyandi, K. Rama Rao, P.V. Subba Rao, P.C. Thomas, S.H. Zaidi and K. Subbaramaiah** 1998. Seaweed resources and distribution in deep waters from Dhanushkodi to Kanyakumari, Tamilnadu. *Seaweed Res. Utiln.*, 20(1&2): 141-151.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : The deepwater seaweed resources survey was carried out during 1986-1991 at the depths ranging from 5 to 22 m in Tamilnadu Coast from Dhanushakodi to Kanyakumari, India. The vegetation of seaweeds and seagrasses occurred in all areas except Dhanushkodi-Mandapam and Manapad-Kanyakumari. A total number of 100 algae and 5 seagrasses were recorded. Among the 100 algal species recorded, 20 species belonged to Chlorophyta, 18 species to Phaeophyta, 61 species to Rhodophyta and 1 species to Cyanophyta. The total estimated standing crop (wet wt.) from 1,863 sq. km. sampled area was 75,374.5 tons consisting of 2,750 tons

of *Sargassum* spp., 962.5 tons of *Gracilaria* spp. 5,262.5 tons of *Hypnea* spp. and 66,399.5 tons of other seaweeds. The quantitative analysis of economically important seaweeds revealed the feasibility of commercial exploitation of Sargassum from Mandapam to Kilakkarai and Tuticorin areas, *Hypnea* from Mandapam to Vembar area and *Gracilaria* from Vembar to Nallathanni island region. Hydrological data were also collected from the area surveyed.

1188. **Kaliaperumal, N.** 2000. Marine plants of Mandapam Coast and their uses. *Golden Jubilee Celebrations, Sourvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp. 40-43.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1189. **Kaliaperumal, N and P. Uthirasivan** 2001. Commercial scale production of agar from the red algae *Gracilaria edulis* (Gmelin) Silva. *Seaweed Res Utiln.,* 23(1&2): 55-58.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Agar is produced on commercial scale from August, 1999 onwards in the Agar Plant at Regional Centre of Central Marine Fisheries Research Institute, Mandapam Camp, Tamil Nadu, India using the red seaweed *Gracilaria edulis* (Kanji Pasi) as raw material. Agar is manufactured in sheet form by washing the agitator tank, treating with HCl, cooking in the digester by passing steam, collecting the agar gel in aluminium trays, freezing the gel in freezing unit, thawing, bleaching and sun-drying of agar sheets. The yield of agar is found to be 6 to 8%. The gel strength, gelling and melting temperature of 1.5% agar ranged from 74 to 122 g/cm^2, 44° to 46°C and 95° to 97°C respectively. The bleached agar sheets are marketed by packing them in polythene bags. The methods for improving the yield and quality of agar are suggested.

1190. **Kaliaperumal, N.** 2002. Seaweed resources in India - Status, problems and management strategies. *National Seminar on Mar. Coastal Ecosystem; Coral and Mangrove- problems and management strategies*. 26-27 Sep., 2001 pp. 139-144.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds are one of the commercially important marine living renewable resources. Seaweeds occur in the intertidal, shallow and deep waters of sea upto 150 m depth and also in estuaries and backwaters seaweeds contain different vitamins, minerals, trace elements, proteins, iodine and bioactive substances. They are only source for the production of phytochemicals such as agar, carrageenan and alginate. This paper highlights seaweed resources and distribution along the coasts of India, their commercial exploitation, need for conservation and its culture. Also estimates of standing crops of seaweeds in Indian waters and timetable for commercial harvest of economically important seaweeds from Tamil Nadu coast are presented.

1191. **Kaliaperumal, N., J.R. Ramalingam, S. Kalimuthu and R. Ezhilvalavan** 2002. Seasonal changes in growth, biochemical constituents and phycocolloid of some marine algae of Mandapam coast. *Seaweed Res. Utiln.*, 24(1): 73-77.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seasonal variation in growth and biochemical constituents such as protein, carbohydrate and lipid in *Hypnea valentiae, Acanthophora spicifera, Laurencia papillosa, Enteromorpha compressa, Ulva lactuca* and *Caulerpa recemosa* were observed for one year from April 1995 to March 1996. Carrageenan content was estimated from *H. valentiae, A. spicifera* and *L. papillosa*. In general, peak growth and biomas of these algae occurred during the period June-August and January-March. The maximum values in these algae varied from 12.5 to 13.2% for protein, 13.0 to 13.3% for carbohydrate and 10.3 to 12.0% for lipid. The yield of phycocolloid recorded 11.3%, 6.0% in *H. valentiae, A. spicifera* and *L. papillosa* respectively.

1192. **Kaliaperumal, N., Reeta Jayasankar and J.R. Ramalingam** 2003. Outdoor culture of agar yielding red alga *Gracilaria edulis* (Gmelin) Silva. *Seaweed Res. Utiln.,* 25(1&2): 159-164.

Address : Regional Centre of Central Marine Fisheries Research Institute, Marine Fisheries - 623 520, Mandapam Camp, Tamil Nadu, India and Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Agar yielding red alga *Gracilaria edulis* was successfully cultured in fibreglass tanks with running seawater at outdoor environment. The biomass of cultured seaweed showed a crop growth rate ranging between 3.9 - 8.0 g/ day after different days of culture. The tanks stocked with lesser quantity of seed material showed better growth rate. Experiments were also conducted by providing the seed material with different quantities of NPK, Urea, Ammonium sulphate + Sodium phosphate and Potassium nitrate + Phosphate + EDTA at weekly intervals. Higher crop growth rates (CGR) of 4.3 g/ day with 700 mg NPK and 5.2 g/ day with 80 mg urea were attained respectively. The growth rate recorded was 3.6 g/ day in the tanks provided with Ammonium sulphate

+ Sodium phosphate and 3.7 g/ day in the tank provided with Potassium nitrate + Phosphate + EDTA. Data on the environmental and hydrological parameters from seaweed culture tanks were recorded.

1193. **Kaliaperumal, N., J.R. Ramalingam, K. Diwakar and R. Ezhilvalavan** 2003. Effect of growth promoters on the onshore culture of *Gracilaria edulis* (*Gmelin*) Silva. *Seaweed Res. Utiln.*, 25(1&2): 169-174.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Culture of agar yielding red alga *Gracilaria edulis* was carried out in fibreglass tanks by providing running seawater and aeration under a shed with transparent roof. The seed material was pretreated for 12 hours at different concentrations of growth promoters IAA, IBA, GA, Ascorbic acid, EDTA and Inositol. In general, more increase in growth and biomass was obtained in the plants pretreated with lower concentrations of these growth promoters.

1194. **Kaliaperumal, N., S. Kalimuthu and J.R. Ramalingam** 2003. Pilot scale field cultivation of the agarophyte *Gracilaria edulis* (Gmelin) Silva at Vadakadu (Rameswaram). *Seaweed Res. Utiln.*, 25(1&2) : 213-219.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Pilot scale field cultivation of the agar yielding red alga *Gracilaria edulis* was carried out at Vadakadu near Rameswaram from July, 2001 to July, 2002 involving the local fisher folk. The growth of plants during July 2001 to January 2002 was good and they reached harvestable size of 19.6 to 28.9 cm (mean length) after 60 to 80 days growth and harvests were made. The seed material introduced during March to July 2002 degenerated due to turbid seawater, sedimentation and high seawater temperature. Data collected on environmental and hydrological parameters from the culture site at fortnightly intervals were correlated with the growth of cultured seaweed. The results obtained in this experiment revealed that commercial scale cultivation of *G. edulis* could be done successfully in the nearshore area of Vadakadu during the period July to January.

1195. **Kaliaperumal, N.** 2003. Conservation and management of seaweed resources for sustainable utilization. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 70.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds constitute one of the commercially important and reef associated marine living removable resources. They contain many trace elements, minerals, protein, iodine, bromine, vitamins and many bioactive compounds. They are the only source for the production of phytochemicals such as agar, carrageenan and algin, which are widely employed as gelling stabilizing and thickening agents in many industries like food, confectionary, pharmaceutical, dairy, textile, paper, paint & varnish etc. Seaweeds are also used as human food, animal feed and fertilizer. About 271 genera and 1053 species of marine algae belonging to four groups of algae namely Chlorophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae have been recorded so far from Indian waters. Many of these species grow in the reef areas. The total standing crop of seaweeds from intertidal and shallow waters of all maritime states and Lakshadweep was estimated as 91,333 tons (wet wt.). The quantity of seaweeds estimated in deep waters of Tamil Nadu was 75,373 tons (wet wt.) in an area of 1,863 sq.km. from Dhanushkodi to Kanyakumari. Annually about 5,000 tons (wet wt.) of alginophytes *Sargassum* spp., *Tunbinaria* spp and *Cystoseura trinodis* and 1,000 tons (dry wt) of agaraphytes *Gelidilla acerosa*, *Gracilaria edulis*, *G. crassa*, *G. folifera* and *G. verrucosa* are exploited from the natural seaweed beds of Tamil Nadu and used as raw material for the production of agar, alginate and liquid seaweed fertilizer in the country. The agar yielding seaweeds are over exploited due to more demand of raw material from agar industries. The ways and means for sustainable exploitation and conservation of seaweed resources for uninterrupted supply of raw materials to the seaweed based industries are given in this paper.

1196. **Kaliaperumal, N.** 2003. Products from seaweeds. *SDMRI Res. Publ.*, 3: 33-42.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds constitute one of the commercially important marine living renewable resources. They are the only source for the production of phytochemicals such as agar, agarose, carrageenan and algin which are widely used in various industries as gelling, stabilizing and thickening agents. Seaweeds are good sources of food and medicine. Food products like jelly, jam, pickle etc. can be prepared from seaweeds. Many bioactive compounds can be extracted from seaweeds. Seaweed meal and seaweed liquid fertilizer are also manufactured from marine algae. The methods for manufacturing different phytochemicals and products from seaweeds are given in this paper.

1197. **Kaliaperumal, N.** 2004. Production of agar from the seaweeds of Gulf of Mannar and Palk Bay. *Central Marine Fisheries Research Institute (CMFRI) Annual Report*, 2003-2004. pp. 82-83.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1198. **Kaliaperumal, N.** 2004. Seaweed research and utilization in India: Past, Present and Future. *Proc. Nat. Seminar on New Frontiers in Marine Bioscience Research,* January 22-23, 2004.

Address : Central Marine Fisheries Research Institute, Regional Centre, Mandapam Camp, India.

Abstract : Seaweeds or marine algae constitute one of the commercially important marine living renewable resources. They are the only source for the production phytochemicals such as agar, carrageenan and algin. These phytochemicals are widely employed as gelling, stabilizing and thickening agents in many industries. Seaweeds contain many trace elements, minerals, protein, iodine, bromine, vitamins and many bioactive substances. Seaweeds are considered to be medical food of the 21st century. Many protein rich edible seaweeds are consumed in the form of soup, salad and porridge. The food products like jelly, jam, chocolate, pickle and wafer can be manufactured from certain seaweeds. Marine algae are also used as animal feed and fertilizer for land plants.

1199. **Kaliaperumal, N and S. Kalimuthu** 2004. Commercial exploitation of Seaweeds in India. *Nat. Symp. & Expo.* pp. 35-37.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds are one of the commercially important marine living renewable resources. They occur in the intertidal and shallow waters of the sea and also in estuaries and backwaters. Seaweeds are used as human food and production of phytochemicals such as agar, carrageenan and alginate. In India, seaweeds are used as raw material for the manufacture of agar, alginates and liquid seaweed fertilizer. The seaweeds exploited from the natural seaweed beds are used as source for these finished products.

1200. **Kaliaperumal, N., S. Kalimuthu and J.R. Ramalingam** 2004. Present scenario of seaweed exploitation and industry in India. *Seaweed Res. Utiln.,* 26(1&2): 47-53.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Data collected on the commercial exploitation of seaweeds from the natural seaweed beds of Tamilnadu, India during 4 years period from 2000 to 2003 showed that the quantity of agarophytes viz. *Gelidiella acerosa*, *Gracilaria edulis*, *G. crassa*, *G. foliifera* and *G. verrucosa* varied from 965 to 1,518 tons (dry wt) and alginophytes *Sargasssum* spp and *Turbinaria* spp from 1,433 to 2,285 tons (dry wt) per year. The commercial harvest of seaweeds in Gulf of Mannar and Palk Bay is recommended only during the peak growth period of the algae from July/August to January. The harvest of commercially important seaweeds in a rational way from other parts of Indian coast, Lakshadweep and Andaman-Nicobar Islands is suggested. The need for large scale cultivation of agarophytes to augment the resources and uninterrupted supply of raw materials to the seaweed industries is emphasized.

1201. **Kaliaperumal, N.** 2005. Seaweed research and utilization in India : Past, present and future. *Nat. Symp. Marine Plants, their chemistry and utilization.* Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. pp. 23-25.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds or marine algae constitute one of the commercially important marine living renewable resources. They are the only source for the production of phytochemicals such as agar, carrageenan and algin. These phytochemicals are widely employed as gelling, stabilizing and thickening agents in many industries. Seaweeds contain many trace elements, minerals, protein, iodine, bromine, vitamins and many bioactive substances. Seaweeds are considered to be medical food of the 21st century. Many protein rich edible seaweeds are consumed in the form of soup, salad and porridge. The food products like jelly, jam, chocolate, pickle and wafer can be manufactured from certain seaweeds. Marine algae are also used as animal feed and fertilizer for land plants.

1202. **Kaliaperumal, N.** 2005. Prospects of seaweed farming in India. *Proc. Ocean life food and Med. Expo.,* Aquaculture Foundation of India, Chennai. p. 384.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seaweeds constitute one of the commercially important marine living renewable resources. They are used as human food, feed for animals, fertilizer for land crops, source of chemicals and drugs. The estimated total standing crop of seaweeds from intertidal and shallow waters of all maritime states, Lakshadweep and Andaman was 91,339 tons (wet wt.). The quantity of seaweeds estimated in deep waters of Tamilnadu was

75,373 tons (wet wt.) in an area of 1,863 sq.km. from Dhanushkodi to Kanyakumari. Annually about 5,000 tons (dry wt.) of alginophytes *Sargassum* spp, *Turbinaria* spp and *Cystoseira trinodis* and 1,000 tons (dry wt.) of agarophytes *Gelidiella acerosa, Gracilaria edulis. G. crassa, G. folifera* and G. *verrucosa* are exploited from the natural seaweed beds of Tamil Nadu and used as raw materials for the production of agar, alginates and liquid seaweed fertilizer. In India, experimental / pilot scale culture of agarophytes *Gelidiella acerosa, Gracilaria edulis* and *Gracilaria* spp and carrageenophytes *Hypnea* spp and *Kappaphycus alvarezii* is going on. The need for taking up large scale cultivation of these seaweeds to meet the raw material requirement of Indian seaweed industry is emphasized. The prospects of seaweed research and utilization in our country are discussed in this paper.

1203. **Kaliaperumal, N and J.R. Ramalingam** 2005. Effect of different fertilizers on the growth of *Gracilaria edulis* (Gmelin) silva in onshore cultivation. *Indian Hydrobiol.*, 7: 63-67.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Culture of agar yielding red alga *Gracilaria edulis* was carried out using fiberglass tanks in onshore condition under a shed with transparent roof and providing running seawater system and aeration. The seed material was pretreated for 12 hours at different concentrations of Urea, NPK, Superphosphate, Di-ammonium phosphate, Ammonium sulphate, Organic fertilizer, Organic mixture, Potash, Ammonium Chloride, Calcium nitrate, Magnesium sulphate and Ferrous sulphate. In general, the growth and biomass of cultured seaweed were found to be more in plants treated with low concentrations of these fertilizers than untreated and plants treated with higher concentrations. Data on the environmental and hydrological parameters from seaweed culture tanks were recorded.

1204. **Kalimuthu, S.** 1980. Variations in growth and mannitol and alginic acid contents of *Sargassum myriocystum* J. Agardh. *Indian J. Fish*., 27(1&2): 265-266.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies on the changes in growth and mannitol and alginic acid contents of *Sargassum myriocystum* carried out for one year, 1969, are presented. Young plants appeared from December to March and reached a maximum size during the period, May to August. The estimated mannitol content was 1.8 to 5.0% and the yield of alginic acid was 14.26 to 26.07%.

1205. **Kalimuthu, S., V.S.K. Chennubhotla, M. Selvaraj, R. Panigrahy and M. Najmuddin** 1980. Alginic acid and mannitol contents in relation to growth in *Stoechospermum marginatum* (C. Agardh) Kuetzing. *Indian J. Fish*., 27(1&2): 267-269.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Results obtained on the yield of alginic acid and mannitol contents of *Stoechospermum marginatum* carried out for one year during 1976 are presented. Young plants of *S. marginatum* appeared from May and June and reached harvestable size in September. The yield of alginic acid and mannitol was found to be lower than *Sargassum* and *Turbinaria* spp. The alginic acid content was found to be high during the months September to December. Alginic acid content varied from 14.5 to 23.8% and the mannitol content varied from 1.2 to 2.7%.

1206. **Kalimuthu, S., N. Kaliaperumal and J.R. Ramalingam** 1990. Present status of seaweed exploitation and seaweed industry in India. *Mar. Fish. Infor. Serv. T & E. Ser.*, 103: 7-8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The seaweeds are the only source for the production of phytochemicals such as agar, carrageenan and algin. During 1986-89, the CMFRI conducted surveys for seaweed resources of deeper areas.

1207. **Kalimuthu, S.** 1991. Unusual landings of agar yielding seaweed *Gracilaria edulis* in Kottaipattanam - Chinnamanai area. *Mar. Fish. Infor. Serv. T & E. Ser.*, 108: 10-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The quantity of seaweed landed (dry weight in tonnes) in different places in the Gulf of Mannar are discussed.

1208. **Kalimuthu, S., N. Kaliaperumal and J.R. Ramalingam** 1991. Standing crop, algin and mannitol of some alginophytes of Mandapam Coast. *J. Mar. Biol. Assoc. India*, 33(1&2): 170-174.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies were made from September 1985 to August 1986 on the standing crop, algin and mannitol

contents of three brown algae *Colpomenia sinuosa, Hydroclathrus clathratus* and *Rosenvingea intricata* growing at Shingle Island and Kilakkarai near Mandapam. The vegetation of these species occurred between September and March with maximum biomass of plants from December to February. The standing crop varied from 0.814 to 4.250 kg wet/m^2 for *C. sinuosa*, 1.823 to 4.971 kg wet/m^2 for *H. clathratus* and 3.309 to 12.024 kg wet/m^2 for *R. intricata* and the algin content ranged from 4.7 to 14.1%, 7.5 to 14.7% and 10.4 to 20.5% respectively with maximum values during December-February. The mannitol content varied from 0.5 to 2.2% in these seaweeds. There was no marked seasonal variation in the yield of algin and mannitol in these algae. The period from December to February is suitable for the harvest of these alginophytes for the production of sodium alginate.

1209. **Kalimuthu, S., N. Kaliaperumal and J.R. Ramalingam** 1992. Distribution and seasonal changes of marine algal flora from seven localities around Mandapam. *Seaweed Res. Utiln.*, 15(1&2): 119-126.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies on the distribution and seasonal changes in the marine algal flora were made for a period of one year from July '83 to June '84 by making fortnightly collection of algae from intertidal and subtidal regions, upto 1m depth at seven localities along Mandapam coast namely Rameswaram, Pamban, Krusadai Island, Thonithurai, Seeniappa Darga, Pudumadam and Kilakarai. Totally 104 algal species belonging to the groups Chlorophyta, Phaeophyta, Rhodophyta and Cyanophyta were recorded from these places. A maximum number of 77 algal species at Krusadai Island and a minimum number of 35 species at Rameswaram were recorded.

1210. **Kalimuthu, S., N. Kaliaperumal and J.R. Ramalingam** 1993. Effect of repeated harvesting on the growth of *Gelidiella acerosa* amd *Gracilaria corticata* var. *Corticata* occurring at Mandapam coast. *Seaweed Res. Utiln.*, 16(1&2): 155-160.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The effect of repeated harvesting on the growth of *Gelidiella acerosa* was studied for one year from August '87 to July '88 and *Gracilaria corticata* var. *corticata* for two years from July '87 to May '89. The growth of these agar yielding seaweeds depended on the harvesting season and the interval between successive harvests. The re-growth of these red algae continues as long as the basal rhizomatous portion is intact with the substratum. Hence harvest should be done by pruning the plants leaving the basal portions instead of plucking the whole plants. The commercial exploitation of G. *acerosa* should be made only during April to July and G. *corticata* var. *corticata* during April to June and September to November giving ample interval for their regrowth to harvestable size.

1211. **Kalimuthu, S., N. Kaliaperumal and J.R. Ramalingam** 1995. Distribution of algae and seagrasses in the estuaries and backwaters of Tamilnadu and Pondicherry. *Seaweed Res. Utiln.*, 17(1&2): 79-86.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1212. **Kalimuthu, S.** 2000. Seaweed exploitation and industry in India. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp. 71-74.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Since the inception of Central Marine Fisheries Research Institute at Mandapam in 1947, research on seaweeds and their utilisation is being carried out. Later on research on Indian seaweeds was started by Central Salt & Marine Chemicals Research Institute, Bhavnagar, National Institute of Oceanography, Goa and some State Government Fisheries Departments. In addition Universities of Madras, Annamalai, Andhra and Kerala have also started investigations on various aspects of seaweeds and seagrasses. These studies made by various organisations have contributed to the development of agar and algin industries in India.

1213. **Kalkman, I., I. Rajendran and C.L. Angell** 1991. Seaweed (*Gracilaria edulis*) farming in Vedalai and Chinnapalam, India. BOBP/WP/65.,GCP/RAS/1, 18/MUL, 28 pp.

Address : Bay of Bengal Programme (Fisheries development), Madras, India.

Abstract : This paper describes some trials with seaweed *(Gracilaria edulis)* farming in the open sea. These trials were carried out between 1987 and 1990 in Vedalai and Chinnapalam, two coastal villages in Ramanathapuram district, Tamil Nadu, India. The purpose of the trials was to discover whether the collectors of wild seaweed in the area could augment their income by cultivating seaweed and, thereby, also possibly preserve their natural resource, which is believed to be diminishing through over-exploitation. The trials were undertaken by the villagers themselves, with support from the Bay of Bengal Programme (BOBP) and the Tamil Nadu Department of Fisheries. The seaweed farming project, and this paper, which reports on it, have been, sponsored

by BOBP's "Small-Scale Fisherfolk Communities in the Bay of Bengal" (GCP/RAS/1/18/MUL), a project jointly funded by SIDA (Swedish International Development Authority) and DANIDA (Danish International Development Agency) and executed by FAO (Food and Agriculture Organization of the United Nations). Parallel with the culture trials, attempts were made to introduce simple agar processing technology at village level and this is described elsewhere. That work was carried out but the Post-Harvest Fisheries project of BOBP, which is funded and executed by the ODA (Overseas Development Administration) of the United Kingdom. The BOBP is a multi-agency regional fisheries programme, which covers seven countries around the Bay of Bengal - Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand. The Programme plays a catalytic and consultative role: it develops, demonstrates and promotes new techniques, technologies or ideas to help improve the conditions of small-scale fisherfolk communities in member-countries.

1214. **Kalyani, M., B.N. Kumar, S. Kathiroli and P.K. Suresh** 2003. Numerical model studies for the development of fisheries harbour at Thengapattinam. *National Seminar on Harbour Structures (NASHAR-2003), 20, 21 and 22 February, 2003, IIT Madras, Chennai.* pp. 105-114.

Address : National Institute of Ocean Technology, Tambaram - Velachery Main Road, Chennai - 601 302, Tmailnadu, India.

Abstract : Thengapattinam village (longitude of 77^{o} 10' and latitude of 8^{o} 14') is situated in Kanyakumari district having a coastline of 68 km with continuous fishing activity all along the coast. The fish production in the parts of Tamilnadu other than Kanyakumari district is continuously increasing from the year 1986. Further, there are not any proper infra-structural facilities like landing and berthing in this area. Understanding the need, the Government of Tamilnadu proposes to develop a fisheries harbour at Thengapattinam. Since the construction of breakwaters is on open coast, the behaviour of the same cannot be predicted without detailed model studies based on either numerical methods or physical modeling. This paper includes the details of planning of layout and numerical model studies on the wave tranquility within the harbour.

1215. **Kanagasabhapathy, M., K. Nagata, Y. Fujita, T. Tamura, H. Okamura and S. Nagata** 2004. Antibacterial activity of the marine sponge *Psammaplysilla purpurea*: Importance of its surface-associated bacteria. *Ocean '04 - MTS/IEEE Techno-Ocean '04: Bridges across the Oceans - Conference Proceedings*. 3: 1323-1329.

Address : Research Center for Inland Seas, Kobe University, Japan; Faculty of Maritime Sciences, Kobe University, Japan; Department of Bacteriology, Hyogo College of Medicine, Japan; Department of Chemistry, Hyogo College of Medicine, Japan.

Abstract : Among marine invertebrates, sponges are the most prolific phylum, with regard to presence of novel pharmacologically active compounds. Several marine sponges were collected from Gulf of Mannar, India and screened for their antibacterial activity against various pathogenic bacteria. The sponge *Psammaplysilla purpurea* that showed remarkable antibacterial activity was selected for the present study. Antifouling activity was checked against a set of fouling bacteria isolated from antifouling paint coated plates. Sponge microbial associations have long been documented, but relatively little is known about the nature of their interactions. Bacteria living on the surface of marine invertebrates have been found to produce chemicals that are having potential antibacterial and antifouling activities. To test this hypothesis about 102 bacterial isolates associated with the sponge were obtained using standard procedures. Among them three isolates were selected and further investigated not only for the ability and enhancement of antibiotic production against pathogenic *Escherichia coli* but also for the ability to inhibit the growth of fouling bacteria. The present findings show the importance of sponge surface-associated bacteria in producing new natural compounds.

1216. **Kandasami, D and P. Muthiah** 1988. Microencapsulated diet for larvae and spat of *Crassostrea madrasensis*. *CMFRI Bulletin,* 42(2): 354-358.

Addres : Central Marine Fisheries Research Station, Cochin - 682 018, India.

Abstract : Edible oyster larvae spat with *Isochrysis galbana* supplemented with micro encapsulated diet prepared from oyster, clam or fish oil extracts. In the experiments conducted with oyster larvae, spat setting was higher in the larvae fed with algal diet supplemented with oyster oil extract encapsulated diet than those fed with algal diet. Better growth and more weight increase was observed among the spal fed with algal diet supplemented with microencapsulated diet containing oyster Oil and fish oil, compared to that in oyster spat fed with algal diet alone.

1217. **Kandasami, D.** 2000. Marine Seaweed Culture. *Golden Jubilee Celebrations, Souvenir 2000, Mandapam*

Regional Centre of CMFRI, Mandapam Camp, pp. 28-35.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Since the inception of Central Marine Fisheries Research Institute at Mandapam in 1947, research on seaweeds and their utilisation is being carried out. Later on research on Indian seaweeds was started by Central Salt & Marine Chemicals Research Institute, Bhavnagar, National Institute of Oceanography, Goa and some State Government Fisheries Departments. In addition Universities of Madras, Annamalai, Andhra and Kerala have also started investigations on various aspects of seaweeds and seagrasses. These studies made by various organisations have contributed to the development of agar and algin industries in India.

1218. **Kandhasamy, M.** 2004. Microbial Pollution of the coastal Waters of the Pilgrim Town Rameswaram Due to Tourists Inflow. Madurai Kamaraj University, *Ph.D Thesis.* 152 pp.

Address: Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai - 625021, Tamil Nadu, India.

Abstract : In the present study influence of mass bathing, sewage disposal and run-off water on microbial quality of seawater, sediments and marine invertebrates at bathing place, Agnitheertham, Sewage Mixing Place of Rameswaram Island and Kudankulam respectively, was evaluated. Fortnight samplings were made from August 1994 to July 1996. Indicator bacteria such as total coliforms fecal coliforms and fecal streptococci were isolated from all the samples collected from all three sampling sites, throughout the study period. Generally density of total colifroms was higher than fecal coliforms, fecal streptococci and the density of fecal coifroms was the least, in all samples analyzed. The density of indicator bacteria in sediments was higher than in water. All samples collected from Sewage mixing place contained high density of indicator bacteria than Agnitheertham and Kudankulam. High densities of indicator bacteria were observed during the first year of the study period than in the second year of the study period. High densities of indicator bacteria were observed at Agnitheertham, sewage mixing place and Kudankulam during summer season and monsoon season. The densities of total coliforms, fecal coliforms, and fecal streptococci in water at Agnitheertham ranged from 3.26 to 5.78 $\log_{10}$ cfu/100ml, 2.17 to 5.02 $\log_{10}$ cfu/100ml and 2.02 to 4.37 $\log_{10}$ cfu/100ml respectively; in sewage mixing place 4.03 to 6.0 $\log_{10}$ cfu/100ml, 3.81 $\log_{10}$ cfu/100ml and 2.14 to 4.89 $\log_{10}$ cfu/100ml and in Kudankulam 2.14 to 4.89 $\log_{10}$ cfu/100ml, 2.01 to 4.45 $\log_{10}$ cfu/100ml and 1.89 to 4.23 $\log_{10}$ cfu/100ml respectively. In sediments of Agnitheertham, the densities of total coliforms, fecal coliforms, and fecal streptococci ranged between 4.4 and 7.27 $\log_{10}$ cfu/g, 3.25 and 5.91 $\log_{10}$ cfu/g, and 3.11 and 5.26 $\log_{10}$ cfu/g respectively; in sewage mixing place 5.21 and 7.9 $\log_{10}$ cfu/g, 5.03 and 6.34 $\log_{10}$cfu/g and 5.01 and 6.03 $\log^{10}$cfu/g and in Kudankulam 2.89 and 6.4 $\log_{10}$cfu/g, 2.79 and 2.79 $\log_{10}$cfu/g and 2.01 and 5.24 $\log_{10}$ cfu/g respectively. Densities of indicator bacteria were directly proportional to the number of pilgrims gathered and took bath at Agnitheertham of Rameswaram island. It was proved by 12h study, of mass bathing at different festivals. Among the festivals, Audi ammavasai showed high density of indicator bacteria than other festivals and least density of fecal streptococci were observed in Panguni Uthiram. Diurnal variation was also observed in the mass bathing. High densities of indicator bacteria were observed in the early morning (5AM) which gradually increased and attained a peak at 12 Noon and then decreased and again the densities of indicator bacteria increased in the evening at 5 O'clock when large number of pilgrims took bath at Agnitheertham. Halophilic vibrios such as *Vibrio parahaemolyticus* and *vibrio alginolyticus* were isolated from seawater (4.11 to 4.97 $\log_{10}$ cfu/100ml and 5.34 to 5.9 $\log_{10}$ cfu/100ml respectively), and sediments of Agnitheertham (5.4 to 7.3 $\log_{10}$ cfu/g and 6.5 to 8.6 $\log_{10}$ cfu/g respectively), sewage mixing place (in water 3.32 to 4.76 $\log_{10}$ cfu/100ml and 5.34 to 5.9 $\log_{10}$ 100ml and in sediments 6.2 to 8.1 log10 cfu/g and 6.5 to 8.6 $\log_{10}$ cfu/g respectively) and Kudankulum (in water 3.6 to 4.95 $\log_{10}$ cfu/100ml and 5.81 to 8.9 $\log_{10}$ cfu/100ml and in sediments 5.3 to 7.2 $\log_{10}$ cfu/g and 6.4 to 8.1 $\log_{10}$ cfu/g respectively). The density of *Vibrio alginolyticus* was higher than *Vibrio parahaemolyticus*, in water and sediments of all sampling sites. Indicator bacteria *Vibrio parahaemolyticus* and *Vibrio alginolyticus* were isolated from marine invertebrates collected at all sampling sites, throughout the study period. As observed in water and sediments samples total coliforms was higher than fecal coliforms and fecal streptococci. The density of fecal streptococci was the least in their density in all samples of marine invertebrates analyzed. Density of *V. alginolytidus* was higher than *v. parahaemolyticus*. Invertebrates collected from sewage mixing place showed high density of indicator bacteria and halophilic vibrios. Among the invertebrates analyzed, bivalves showed high density of indicator bacteria and halophilic vibrios. Among bivalves, *Donax faba* showed high density of indicator bacteria (Total coliforms 3.185 to 6.814 $\log_{10}$ cfu/g, fecal coliforms 1.115 to 4.821 $\log_{10}$/g and fecal streptococci 1.935 to 4.513 $\log_{10}$ cfu/g) halophilic vibrios (*V. parahaemolyticus* 2.214 to 3.541 $\log_{10}$ cfu/g and *V. alginolyticus* 2.126 to 3.145 $\log_{10}$ cfu/g). Seawater at Agnitheertham was not suitable for bathing and recreational activities, since the density of indicator bacteria was beyond the standard safety limit for bathing and other recreational water

quality. Sewage mixing place was heavily polluted due to continuous disposal of sewage and the pathogens present in the seawater of sewage mixing place will infect the seafood organisms. If such contaminated seafoods are consumed, they may cause health hazards to the consumers. Proper monitoring and attention should be given to the bathing place Agnitheertham, otherwise the bathers will be infected by the pathogens and hence proper treatment should be given to the sewage before disposal into the sea.

1219. **Kanimozhi. G., N. Nadimuthu and A. Pannerselvam** 2005. Occurrence of filamentous fungi in mangrove substratum along Palk Bay coast. (Abstract only). *Nat. Symp. Marine Plants, their chemistry and utilization.* Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. p 21.

Address : P.G. and Research Department of Botany and Mcrobiology, A.V.V.M. Sri Pushpam College, Poondi-613 503, Tamilnadu, India.

Abstract : Partially decomposed litter samples were collected from 10 stations in Pall Bay during the month of May 2003. Altogether 557 litter samples belong to six different plant origin *(Avicennia* pnematophore, wood, *Suaeda* sp., *Salicornia* sp., *Rhizophora* sp., *Exocaria* sp and *Aegiceros* sp). Totally 20 species of obligate marine fungi belonging to 9 Ascomycetes, one Basidiomycetes and 10 Deutromycetes were identified by direct examination method.

1220. **Kannan, L.** 1996. Report on the biodiversity of microbial flora (bacteria and phytoplankton) of the coral reef of the Gulf of Mannar. *Report submitted to Ministry of Environment and Forest New Delhi. Govt of India.*

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

1221. **Kannan, L.** 1998. Plankton and their productivity. *Proc. Technical Workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve,* MSSRF Publ. pp. 76-85.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

Abstract : Plankton is one of the important components of the coral reef ecosystems. This is obvious from the abundant occurrence of planktonivorous animals in the coral reef communities. Among plankton, phytoplankton is the primary source of food in the marine pelagic environment, initiating the food chain, which may culminate even in large mammals. Though the phytoplankton production is considered to be of secondary importance compared with the benthic autotrophs and symbionts in the coral reef environment (Odum and Odum 1955), there are increasing evidences from studies conducted after 1960s and recent studies (Angot 1968; Soumia 1968; Glynn 1973; Sorokin 1979; Kannan 1996) to demonstrate that the phytoplankton are equally important in the ecosystem as any other producer. It holds good for the coral reef ecosystem of the Gulf of Mannar Biosphere Reserve also.

1222. **Kannan, L., K. Kathiresan and A. Purushothaman** 1998. Biodiversity of microbial flora (Bacteria and Phytoplankton) of the Coral reef of the Gulf of Mannar. *Himavikas occasional Publ.,* 12: 207-220.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

Abstract : The coral reef ecosystems are unique, fragile and highly productive ecosystems endowed with a plethora of flora and fauna. Microbes are important components in the coral reef biota and among them, bacteria play a key role in the regeneration of nutrients, thereby maintaining the productivity of that environment. Like bacteria, phytoplankton are also equally important in the coral reef environment as they are the primary producers initiating food-web process. In addition, these organisms serve as indicators of water quality with their ability to detect even the subtle changes taking place in their immediate environment by changing their species composition, diversity, dominance, distribution, standing crop and primary production. Studies on such important organisms in the fragile ecosystems have received only little attention globally (Sorokin, 1990) and in India, especially in the Gulf of Mannar Biosphere Reserve (Bakus, 1993). This study is the first of its kind in India to evaluate the microbial (bacteria and phytoplankton) diversity in the coral reef environment of the Gulf of Mannar.

1223. **Kannan, L., P. Anantharaman and M.M. Pillai** 1998. Micro-phytobenthic diatoms of the Tamil Nadu coast. *Phykos,* 36(1&2): 103-113.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

Abstract : Among the 29 stations investigated, Pitchavaram, Tamil Nadu, India supported a good growth of micro-phytobenthic diatoms. Richness of species was noticed here followed by Golden Beach, Parangipettai, Chinnavaikal, Cuddalore, Kovalam (Kanyakumari), Mahabalipuram, Manora, Nagapattinam, Cooum Mouth, Kasimedu, Thiruvanmiyoor, Tranquebar, Kanyakumari and Poombukar in that order. A total of 96 micro-phytobenthic diatoms were identified.

1224. **Kannan, L., T. Thangaradjou and P. Anandharaman** 1999. Status of seagrasses of India. *Seaweed Res. Utiln.,* 21(1&2): 25-34.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

1225. **Kannan, L.** 2004. Studies of CAS in coral reef research. *Seshaiyana,* 12(1): 10-13.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

Abstract : Coral reefs are tropical shallow water ecosystems, largely restricted to the seas between the latitudes 30° N and 30° S. Reefs protect the coastline against waves, prevent erosion and contribute to the formation of sandy beaches and sheltered harbours. Biodiversity of such coral reef ecosystems is unique in embracing a plethora of flora and fauna. The Centre of Advanced Study in Marine Biology, Annamalai University has carried out studies on many interesting aspects from microbes to pollution in the coral reef environments of the east coast of India in the Gulf of Mannar, Palk Bay and Great Nicobar Island.

1226. **Kannan, L.** 2005. Seagrasses of India: Eco-biology and conservation. *Nat. Symp. Marine Plants, their chemistry and utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. p 13.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu India.

Abstract : Seagrasses are marine flowering plants capable of completing their life cycle when they are submerged fully under seawater and are found distributed in almost all the seas of the world except the polar seas. In India, there are 14 species of seagrasses recorded along the east and west coasts. The Gulf of Mannar, Palk Bay, Andaman and Nicobar Islands and Lakshadweep islands are known for seagrass resources. Seagrass species *viz. Enhalus acoroides, Thalassia hemprichii, Cymodocea* spp and *Halodule* spp contribute more biomass in these regions and their photosynthetic productivity is also higher as compared to the other most productive seagrass regions of the world. Environmental (meteorological and physico-chemical) conditions including sediment characteristics play a major role in controlling the distribution, diversity, biomass and productivity of the seagrasses. Among the various ecological parameters, temperature, salinity, turbidity, nutrients and sand-silt composition are the key factors that influence the biomass, distribution and productivity of the seagrasses.

1227. **Kannan, P and M. Rajagopalan** 2004. Role of marine macrophytes as feed for green turtle *Chelonia mydas*. *Seaweed Res. Util.,* 26(1&2): 187-192.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This paper deals with the food and feeding habits of the green turtle *Chelonia mydas* caught incidentally in different fishing gears during 1998-2000 at Tuticorin and Pamban areas. The seaweeds and seagrasses observed in their gut contents are *Gelidiella acerosa, Hypnea valentiae, Solieria robusta, Sargassum spp., Pocockiella variegata, Dictyota dichotoma, Halimeda macroloba, Caulerpa fergusonii, Ulva reticulata* and *Chaetomorpha* sp (seaweeds), *Halophila ovalis, Thalassia hemprichii* and *Cymodocea serrulata* (seagrasses). The marine macrophytes play the major role in the survival of adult animals since they are purely herbivores.

1228. **Kannan, R., A.K. Kumaraguru, A. Sundaramahalingam, M. Ramakrishnan and M. Rajee** 2001. Socioeconomic status of coral reef resource users of Pamban region, Gulf of Mannar, South India. *Man in India*, 81(1& 2): 103-121.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai-625 021, India.

Abstract : The present study assumes importance because the coastal fishing community relying on the coral reef resources by and large remains isolated from the mainstream and as such it evokes interest of the academics with multifarious research interests. The fishers concerned constitute a social and economically backward section

of the society. They are solely depending on the unstable income from fishing and fishing related activities, using different types of fishing gears, throughout the seasons of a year. In the pursuit of their occupation, they are also doing extensive damage to coral reefs that support a variety of marine fauna and flora such as gorgonians, seacucumber, seaweeds, etc. The fishers residing in Pamban region are living in abject poverty, both the government and the local fishermen associations attempt to improve their living standard and try to remove their bondage from usurious moneylenders.

1229. **Kannapiran, E and L. Kannan** 1995. Distribution of seaweeds in some Islands of the Gulf of Mannar. *Nat. Symp. Algal potential and its exploitation, Madurai,* p 42.

Address : CAS in Marine Biology, Annamalai University, Parangipettai 608 502, Tamil Nadu, India.

1230. **Kannapiran, E.** 1997. Heterotropic phosphatase producing and phosphate solubilising bacteria of the coral reef environment of the Gulf of Mannar Biosphere Reserve (Southeast coast of India): An inventory. *Ph.D. Thesis*, Annamalai University, India, 103 pp.

Address : CAS in Marine Biology, Annamalai University, Parangipettai 608 502, Tamil Nadu, India.

1231. **Kannapiran, E., A. Purushothaman, L. Kannan and S. Saravanan** 1999. Magneto bacteria from estuarine, mangrove and coral reef environs in Gulf of Mannar. *Indian J. Mar. Sci.,* 28(3): 332-334.

Address : CAS in Marine Biology, Annamalai University, Parangipettai 608 502, Tamil Nadu, India.

Abstract : Totally 37 strains from three biota were isolated with predominance of *Bacillus* spp. followed by *Pseudomonas spp., Spirillium spp.*, and *Vibrio spp.* Based on the fatty acid profile, a few of the strains were identified as *Pseudomonas mesophilico, Pseudomonas caryophylli* and *Bacillus cereus.* Of the three biota studied, the coral reef harbours higher percentage of magnetotactic bacteria followed by the mangroves and estuaries. The strains were further studied for growth, salinity optimum, magnetotaxis and survival. The bacterial growth was observed as a ring formation between 7 and 14 days of inoculation. The distance to the ring from the top surface of culture medium ranged from 0.5 to 4.6 cm. The ring was prominent in a salinity of 20 ppt. Regarding magnetotaxis, a 3 h exposure to the external magnetic field was required for 100% aggregation of bacterial cells. The magneto bacteria isolated from coral reef were able to survive for 5 to 6 months whereas those from mangroves and estuaries survived for 4 and 2 months respectively.

1232. **Kannappan, S., G. Indra Jasmine, P. Jeyachandran and A.T. Selvi** 1999. Polyaromatic Hydrocarbons in Fresh Marine Fin and Shell Fishes. *J. Food Sci. Technol.*, 36(5): 472-474.

Address : Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu, India; Division of Microbiology, Defense Food Research Laboratory, Siddarthanagar, Mysore-570 011, Karnataka, India.

Abstract : Different varieties of fresh marine fin and shell fishes from the same catch of Tuticorin waters were analyzed for polyaromatic hydrocarbons [PAHs] by HPLC. The results showed that chrysene followed by dibenzanthracene was present in the majority of the samples analyzed. Benzo (a) pyrene was not detected in the fishes.

1233. **Kannappan, S., G. Indra Jasmine, P. Jeyachandran and A.T. Selvi** 2000. Polyaromatic Hydrocarbons in Processed Fishery Products. *J. Food Sci. Technol.*, 37(6): 596-601.

Address : Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu India; Division of Microbiology, Defence Food Research Laboratory, Siddarthanagar, Mysore-570 011, Karnataka, India.

Abstract : Different varieties of fresh marine fin and shell fishes like sardine, mackerel, tuna, red snapper, ribbon fish, catfish, shrimp, oyster, squid etc., from the same catch of Tuticorin waters were processed in the laboratory and analyzed for polyaromatic hydrocarbons (PAHs) like chrysene (CRY), dibenzanthracene (DBA) and benzo(a)pyrene (BAP). Similarly, commercially available processed fishery products were also analyzed. Variations in the methods of cooking on the contents of PAHs in sardine fish were observed. The results showed that CRY was present in the majority of the samples analyzed. Salt cured shark fish contained 2.30 ± 05µg CRY/ g.2.60 ± 0.15 µg DBA/g and 3.78 ± 0.5 µg BAP/g. Commercially processed salt cured sardine also contained all the three hydrocarbons. Boiled sardine contained 0.04 ± 0.01µg BAP/g, while grilled sardine contained 0.02 ± 0.009 µg BAP/g.

1234. **Karl Marx, K.** 1997. Experimental culture of tilapia in brackishwater ponds. *Indian Vet. J.*, 74(6): 486-487.

Address : Fisheries College and Reseach Institute, Turicorin - 628 008, Tamilnadu, India.

Abstract : Tilapia (*Oreochromis mossambicus*) was first intoduced into India in 1952 and is widely considered to be a weedfish in freshwater fish farming systems. Although Tilapia could be cultured in brackishwaters, research studies on these aspects in India are very limited. Hence, this experiment was carried out at the Fisheries College and Research Institute, Tuticorin between March and June, 1994.

1235. **Kartha, K.N.K.** 1959. A study of the copepoda of the inshore waters of Palk Bay and Gulf of Mannar. *Indian J. Fish.,* 6(1&2): 265-267.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : The paper deals with a detailed study of the composition of the population and behaviour of the dominant species of copepods in the Gulf of Mannar and Palk Bay. It is observed that the species which contributed to the bulk of the copepod stock were same at both the stations and the differences in the modes of fluctuation of the total copepods between them were due to the differences in the occurrence of copepodites and to the diversity of patterns of distribution of the individual species. Details of the distribution patterns of the important species are given. The spawning activity of the copepod populations of the two stations, as indicated by nauplii and copepodites, was also different during the three years. Intensity of spawning appears, in general, to be high at station P, where during May- September the nauplii and copepodites reached numerically high magnitudes.

1236. **Karthikeyan M., M.G. Pillai and M. Badrudeen** 1989. Population dynamics of Silverbelly *Leiognathus jonesi* James in the trawling grounds of Rameswaram. *Indian J. Fish.,* 36(2): 103-106.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Von Bertalanffy growth parameters for *Leiognathus jonesi* are estimated as: $L_{(inf)}$ = 146.617 mm and K = 0.917 per year. The coefficient of total mortality (Z), natural mortality (M) and fishing mortality (F) rates are estimated. The length-weight relationship of the fish is W= $0.000030335_L 2.887$. Beverton and Holt yield per recruit analysis shows that an increase in Lc results in better yield per recruit. The estimated average annual stock ranges between 8,800 and 9,100 tonnes and the average standing stock between 1,700-1,900 tons.

1237. **Karunagaran, V.M., S. Babu, R.Babu Rajendran and A.N. Subramanian** 1994. Organochlorine insecticide (HCHs and p.p - DDE) residues in fishes from Kanyakumari. *Indian J. Mar. Sci.,* 23: 182-183.

Address : CAS in Marine Biology, Annamalai University, Porto Novo, India.

Abstract : Eight species offish comprising carnivorous, herbivorous and planktivorous forms were analysed for HCH isomers (ex, p and y) and p, p - DDE residues in edible tissues. Total HCH concentration ranged between 4.2 $ng.g^{-1}$ wet wt in *Sardinella longiceps* and 23.1 $ng.g^{-1}$ in *Scomberomorus guttatus.* The lowest concentration of p.p - DDE was recorded in *Scomberomorus guttatus* (0.11 $ng.g^{-1}$) and the highest (2.2 $ng.g^{-1}$) in *Nemipterus japonicus.* The residual concentrations in fishes were well below the tolerance levels prescribed.

1238. **Kasinathan, C.** 1988. Olive ridley landed at Pamban reported. *Mar. Fish. Infor. Serv. T & E. Ser.,* 84: 10.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : Landing of *Lepidochelys olivacea* on 7th Jan'1988 at Pamban caught in trawl net from the Gulf of Mannar off Dhanushkodi at a depth of 12-15 m has been reported.

1239. **Kasinathan, C.** 1988. Bumper catch of 'Kalaru' from Dhanushkodi and Moondrurayar chathiram (Palk Bay), Rameswaram Island. *Mar. Fish. Infor. Serv. T & E. Ser.,* 89: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : The five-spotted herring *Hilsa kelee* catch in various nets operated at Dhanushkodi were observed and the catching rates are given.

1240. **Kasinathan, C and M. Bose** 1989. On a bumper catch of catfish Manthan Keluru landed at Verkottil centre, Rameswaram Island. *Mar. Fish. Infor. Serv. T & E. Ser.,* 95: 8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : The observation on the trawl net fishing near Verkottil near Rameswaram revealed the bumper catch of *Arius caelatus*. The total quantity landed and the size of catfish are discussed.

1241. **Kasinathan, C and A. Palanichamy** 2002. On two species of marine turtles stranded at Mandapam. *Mar. Fish. Infor. Serv., T&E Ser.,* 171: 10.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : A female olive ridely turtle *Lepidochelys olivacea* was stranded on 21.7.2000 near CMFRI jetty at Gulf of Mannar coast. Another female green turtle *Chelonia mydas* was stranded on 06.09.2000 at the same place. Both the turtles had severe injuries, perhaps the cause of death in the sea and then stranded. Their carapace length was 58, 82 cm and width 56, 62 cm respectively. The morphometric measurements (cm) of the turtles are given.

1242. **Kasinathan, C., K. Muniyandi, M. Bose and A. Gandhi** 2002. Observations on whale shark *Rhincodon typus* (Smith) caught at Pamban, Palk Bay and Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 174: 12-13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : A male whale shark *Rhincodon typus* of 688 cm in total length caught in a No.4 gill net was landed on 20-01-2001 at Pamban light house landing centre. The whale shark was estimated to weigh around 1.5 tons. The fishing ground was 40 km northeast from the landing centre.

1243. **Kasinathan, C and P. Kannan** 2005. On a spinner dolphin, *Stenella longirostris* (Gray) washed ashore at Dhanushkodi along Gulf of Mannar. *Mar. Fish. Infor. Serv., T&E Ser.,* 183: 19.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : A dead dolphin was washed ashore at CMFRI jetty along Gulf of Mannar coast on 19-7-2004. From the external characters, mainly the number of teeth, it was identified as spinner dolphin, *Stenella longirostris*. The specimen was a female of 132 cm in total length and 30 kg weight, having fresh external wounds in the flipper, dorsal side of body and caudal regions, which suggested the possibility of having hit by boats.

1244. **Kasinathan, C., P. Kannan and N. Ramamoorthy** 2005. On a spinner dolphin, *Stenella longirostris* (Gray) washed ashore at Dhanushkodi along Gulf of Mannar. *Mar. Fish. Infor. Serv., T&E Ser.,* 183: 19.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : At Dhanushkodi, one live dolphin was sighted near the shore on 13-9-04. The fishermen pushed the dolphin to deeper area. But it died in a couple of hours. From the external characters, mainly the number of teeth, it was identified as spinner dolphin, *Stenella longirostris* (Gray). The specimen was a female measuring 170 cm in total length and 37 kg in weight.

1245. **Kasinathan, C and Sandhya Sukumaran** 2005. A note on the coral reef degradation in some islands of Gulf of Mannar. *Mar. Fish. Infor. Serv., T&E Ser.,* 184: 15-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : The coral reefs of Gulf of Mannar are facing increasing threats from anthropogenic impacts like sedimentation, illegal coral mining, fishing and pollution. It was found that the northern side of the islands of Manauli and Hare and the southern side of Pullivasal which had rich coral populations earlier, have been totally destroyed.

1246. **Kasinathan, C., Sandhya Sukumaran, N. Ramamoorthy and K. Balachandran** 2006. Whale shark, *Rhincodon typus* landed at Mandapam, Gulf of Mannar. *Mar. Fish. Infor. Serv., T&E, Ser.,* 187: 21.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623520, Tamilnadu, India.

Abstract : A male whale shark *Rhincodon typus* measuring 8.2m in length and approximately tonnes in weight was caught in pair trawl net operated 30km away from the shore in Gulf of Mannar at a depth of 55mm on 11-1-2006.

1247. **Kasinathan, R and K. Govindan** 1975. Egg masses and development of *Cerithium morus* Lamarck (Mesogastropoda: Mollusca) under laboratory conditions. *Indian J. Mar. Sci.*, 4(1): 96-97.

Address : National Institute of Oceanography, Bombay - 400 061, India.

Abstract : Spawning, larval development and metamorphosis of *Cerithium morus* have been observed. The breeding activity of this species at Bombay is compared with that of the Gulf of Mannar. The present study also

indicates that this species could easily be maintained in the lab for a long period.

1248. **Kasinathan, R., P. Madeswaran and G.A. Thivakaran** 1989. Rare occurrence of *Balanus amphitrite* Darwin, 1854, inside the Cock's comb oyster *Crassostrea cristagalli* (Linnaeus, 1758). *Curr. Sci.*, 58(12): 702-704.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : During a routine survey in the rocky shore at Tuticorin, Tamil Nadu, the authors came across a live barnacle, *Balanus amphitrite*, attached inside the left valve of the Cock's comb oyster, *Crassostrea cristagalli*. The barnacle was found attached to the adductor muscle. The shell of the oyster measured 4.7 cm in length and 4 cm in width. The barnacle measured 0.89 cm in height and 0.67 cm in diameter. The barnacle was active during collection, with the cilia actively sweeping the water for food particles.

1249. **Kathal, P. K.** 2005. Sethusamudram ship canal project: Oceanographic/geological and ecological impact on marine life in the Gulf of Mannar and Palk bay, southeastern coast of India. *Curr. Sci.,* 89(7): 1082-1083.

Address : Centre of Advanced Study in Geology, Dr.H.S.G University, Sagar-470 003, India. E-mail: pkkathal@rediffmail.com

Abstract : Sethusamudram Ship Canal (SSC) to be dredged, across a natural chain of shoals of the Adam's Bridge connecting the Gulf of Mannar to Palk Bay along the south-eastern Indian coast of India may trigger ecological imbalance in the region. Environmentally stressed factors like turbidity caused by dredging/displacement of around 9.7 million cubic meter bulk of rock, shoal and sediments during the operation will disturb the O_2-CO_2 ratio, imperative for life and health of phytoplankton. This in turn will retard photoinhibitation and lower the pH of water, amidst a slow pace of photosynthesis besides encouraging an abundant growth of anaerobic organisms that may affect the health of other organisms including marine algae, fish and corals within a very short span of time. A few ecological indicators have been suggested enabling the resource managers to minimise the environmental impact of the canal with affordable procedures in order to safe-guard the earth's second highest marine biodiversity.

1250. **Kathiresan, K., P. Moorthy and S. Ravikumar** 1995. Studies on root growth in seedlings of a tropical mangrove tree species. *Inter. Tree, Crop. J.*, 8:183-187.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

Abstract : The influence of propagule length, plantation depth, soil type and irrigants on root growth of *Rhizophora* spp. was studied. Propagule lengths of 25-30 cm for *R. apiculata* and 25-40 cm for *R. mucronata* planted to a depth of one third of their length in a silt clay substratum irrigated with 1.5 $g.l^{-1}$ seawater for *R. mucronata* and fresh water for *R. apiculata* showed better rooting and establishment of mangrove seedlings in nursery conditions.

1251. **Kathiresan, K and N. Rajendran** 1998. Mangroves - Associated Communities. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve,* MSSRF Publ. pp. 156-164.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu. India.

Abstract : Mangroves are of great ecological and economic significance and are among the most productive ecosystems. Their daily rate of organic matter fixation (20g organic matter/m^2/day) which is about 70 times the maximum value reported for tropical oceanic waters, and 6 times the mean reported for marine flagellate blooms in neritic waters (Ryther 1969; Burkholder *et al*, 1967; Cintron and Novelli, 1982). Because of this high rate of production of organic matter, the mangroves are able to sustain a diverse community of organisms, ranging from bacteria to fishes, birds, and mammals. The mangrove ecosystems exist alongside other productive ecosystems such as seagrass meadows and coral reefs. When this is the case, the coastal marine environment becomes highly productive in tropical waters which are otherwise "Biological deserts" due to very poor nutrients and low phytoplankton populations.

1252. **Kathirvel, M.** 1978. Harvesting and marketing of cultured prawns. *CMFRI Spec. Publ.,* 3: 121-127.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Harvesting and marketing are the final phases of a culture operation. The economy of the culture operation depends on the quantity harvested and that of marketing on the quality produced. In the traditional

prawn culture practices of the Indo-pacific region harvesting is carried out by nets, by bamboo-screen traps, by draining and by hand picking, while the mechanically operated drag nets are employed in the more advanced countries.

1253. **Kavitha, A., G.S. Regini Balasingh, A. Palavesam and A.D.S. Raj** 2006. Culture of diatom *Navicula halophila* for application as live feed in aquaculture. *Seaweed Res. Utiln.,* 28 (1): 171-174.

Address : Department of Botany and Research Centre, Scott Christian College, Nagercoil - 629 003, Tamilnadu, India.

Abstract : The pinnate diatom *Navicula halophila* is being used as live feed in aquaculture. In the present study, this microalga was cultured in low cost less expensive nitrogen rich growth medium enriched by *Azolla* and *Ulva* extracts under laboratory conditions. Cells harvested at stationary phase provided valuable information with high chlorophyll *a*, carotenoid, protein, carbohydrate and lipid contents. This low cost medium contributes more production of proteinaceous unicellular alga, opening new vistas for supplementary food and feed production.

1254. **Kavitha, A., G.S. Regini Balasingh, A. Palavesam and A.D.S. Raj** 2006. Microalgal diversity of Rajakkamangalam estuary, south west coast of Tamilnadu. *Seaweed Res. Utiln.,* 28(1): 33-41.

Address : Department of Botany and Research Centre, Scott Christian College, Nagercoil - 629 003, Tamilnadu, India.

Abstract : The present investigation was carried out from January to December, 2000 at four stations of Rajakamangalam estuary in southwest coast of Tamilnadu. The micro algal population density, species diversity, species evenness, species richness and similarity index were studied. Maximum cell density was observed in the month of August with a prominent peak. Out of 85 species, diatoms dominated 60 species. 3 Dinoflagellates and 22 other algae were also observed. Maximum species diversity was noted during non-monsoon period as a result of higher temperature, salinity tolerance and with several other physico-chemical characters.

1255. **Kelleher, G.** 1997. Conservation and Sustainable use of Coral Reefs. *Regional workshop on the conservation and sustainable management of coral reefs,* Proceedings No. 22, CRSARD, Madras. pp. C87-C89.

Abstract : The seas of South Asia include areas of extremely high biological productivity as well as biological diversity. Coral reefs are the most biologically diverse ecosystems on earth, but they and other marine ecosystems are subject to degradation from a variety of human activities, even though it is widely recognised that their living resources are vital to the survival of many of the region's human communities. The region has a long history of human interaction with the natural environment both on land and in the sea. It is necessary to preserve this cultural relationship and to build on it so as to achieve ecologically and culturally sustainable use of the marine environment. It follows procedures to evaluate and protect the region's coral reefs that must focus on both cultural and ecological attributes. This conclusion is supported by almost universal experience from around the world. Nowhere has marine management been successful where the interests, traditions and involvement of local communities have been neglected.

1256. **Kesava Rao, C and A.G. Untawale** 1991. Polyphenols content of Indian seaweeds. *Mahasagar,* 24(2): 99-102.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

Abstract : Water soluble polyphenols content of 15 species of brown seaweeds collected from Goa, Mandapam and Visakhapatnam coasts (India) have been reported. The concentration ranged from 0.23 to 2.06% dry wt. Analysis of different parts of *Sargassum* and *Turbinaria* revealed that polyphenols accumulate variable quantities with a maximum in apical frond like portions and minimum in the middle thallus.

1257. **Kewalramani, K.M.** 1972 Theory and practice of tagging with reference to commercially important fishes of India. *Seafood Export J.,* 4(1): 151-156.

1258. **Kewalramani, K.M and E.S. Kadri** 1972 Shell fisheries of India. *Seafood Export J.,* 4(12): 29-39.

Abstract : The authors state that *Oliva gibbosa* are occasionally collected from Palk Bay and Gulf of Mannar for food. Pearl fisheries in Gulf of Mannar is famous since olden days. The pearl fisheries are not regularly operated in GOM. Great fluctuations have also been observed in pearl production; as such the fishery is stopped

since 1962. The fishing method of pearl oyster is quite different in GOM than that of Gulf of Kutch. *Pinctata* contributes famous pearl fisheries of the GOM. The authors also state that Ramesary type of chank from Rameswaram is recognized in the commercial field.

1259. **Kilburn, R.N.** 2002. Biogeography of Indian Marine Molluscs. *Spec. Publ. Phuket Mar. Biol. Cent.,* 26: 5-17.

Address : Natal Museum, P/Bag 9070, Pietermaritzburg, 3201 South Africa; E-mail: dkilburn@nmsa.org.za

Abstract : Analysis of provisional list shows the marine molluscan fauna of the Indian region to be predominantly Indo-Polynesian, with perhaps 4-7% endemism (the exact figure partly depending on whether fresh- and brackish water vicariates of marine groups are included). Significant differences in oceanographic conditions between the Bay of Bengal and Arabian Sea are summarized, and attention is drawn to factors that have created potential barriers or filter-routes. Based on these factors and on the limited faunal inventories available, four subregions are tentatively recognised as the basis for a working hypothesis. There appear to be two centres of endemism: (1) south-eastern India (*i.e* the Gulf of Mannar/Chennai area): it is suggested that the key elements may have vicariated in Palk Bay during periods of emersion of the Mannar shelf, and (2) the estuaries and backwaters of Orissa, West Bengal and Bangladesh, which serve as refugia for various euryhaline marine taxa that may have evolved under hyposaline conditions in the northern Bay of Bengal. Conservation prospects for these two centres are discussed.

1260. **Knaap, M.V.D.** 1989. Shrimp fisheries in the Bay of Bengal. *BOBP/WP/58/RAS/81/051*. 61 pp.

Address : Fishery Biology Division, Bay of Bengal Programme, Madras, India.

Abstract : This paper describes the marine shrimp fisheries in countries around the Bay of Bengal. It summarizes available information on the fishery, catch data, rates and composition, or by-catch. It also reviews the status of exploitation, stock assessment and management in various countries of the region. The paper was sponsored by the Marine Fishery Resources Management project (RAS/81/051) of the Bay of Bengal Programme (BOBP). The project commenced in January 1983 and terminated in December 1986. It was funded by the UNDP (United Nations Development Programme) and executed by the FAO (Food and Agriculture Organization of the United Nations). The project aimed at improving the practice of resource assessment among countries of the region and assisting joint management activities between countries sharing fish stocks.

1261. **Krishnakumar, S and S. Ravikumar** 2004. Identified chemical markers in Halophilic Cyanobacteria and sponges. Se*shaiyana*, 12(2): 6-7.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629502, Kanyakumari, Tamilnadu, India.

Abstract : Biomarkers are compounds or groups of compounds that can be used as signatures of individual organisms or group of organisms or of certain environmental processes (Parrish *et al.,* 2000). They can be signatures of the condition of a sample and certain compounds are used as early warning signals. Both molecular and isotopic analyses of biomarkers have been extensively used in geochemical studies (Villanuera *et al.*, 1997; Guzman-Vega and Mello, 1990) and there is increasing interest now in their use in ecological studies. This article mainly focuses on the smaller chemical molecules that are determined using standard chromatographic techniques.

1262. **Krishnakumar, S.** 2005. Isolation and standardization of antimicrobial compounds from sponge associated antagonistic actinomycetes. *Ph.D., Thesis* submitted to Manonmaniam Sundaranar University, Tamil Nadu, India. 149 pp.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam-629 502, Kanyakumari, India.

Abstract : The marine environment is a potential source that contains actinomycetes, which are capable of producing antibiotics. The ocean remains an untapped source for many drugs and contemporary experimental studies, which indicate that pharmacologically active substances could be isolated from marine organisms. Thousands of marine organisms are known to contain antibiotic substances, but less than one percent have been tapped so far. The sponge microbial association has been a topic of research since a long time, besides studies on actinomycetes are very limited. Keeping this in mind, the present study is initiated to find out potential species of antagonistic actinomycetes from sponge along the coast of Cape Comorin and to evaluate the possible utility as biologically derived eco-friendly, safer antimicrobial agents.

1263. **Krishnakumar, S., S. Ravikumar, E. Shanmugapriya and M. Sukumaran** 2005. Pre-emergence herbicidal compounds from sponges (Southeast Coast of India) for agriculture weed control. *Proc. on Marine Resources*, Department of Botany, S.T.Hindu College, Nagercoil. pp. 66-69.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Herbicides are chemicals used to control weeds in crop fields. Continuous use of chemical herbicides are proved to change the soil conditions and texture and cause human health hazards. Accumulation of such chemicals in the herbs is recently recognized as a global threat. Sponges are multicellular marine animals long been known to have bioactive compounds. Hence the present study has been under taken to find out eco-friendly herbicides from marine resources. Thirty-four sponge species collected from Tuticorin coast were subjected for the extraction of herbicidal compounds by using different solvents. The extracts were tested for herbicidal activity. Water extract gives better results against *Lemna* species but the ethyl acetate extract does not. Among the concentrations tested, 2000 mg concentration of crude extract of *Microciona* species showed maximum percentage of inhibition against *Lemna* seed. Among the sponge species screened for herbicidal activity, *Microciona* species and *Sigmadocia* species showed 100 % inhibition of seed germination. The column fractions of ethyl acetate and butanol showed better herbicidal activity against *Lemna* species than the other fractions.

1264. **Krishnamoorthy, P and P. Subramanian** 1998. Meroplankton production in the Gulf of Mannar and Palk Bay on the southeast coast of India. *J. Mar. Biol. Assoc. India*, 39: 44-48.

Address : Department of Animal Science, School of Life Science, Bharathidasan University, Trichy- 620 024, Tamilnadu, India.

Abstract : A study was carried out to understand the changes in the meroplankton production in the two adjoining seas, Gulf of Mannar (Site-I) and Palk Bay (Site-II). Fortnightly collections were made from each station round the year. These two collection sites are closer to each other but still varied in many physical oceanographic aspects. Numerical abundance of meroplankton were observed maximum during the month of November '93 (1,44,993 nos/m^3 at site I and 1,56,695 nos/m^3 at site II) and their minimum, were recorded during the month of July '94 at the site I (8814 nos/m^3) and May '94 at the site II (10,094 nos/m^3). The meroplanktoinic components include nauplius, protozoea and mysis larvae of prawns, such as *Penaeus semisulcatus, P. merguiensis, P. indicus, P. monodon*, zoea of branchyura, zoea of petrolisthes, zoea of *Emerita*, megalopa larvae, eggs, fish larvae, bivalves and gastropod larvae. The *in-situ* physico-chemical variables such as pH, temperature, dissolved oxygen, salinity and electrical conductivity and nutrients like phosphate, nitrate and silicate were also estimated. The relationship between physico-chemical variables and meroplankton is discussed.

1265. **Krishnamoorthy, P and P. Subramanian** 1999. Organisation of commercially supporting meroplankton in Palk Bay and Gulf of Mannar biosphere reserve areas, southeast coast of India. *Indian J. Mar. Sci.*, 28(2): 211-215.

Address : Department of Animal Science, Bharathidasan University, Tiruchirappalli, 620024, Tamil Nadu, India.

Abstract : The samples were collected along the southeast coast of India at three different stations - station 1 is nearer to Mandapam in Palk Bay, station 2 nearer to Mandapam, the head of Gulf of Mannar and station 3 nearer to Kudankulam, the foot of Gulf of Mannar. The Palk Bay and Gulf of Mannar (near Mandapam) are coral dominated, partially closed shallow seas, harbour rich flora and fauna. Kudankulam is directly exposed to open sea with rocky patches of sandy bottom. The highest species diversity was encountered in station 2 followed by station 3 and station 1 (2.18 > 2.1 > 1.9) indicates the high fertility and optimal environmental conditions of Gulf of Mannar. It was also underscored by high species evenness at station 2 followed station 3 and station 1 (1.5 > 1.4 > 1.3). The influence of west coast current, and conglomeration of open ocean species cause the maximum of species richness at station 3, which is followed by station 2 and station 1 (3.26 > 3.13 > 3.0). Dominance index (79.3 > 74.6 > 71.6) was found maximum at station 2 followed by station 1 and station 3 denote protective nature of coral beds for these young ones at Gulf of Mannar and Palk Bay.

1266. **Krishnamoorthy, P., S. Arun and P. Subramanian** 1999. Commercially important meroplankton production and fishery potential in the Gulf of Mannar. *Indian J. Mar. Sci*., 28(2): 216-218.

Address : Department of Animal Science, Bharathidasan University, Tiruchirappalli – 620024, Tamil Nadu, India; Department of Biochemistry, J.J. College of Arts and Science, Pudukkottai - 622 404, Tamil Nadu, India.

Abstract : Meroplankton productivity and the fish landing were recorded from selected two inshore stations,

Mandapam and Kudankulum along the east coast of India. Meroplankton such as nauplius, protozoea and mysis of penaeus and metapenaeus prawns; zoea and megalopa of crab; veliger larvae of mollusc; fish larvae and eggs were segregated and quantified from the zooplankton sampled for two years (November 1993 to October 1995). The meroplankton production was compared with fishery potential and found that both meroplankton production and fishery potential go hand in hand during most months of the study period. It reveals these locales are the ideal breeding sites for such fishes and shellfishes.

1267. **Krishnamoorthy, P and P. Subramanian** 2003. Seasonal variations and species association of meroplankton in the Palk Bay and Gulf of Mannar along the east coast of India. *J. Mar. Biol. Assoc. India*, 45(2): 152-157.

Address : Department of Animal Science, Bharathidasan University, Trichy, Tamilnadu, India.

Abstract : A study on the seasonal variations and species association of the meroplankton from the Palk Bay and the Gulf of Mannar biosphere reserve areas along the southeast coast of India during October 1993 and November 1995 was undertaken. The results indicated that the water quality differed between the two stations. The number of meroplankton reached maximum by October-December and gradually decreased during June to August. The average number of meroplankton was highest in Palk Bay. The meroplankton was constituted by the larval stages of commercial penaeids such as *Penaeus semisulcatus. P. indicus, P. monodon, Metapenaeus monoceros, M. dobsoni* and *M. affinis;* zoea and megalopa of crabs, veliger larvae of gastropods and bivalves; and the fish larvae. The veliger larvae of gastropod and bivalves constituted 66% of the total meroplankton.

1268. **Krishnamoorthy, R.** 1996. Remote sensing of mangrove forests in Tamilnadu coast, India. *Ph.D Thesis*, Anna University, Chennai.

Address : Institute of Ocean Management, Anna University, Chennai – 600 025, Tamilnadu, India.

Abstract : The objective of the present study was to derive the spectral properties of mangrove species and to understand their seasonal changes, the influence of local environment and background soil surface on the mangrove canopy reflectance. Mangrove species canopy radiance and reflectance in visible and near infrared were measured using ground–based spectroradiometers. Mangrove species occurring in different environmental sites were chosen for the study. The experiments were conducted during May 1994 and February 1995 using radiometers with Landsat MSS and TM and IRS LISS bands. The results indicate that the influence of the soil background on the spectral properties of a mangrove canopy is not discernible. Seasonal changes in the reflectance of mangroves were also studied. Both the increase in leaf chlorophyll and decrease in the leaf water content were found to affect (decrease) the red reflectance. The near infrared radiance and reflectance are much influenced by leaf adaxial surface wax and the ageing of species. The leaf wax is found responsible for the variations in the spectral radiance and reflectance in the near infrared when compared to the leaf pattern and the canopy structure. Apart from the vegetation parameters, the local environments like industrial pollution, also account for the decrease in the radiance and reflectance. Since the spectral properties of mangroves vary temporally in relation with their plant parameters, this technique can be used to assess the plant health, biomass, etc. also.

1269. **Krishnamoorthy, R., S. Ramachandran and S. Sundaramoorthy.** 1997. Remote sensing and GIS for coral reefs mapping. *Regional workshop on the conservation and sustainable management of coral reefs*, Proceedings No. 22, CRSARD, Madras. pp C87-C89.

Abstract : The launch of Earth Resources Technology Satellite -1 (ERTS-1) in 1972 proved to be of great importance as it gave a new tool of remote sensing to the scientific community. The subsequent launch of the Landsat series of satellites, the French satellite *Systeme Probatorie d'Observation de la Terre* (SPOT) and the *Indian Remote Sensing* (IRS) satellites with high spatial resolution increased the potentiality of this new tool for coral reef mapping. Case studies in Gulf of Mannar and Andaman & Nicobar Islands have proved the mapping of reef categories such as fringing reef, patch reef, platform reef with or without central lagoon which are clearly discernible in SPOT and IRS satellite imagery. Also the tidal action and water circulation patterns in reef areas between 2 and 10 km coastal belt of Andaman & Nicobar Islands were mapped using remote sensing data. Case studies in Gulf of Mannar using GIS tool have brought out the changes in coastal configuration due to erosion and accretion and its impact on the adjacent coral reef ecosystem.

1270. **Krishnamoorthy, R and S. Ramachandran** 2003. Remote sensing and GIS applications for conservation and sustainable utilisation of coral reef resources - Review of case studies. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 71.

Address : Department of Applied Geology, University of Madras, Guindy Campus, Chennai-600 025, Tamilnadu,

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Abstract : Multispectral remote sensing data have been used to map and monitor the coral reef resources in India during the last two decades. The spectral reflectance especially in the visible bands of Electromagnetic spectrum contributes tonal changes, which is more useful to demarcate the coral reefs using satellite data. The variations in spectral reflectance are mainly attributed to the following factors: 1) the depth of occurrence, 2) deposition of sand over reef, 3) growth of vegetation over reef, and 4) turbidity or suspended sediments concentration (SSC). All the above factors will influence the changes in tonal characteristics of multispectral remote sensing data. The following observations were made during the mapping of coral reef resources in Gulf of Mannar and Andaman & Nicobar Islands. Coral reefs which occur in depths up to 12 to 15 m without the influence of turbidity especially in Andaman & Nicobar Islands can be demarcated based on their tonal characteristics by visual interpretation of FCC imagery. Image enhancement of digital data is required to map the shallow reefs much affected by and deposition and high turbidity in coastal waters especially in Gulf of Mannar Islands. The mapping of reef resources using multispectral data requires skilled manpower, application of selected digital analysis techniques and optical remote sensing data for accurate estimation of reef resources and their status. The Geographical Information System (GIS) is another important tool, which could be used to analyse the relevant spatial and non-spatial data. Scientific database could be created by the combined use of remote sensing and GIS tools for the preparation of multilevel resource information and integration of this information for the preparation of conservation and management plans. This paper is aimed to review and highlight the important merits of these tools for coral reef resources conservation and management.

1271. **Krishnamurthy, B.** 1957. Fishery resources of the Rameswaram Island. *Indian J. Fish.*, 4(1&2): 229-253.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : As very little was known about the fishery resources of the Rameswaram Island, a survey to ascertain the fishery resources and to determine the magnitude of fish landings in the Island was commenced in 1952. A preliminary survey was undertaken first to assess the number of fishing villages and the number of fishermen engaged in fishing. The results are given in this paper along with a short description of various types of craft and tackle employed in fishing in the Island. The design of the survey to estimate the annual landings of fish in the Island is also indicated.

1272. **Krishnamurthy, B.** 1958. Observations on the spawning season and the fisheries of the spotted seer, *Scomberomorus guttatus. Indian J. Fish.*, 5(2): 270-281.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The spotted seer or *Scomberomorus guttatus, is* an important and much esteemed table fish, standing next in importance to *Leiognathus splendens* in the fishery of Rameswaram Island, where approximately 320 tons of this fish, fetching a market price of about Rs. 250,000, are landed every year (Krishnamoorthi, 1958). It is well known in the fishery of all coastal areas of India. Nevertheless the available literature furnishes little exact information about its biology except for some remarks on taxonomy and geographical distribution by Day (1889) and Weber and Beaufort (1951), a description of the egg by Delsman (1931) and notes on life-history, and feeding habits, by Vijayaraghavan (1955). Accordingly, the present study was initiated to gather some knowledge of the biology of this important commercial species.

1273. **Krishnamurthy, K.** 1987. The Gulf of Mannar Biosphere Reserve. 105 pp.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Porto Novo - 608 502, Tamilnadu, India.

Abstract : The proposed Marine Biosphere Reserve in the Gulf of Mannar will be the first of its kind in India and in Southeast Asia. The Indian part of the Gulf covers approximately an area of 10,500 km^2. Running southward and parallel to the mainland coastline have an arc of about 20 Islands starting from the northern most Pamban Island to Tuticorin. The Gulf s*ui generis* is unique for its biological wealth and some of the Islands are veritable 'biologist's paradise'. It holds within maximum genetic diversity. It is equally rich in algal, seaweed. seagrass and mangrove resources as well as in coral reefs, pearl banks, sacred chank beds and prochordates. For the sake of convenience the entire neritic area of the Gulf from Pamban Island to Kanyakumari is grouped into four regions. In each region the core zone, buffer zone, and manipulation or utilisation zone have been demarcated. Their locations and continuous areas are indicated.

1274. **Krishnamurthy, V.** 1960. *Willeella ordinata* Boerg. from Cape Comorin, South India. *Phytomorphology,* 10: 234-238.

1275. **Krishnamurthy, V.** 1967. *Aneuria parthasarathii* sp. nov. a dorsiventral Rhodomelaceae from cape Comorin, South India. *Phykos,* 5: 181-186.

1276. **Krishnamurthy, V.** 1967. Field unit for marine algal studies at Mandapam camp. *Salt. Res. Ind.,* 4(4): 139-140.

1277. **Krishnamurthy, V., R. Venugopal, J.C. Thiagaraj and H.N. Shah** 1967. Estimating drift seaweeds on the Indian coasts. *Proc. Seminar Sea, Salt and Plants, CSMCRI, Bhavnagar,* December 20-23, 1965. pp. 315-320. *Also Salt Res. Ind.,* 3(1) : 20.

1278. **Krishnamurthy, V.** 1967. Marine algal cultivation - Necessity, Principles and problems. *Proc. Seminar Sea Salt and Plants, CSMCRI, Bhavnagar,* 1965. pp. 343-351.

1279. **Krishnamurthy, V.** 1967. Seaweed-drift on the Indian seashore. *Symp. Indian Ocean, New Delhi, 1967, NISCINCOR., Int. Indian Ocean Exped. Nuwsl.,* 4(4): 17.

1280. **Krishnamurthy, V and P.C. Thomas** 1971. Some new or interesting red algae from the Indian shores. *Seaweed Res. Utiln.,* 1: 30-47.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

1281. **Krishnamurthy, V.** 1971. Seaweed resources of India and their utilisation. *Seaweed Res. Utiln.,* 1: 55-67.

1282. **Krishnamurthy, V and K. Subbaramiah** 1972. The importance of Shore-types in intertidal ecology of Indian marine algae. *Proc. Ind. Nat. Sci. Acad.,* 38B: 259-266.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

1283. **Krishnamurthy, V., P.V. Raju and P.C. Thomas** 1975. On Augmenting Seaweed Resources of India. *J. Mar. Biol. Assoc. India,* 17(2): 181-185.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : In recent years, a number of plants have been set up for manufacturing agar-agar from Indian seaweeds. The available resources of seaweeds are scanty and are likely to dwindle further. Hence, it is necessary to augment the resources by cultivation of the economically important species. Cultivation of seaweeds may be achieved either by vegetative propagation or by collecting and germinating spores in specially designed nurseries and later transplanting the sporelings in the sea. This paper describes the experiments carried out at the Marine Algal Research Station, Mandapam and evaluates the results obtained in these experiments.

1284. **Krishnamurthy, V., P.V. Raju and P.C. Thomas** 1977. On augmenting the seaweed resources of India. *Seaweed Res. Utiln.,* 2(1): 37-41.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Agar manufacturers in India mostly use *Gelidiella acerosa* as the raw material and this alga grows more abundantly on the east coast of South India, especially on the coast of Ramanathapuram District. To a less extent, *Gracilaria edulis* is also used. Other seaweeds which may be used as sources *of* agar are: *Gracilaria corticata, G. folifera* and *G. verrucosa. Hypnea musciformis* which is a very common alga gives an extractive with a low gelling capacity, but this can be improved by suitable treatment (Rao and Krishnamurthy, 1968). Attempts to assess the quantity of economically important seaweeds have been made from time to time. Some of the earlier accounts do not give a clear statement regarding the methods employed in arriving at the estimates and in those instances where definite methods have been described, the report has been of a limited nature, restricted to a small area or extending over a short period.

1285. **Krishnamurthy, V and P.C. Thomas** 1977. Some new and interesting marine algae from the Indian waters.

Seaweed Res. Utiln., 2(1): 42-51.

Address : Government Arts College for Men, Namakkal, Salem District, Tamilnadu, India.

Abstract : In an earlier paper, the authors had recorded and described some new or interesting red algae from the Indian shores (Krishnamurthy & Thomas, 1970). This paper is a cotinuation of the effort but includes algae of other groups as well. *Penicillus mannarensis*, *Chnoospora bicanaliculala* and *Marlensia indica* are new species recorded from the Pamban - Rameswaram region of Tamilnadu coast. Besides these, some observations have been included on *Martensia tragilis* Harv., *Taenioma perpusillum* J. Ag. and *Ceramium cimbriatum* Setch. et Gardn. which occur off Mandapam in the same region.

1286. **Krishnamurthy, V and P.C. Thomas** 1977. Some new or interesting marine algae from the Indian shores. *Seaweed Res. Utiln.,* 2(2): 103-104.

Address : Government Arts College for Men, Namakkal, Salem District, Tamilnadu, India.

1287. **Krishnamurthy, V.** 1991 *Gracilaria* resources of India with particular refernece to Tamilnadu coast. *Seaweed Res. Utiln.,* 14(1): 1-8.

1288. **Krishnamurthy, V and K. Jayagopal** 1995. Calcareous algae of the *Galaxea* reef, Krusadai Island, Tamilnadu. *Seaweed Res. Utiln.,* 17(1&2): 117-121.

Address : Krishnamurthy Institute of Algology, Nanganallur, Madras-600 061, Tamilnadu, India.

Abstract : It is a well known fact that calcareous algae are an integral part of the coral reef ecosystem and that these contribute to a great extent to the building up of the coral rocks and stones, and eventually the reef itself. These calcareous algae include “various kinds of benthic and planktonic algae whose thalli contain biochemically precipitated calcareous skeletal material” (Wray, 1977). These algae belong to various taxonomic groups and show varying degrees of calcification. The extent of calcification is the one factor which resulted in many taxa becoming fossilized and preserved through the ages.

1289. **Krishnamurthy, V.** 2004. Seaweed research and utilization in India. *Nat. Symp. & Expo.* pp. 7 - 9.

Address : Krishnamurthy Institute of Algology, Chennai-600 034, Tamilnadu, India.

Abstract : Seaweed research in India was confined to reporting on the seaweed flora on certain specific coastal regions until about the Second World war. It was during that war serious attempts at study of Indian seaweeds and their utilization took shape. The first reports on the manufacture of agar-agar from Indian seaweeds were those of Bose *et al*, Chakraborty and Joseph & Mahadevan. Those efforts were the result of a need to find local sources for agar-agar as import of agar was becoming scarce due to Japan, who held a monopoly on agar, being involved in the war.

1290. **Krishnamurthy, V.** 2006. Krusadai Island, Gulf of Mannar, A paradise lost; can it be regained? *Nat. Symp. Algae, Man & Biosphere,* 24th - 25th Feb’06. pp. 20-22.

Address : Krishnamurthy Institute of Algology, Chennai-600 034, India.

Abstract : The southern coasts of Tamilnadu have always been and are still the most visited area by marine biologists, because of the richness of its biodiversity. Marine macroalgae of this region comprised more than 400 species of green, brown and red algae, mostly distributed at or near the low water mark.

1291. **Krishna Pillai, N and R.S. Lal Mohan** 1963. Description of the male *Caligus hilsae* shen. *Crustaceana,* 13: 45-48.

1292. **Krishna Pillai, N.** 1964. Report on the mysidacea in the collections of the CMFRI, Mandapam camp. South India - Part I. *J. Mar. Biol. Assoc. India,* 6(1): 1-40.

1293. **Krishna Pillai, N.** 1965. Copepods parasitic on Indian Marine fishes - A review. *Proc. Symp. on Crustacea, MBAI,* 5(2): 1556-1680.

1294. **Krishna Pillai, N.** 1965. A review of the work on the shallow water mysidacea of the Indian waters. *Proc. Symp. on Crustacea, MBAI,* 5(2): 1681-1728.

1295. **Krishna Pillai, N.** 1966. Notes on copepods parasitic on South Indian Marine fishes. *J. Mar. Biol. Assoc. India,* 8(1): 123-140.

Address : Marine Biological Laboratory, University of Kerala, Trivandrum - 7, India.

Abstract : The present paper contains notes on ten species of copepod parasites not included in the earlier publications by the author (1961, 63a, 63b). All are known species, but most of them are new records for this region and others are not adequately described previously. The paper also contains a discussion on the validity of the genera *Midias* Wilson and *Dentigryps* Wilson.

1296. **Krishna Pillai, N and C. Kasinathan** 1985. Note on an oviparous zebra shark *Stegostoma faciatum* (Hermann) landed at Mandapam. *J. Mar. Biol. Assoc. India,* 27(1&2): 195-197.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : An oviparous female zebra shark *Stegostoma faciatum* measuring 205 cm in total length is reported from Mandapam, Tamil Nadu, India. A brief description and morphometric measurements of the specimen are presented.

1297. **Krishna Pillai, N and C. Kasinathan** 1988. On a large adult zebra shark landed at Pamban. *Mar. Fish. Infor. Serv. T & E. Ser.,* 85: 11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : On 7th Dec' 1987, an adult female *Stegostoma faciatum* measuring 207 cm in total length and 49 kg by weight obtained while trawling at 20 m off Pamban in the Gulf of Mannar.

1298. **Krishna Pillai, N and C. Kasinathan** 1988. Report on two dolphins washed ashore near Mandapam. *Mar. Fish. Infor. Serv. T & E. Ser.,* 88: 21.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : The moprhometric measurements of *Tursiops aduncus* is detailed.

1299. **Krishna Pillai, N and C. Kasinathan** 1989. On two species of marine turtles caught off Dhanushkodi, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 102: 17-18.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : This report deals with the morphometric measurements of the two turtles captured from southeast of Pamaban opposite to Dhanushkodi.

1300. **Krishna Pillai, N and M. Badrudeen** 1991. On a young sea cow killed at Periapattinam, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 108: 17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : On 29th September 1990, at about 14.00 hours a young dugong was killed by the fishermen of Periyapattinam in the inshore waters of Gulf of Mannar.

1301. **Krishna Pillai, N and C. Kasinathan** 1995. Movement of a large shoal of *Hilsa kelee* from Palk Bay to Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 140: 8-9.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : Movement of a large shoal of *Hilsa kelee* from Palk Bay to Gulf of Mannar, was observed on November 02, 1988. The size of *H. kelee* ranged from 152 to 712 mm total length and weighed from 34 to 50g.

1302. **Krishna Pillai, N and A.P. Lipton** 1996. Dolphin killed by the propeller of a trawler. *Mar. Fish. Infor. Serv. T & E. Ser.,* 141: 18.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of a dolphin accidentally killed by a trawler are given.

1303. **Krishna Pillai, S.** 1986. Pamban bridge. *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp,* pp. 28-29.

Abstract : It is believed that upto the first quarter of 15th century Mandapam and Pamban were connected by a strip of land. A cyclone in 15th century resulted in the sumergence of that connecting strip of land between Mandapam and Pamban. After that boat service was the only mode of transport between Mandapam and Pamban.

1304. **Krishna Pillai, S.** 1986. Species composition of silverbellies of trawl catch during north-east monsoon month in Gulf of Mannar. *Sci. Cul.,* 59(1&2): 29-30.

1305. **Krishna Pillai, S., M. Selvaraj and M. Najmudeen** 1986. Comparative hydrological study of five ponds near Mandapam and the adjoining inshore water of the Palk Bay. *J. Mar. Biol. Assoc. India,* 28(1&2): 229-232.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : Variation in salinity, temperature and dissolved oxygen of the 5 experimental ponds adjoining the sea near Mandapam, Tamil Nadu, India, were studied from November 1979 to December 1980. The temperature, salinity and pH decreased during the northeast monsoon while dissolved oxygen was high. The low salinity during Nov to Dec (19.02 to 20.94 ppt) was mainly due to rainfall. Higher salinity in Jul-Aug was due to evaporation and seepage. Salinity values of the ponds were compared with the adjoining sea.

1306. **Krishna Pillai, S and C. Kasinathan** 1987. Some observations on Dolphins in Mandapam area with a note on their food. *Mar. Fish. Infor. Serv. T & E. Ser.,* 71: 13-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : The data regarding the date, place of collection, weight, sex and essential characters of all specimens were recorded.

1307. **Krishna Pillai, S., J.D. Ambrose and M. Sivadas** 1989. On an unusually large sea cow *Dugong dugon* landed at Mandapam, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 96: 12-13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : The morphometric measurements and the dimensions of the heart of the dugong (in cm) were measured.

1308. **Krishna Pillai, S., M. Bose and R. Subramanian** 1989. On the accidental catch of the spinner dolphin from Gulf of Mannar, Mandapam. *Mar. Fish. Infor. Serv. T & E. Ser.,* 98: 15-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of spinner dolphin are discussed which has not been recorded so far from Mnadapam in the Gulf of Manar.

1309. **Krishna Pillai, S., C. Kasinathan and N. Ramamurthy** 1991. On the morphometry of dolphin *Sousa chinensis* in Mandapam region. *Mar. Fish. Infor. Serv. T & E. Ser.,* 110: 11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of a stranded dolphin, *Sousa chinensis* in Mandapam region is discussed.

1310. **Krishna Pillai, S.** 1992. Short-term variations of hydrological conditions of surface waters of the inshore sea at Mandapam during northeast monsoon months. *Sci. Cult.,* 58(11&12): 137-138.

Address : Central Marine Fisheries Research Institute, Mandapam Camp 623 520, Tamil Nadu, India.

Abstract : The variations in the concentration of salinity, dissolved oxygen, phosphate, silicate and nitrate of the surface and bottom waters during October 1983 to January 1984 at Mandapam, Tamil Nadu, India were studied. The results of analysis are reported.

1311. **Krishna Pillai, S.** 1993. Species composition of silverbellies of trawler catch during north-east monsoon month in Gulf of Mannar. *Sci. Cult.* 59(1&2): 29-30.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Bulk of the catch during monsoon in the Gulf of Mannar was contributed by silverbellies (Leiognathidae) (95-98% of total catch). The species composition of the same is studied and presented.

1312. **Krishna Pillai, S., M. Badrudeen and M. Bose** 1995. On a leather back turtle *Dermochelys coriaceae* landed at Rameswaram. *Mar. Fish. Infor. Serv. T & E. Ser.,* 140: 11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of *Dermochelys coriaceae* landed at Rameswaram were given.

The total length was observed as 208 cm.

1313. **Krishna Pillai, S.** 1996. Report on a juvenile whale shark *Rhincodon typus* (Smith) caught in a trawler off Kanyakumari. *Sci. Cult.*, 62(9&10): 259-260.

Address : Central Marine Fisheries Research Institute, Vizhinjan (po), Via. Trivandrum, Kerala, India.

Abstract : The present report is on the capture of a live juvenile shark on 23.3.96 off Kanyakumari in a trawler net operated 20 km away from the shore. The shark was alive until it was dragged to the shore on the same day. The whale shark was 4.58 m in total length. Detailed morphometric measurements could not be taken as the information about the capture was received late.

1314. **Krishna Pillai, S.** 1998. On the landing of an Olive ridley turtle at Kanyakumari, Tamil Nadu and updated record of incidental catches of seaturtles. *Mar. Fish. Infor. Serv. T & E Ser.*, 157: 17-20.

Address : Central Marine Fisheries Research Institute, Kottar, Kanyakumari, Tamilnadu, India.

Abstract : A female turtle was caught in a gill net operated off Kanyakumari, on 24-08-96, which was identified as *Lepidochelys olivacea*. The total length observed was 79 cm and the other morphometric measurements are given and discussed.

1315. **Krishna Pillai, S.** 2002. Accidental catches of Dolphins in Kanyakumari coast from 1995 to 2000. *Mar. Fish. Infor. Serv., T&E Ser.*, 173: 8-11.

Address : Central Marine Fisheries Research Institute, Vizhinjam, Kerala, India.

Abstract : Dolphins frequently enter the coastal waters mainly for feeding or breeding and often get entangled in fishing gears such a gill nets, trawl nets and purse seines. Our information regarding dolphins is restricted mainly to the reports on the accidental catch and occasional stranding from different parts of the coast. Accidental catch of 4 dolphins along Kanyakumari coast during 1995-2000 is given.

1316. **Krishnapillai, V.** 1954. Growth requirements of a Halophilic blue-green alga *Phormidium tenure* (Menegh). *Indian J. Fish.*, 1: 130-144.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In order to account for the negligible growth of algae observed in the saline lagoon at Mandapam, a complete knowledge of the normal nutritional and general physiological factors controlling the growth of at least the dominant species of the algal association is necessary. This information will also have applied significance in the maintenance of adequate algal growth, a prerequisite for successful fish culture in these lagoons, regardless of whether or not the fish grown feeds directly on the algae.

1317. **Krishnapillai, V.** 1955. Water soluble constituents of *Gracilaria lichenoides*. *J. Sci. Ind. Res.*, 14B: 473.

1318. **Krishnapillai, V.** 1956. Chemical studies on Indian Seaweeds, I. Mineral Constituents. *Proc. Indian Acad. Sci.*, 44: 3-29.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An attempt has been made to follow the partition of the two important trace elements, Mn and B, in the different seaweeds. It is found that in the young plants a major portion of the Mn exists in a water-soluble form while the percentage decreases as the plant grows. In regard to boron only very small quantities are found in the water-soluble form irrespective of whether the plant is mature or young.

1319. **Krishnapillai, V and M. Rajendranathan Nair** 1957. Determination of total volatile nitrogen in cured fish products. *Indian J. Fish.*, 4(1&2): 295-303.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Estimation of total volatile nitrogenous bases has been generally made use of in routine analysis for the chemical assessment of the degree of spoilage in fish samples. The measurement of this index of spoilage furnishes a reasonably accurate and rapid method for the determination of the keeping quality of cured fish products. In fact it has been pointed out by Velankar (1952) that total volatile nitrogen gives a better than the trimethylamine content. Tarr and Ney (1949) also observed that the test for the amount of trimethylamine present is not likely to prove a very sensitive measurement of the bacterial spoilage of varieties of Pacific coast fishes. It

is suggested that trimethylamine is a product during the early stages of spoilage (Collins, 1938; Hess, 1941) and that it may be lost indiscriminat storage.

1320. **Krishnapillai, V.** 1957. Alginic acid from sargassum seaweeds. *Res. Ind., New Delhi,* 2: 70.

1321. **Krishnapillai, V.** 1957. Chemical studies on Indian Seaweeds II. Partition of Nitrogen. *Proc. Indian Acad. Sci.,* 45: 43-63.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An attempt has been made to study the chemical partition of nitrogen in 11 species of seaweeds belonging to the three major groups, Chlorophyceae, Rhodophyceae and Phaeophyceae. The seasonal variations in the total organic, water-soluble, volatile, protein-nitrogen in and non-protein nitrogen contents were followed by analyzing regular monthly collections of the algae. The importance of each of the fractions in the metabolism of the algae has been discussed.

1322. **Krishnapillai, V.** 1957. Chemical studies on Indian Seaweeds III. Partition of Sulphur and its relation to the carbohydrate content. *Proc. Indian Acad. Sci.,* 45B: 101-121.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Detailed investigations have been conducted on the partition of sulphur in different seaweeds common to the Indian coast. Among the seaweeds studied are tow Chlorophyceae, seven Rhodophyceae and two Phaeophyceae. The amount of total sulphur, total sulphate, and free sulphate in the different seaweeds were estimated periodically by analyzing regular monthly collections. From this study it was also possible to follow the changes in the sulphur content of the algae during the different stages of its growth and during different seasons. An attempt has also been made to bring out possible correlation between the different forms of sulphur and the carbohydrate content of the algae.

1323. **Krishnapillai, V and K. Selvan** 1988. Study on the bacterial quality of edible oyster *Crassostrea madrasensis* and its purification. *CMFRI Bulletin,* 42(2): 426-431.

Address : Fisheries Technological Station, Tuticorin, Tamilnadu, India.

Abstract : Edible oysters (*Crassostrea madrasensis*) collected periodically during the years 1984-1986 from Central Marine Fisheries Research Institute farm at Tuticorin and from the natural beds were studied for their bacterial quality. Seawater samples from the surrounding environs were also simultaneously collected and analysed for physical, chemical and bacteriological parameters. The oyster samples were subjected to purification by employing different methods. The total bacterial count (TBC) of cultured oysters and natural bed edible oysters ranged between 103 to 104 organisms per ml of oyster fluid. The TBC of the seawater around cultured oysters and natural bed oysters ranged between 102 to 103 organisms per ml of seawater. Faecal coliforms were found to be very low and within permissible limits. The pathogenic bacteria *Salmonella, Streptococci* and *Staphylococci* were absent. The variations in pH, temperature, salinity and dissolved oxygen of the seawater samples were insignificant. The edible oysters were subjected to purification by employing different purification methods among which chlorination was found to be better.

1324. **Krishnaswami, S.** 1950. *Eudactylopus krusadensis,* a new species of harpacticoid copepod from Krusadai Island, in the Gulf of Mannar. *Rec. Ind. Mus.,* 48: 117-120.

1325. **Krishnaswami, S.** 1952. Some new species of copepods from the Madras coast. *Rec. Ind. Mus.,* 50: 324.

1326. **Krishnaswami, S.** 1953. Pelagic copepods of the Madras Coast. *J. Madras Univ.,* 23B(1 and 2): 61-75.

1327. **Krishnaswami, S.** 1967. Reproductive and nutritional cycles in a few invertebrates from the east coast of India. *International Indian Ocean Expedition, Newsletter,* 4(4): 18.

1328. **Kulshreshtha, S.M and M.G. Gupta** 1966. Satellite study of Rameswaram cyclonic storm of 20-23 December 1964. *J. Appl. Met.,* 5: 373.

1329. **Kumar, J.S.S., R.M. Xavier and V. Sundararaj** 1994. Hormones and new strains in aquaculture. *Seafood Export J.,* 25(14): 25-29.

Address : Fisheries College and Reserch Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The use of different hormones in aquaculture industry for early maturation, fast growth, sterility and sex reversal of fishes is described.

1330. **Kumar, M.M., P. Muralidhar, N. Krishna and D.V. Rao** 2005. A new scalarane sestquiterpene derivative from the marine sponge *Hyatella cribriformis* of the Indian Ocean. *Proc. Andhra Pradesh Akad. Sci.*, 9(2): 131-134.

Address : Department of Pharmaceutical Sciences, Andhra University, Visakhapatnam- 530003, India.

Abstract : A new scalarane sestquiterpene, 22-acetoxy-12-epi-deoxoscalarin (3) was isolated along with known compounds, scalarolide, 12-epi-deoxoscalarin and 12-epi 12- deacetyl 19- deoxyscalarin from a marine sponge *Hyattella cribriformis*.

1331. **Kumar, M.R., R.K.R. Kumar and R. Senthilathiban** 2004. Analysis of borrowings and repayment of fisherfolk in selected fishing villages of Tamilnadu. *Fish. Technol.,* 41(2): 143-148.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A study on the borrowings and repayment of fisherfolk in two fishing villages in Kanyakumari district of Tamil Nadu, India was taken up. The purpose-wise and source-wise borrowings and the source-wise repayment of the fishermen respondents were analysed. The factors affecting the borrowings and indebtedness of fishermen respondents are presented.

1332. **Kumar, R.A.S., J.E. James and S.S. Babu** 2004. Comparative studies on the impact of seaweed and seagrass liquid fertilizer on the chlorophyll content of *Zea mays*. *Seaweed Res. Utiln.,* 26(1&2): 167-170.

Address : Post Graduate and Research Department of Botany, Scott Christian College, Nagercoil- 629003, Tamilnadu, India.

Abstract : The effect of seaweed and seagrass liquid fertilizer on the chlorophyll-a and b contents of *Zea mays* plant has been studied. Both the Seaweed Liquid Fertilizer (SLF) and Seagrass Liquid Fertilizer (SGLF) not only promoted the seedling growth but also increased the chlorophyll-a and b contents in the leaf up to 12 days of germination in *Z. mays*. The lowest concentration of SLF and SGLF (10%) has shown remarkable effect on plants than high concentrations.

1333. **Kumar, R.A.S and S.S. Babu** 2004. Effect of seaweed extract on oxidising enzymes during the senescence of *Oryza sativa* var. Ambai –16. *Seaweed Res. Utiln.,* 26(1&2): 177-180.

Address : Postgraduate and research department of Botany, Scott Christian College, Nagercoil- 629003, Tamilnadu, India.

Abstract : Seaweeds are among the important marine living resources with tremendous commercial application. The effect of seaweed liquid fertilizer (SLF) prepared from *Spyridia hypnoides* on the activity of oxidising enzymes, peroxidase, polyphenol oxidase and catalase were carried out during the senescence of leaf in *Oryza sativa*. The peroxidase and catalase activity showed an increasing trend in lower concentration.

1334. **Kumar, R.A.S., J.E. James, Y. Premalatha and S. Saravanababu** 2005. Studies on the effect of seaweed extract on the activity of the enzyme amylase in *Oryza sativa* L. var. ambai- 16 during senescence. *Seaweed Res. Utiln*., 27(1&2): 25-27.

Abstract : The effect of seaweed liquid fertilizer, Spyridia hypnoides on the activity of amylase in *Oryza sativa* L. leaf during senescence has been studied. It was found that in low concentration particularly in 10%, the activity of alpha and beta -amylase is significant when compared to other concentrations. Amylase activity gradually increases to a particular level and then declines during senescence period. The results are discussed.

1335. **Kumar, V.** 1993. Biochemical constituents of marine algae from Tuticorin coast. *Indian J.Mar.Sci.*,22:138-140.

Address : Botany Department, V.O.C. College, Tuticorin, Tamilnadu, India.

Abstract : Biochemical constituents such as protein, carbohydrate and amino acid were estimated in 21 species of marine algae belonging to three classes collected at monthly intervals for a period of one year from the Tuticorin coast to assess the nutritive value. The selected algae showed species specific and seasonal variations in their biochemical constituents. Chlorophyceae and Rhodophyceae members were rich in protein and carbohydrate compared to Phaeophyceae. Amino acid content was more or less the same in all the 3 classes of

algae (maximum average value 2.5%). Many of the algal members showed maximum protein content in November and maximum carbohydrate and amino acid contents in September.

1336. **Kumar, V.** 1993. Lipid content of some algae from Tuticorin coast. *Seaweed Res. Utiln.,* 16(1&2): 45-58.

Address : P.G. Department of Botany, V.O.C. College, Tuticorin-628 008, Tamilnadu, India.

Abstract : Twenty-three genera comprising 25 species of green, brown and red algae of Tuticorin coast were analysed for total lipid content which varied from 17 to 140 $mg.g^{-1}$. Chlorophyceae and Rhodophyceae members were rich in lipid content compared to Phaeophyceae.

1337. **Kumar, V and A. Mahadevan** 1993. Algal species diversity as an index of pollution in Tuticorin marine waters. *Mahasagar,* 26(2): 115-121.

Address : P.G. Dept. of Botany, V.O. Chidambaram College, Tuticorin, Tamil Nadu, India.

Abstract : The Tuticorin sea coast is prone to pollution resulting from various sources such as harbour, thermal power station, fertilizer and chemical plants, and sewage disposal. Microalgae showed low species diversity at four of five stations thereby indicating polluted conditions. Macroalgae analysis revealed the brown alga *Padina* sp., to be dominant at stations I and II while the red alga *Jania* sp., was dominant at the stations III and IV.

1338. **Kumar, V and A. Mahadevan** 1993. Physico-chemical *Valoniopsis pachynema* assessment of pollution at Tuticorin coast. *Environ. Ecol.,* 11(2): 462-464.

Address : P.G. Department of Botany, V.O.C. College, Tuticorin-628 008, Tamilnadu, India.

Abstract : Eleven physico-chemical parameters (temperature, transparency, turbidity, pH, DO, BOD, NO_2, NO_3, PO_4 and SiO_4 observed at 5 stations I, II, III, IV and V) along the Tuticorin coast every month from February 1990 to January 1991 are presented. BOD, NO_2, NO_3, PO_4 and SiO_4 levels were higher at stations I and IV compared to station V which indicated their polluted condition.

1339. **Kumar, V and V.R. Mohan** 1994. Effect of seaweed extract SM3 on the cyanobacterium Oscillatoria species. *Biomed. Lett.,* 49(195): 187-189.

Address : Post-Grad. Dep. Bot., V.O. Chidambaram College, Tuticorin-628008, India.

Abstract : The effect of the commercial seaweed extract SM3 on the growth of the cyanobacterium *Oscillatoria* sp., was investigated. SM3 was found to promote all the three growth parameters, viz. Chlorophyll *a*, carotenoids and proteins in this organism. The maximum protein content was recorded in 0.50% SM3 concentration.

1340. **Kumar, V and V.R. Mohan** 2003. Effect of seaweed liquid fertilizer on drought stressed Ragi (*Eleusine coracana* (L.) Gaertn.). *Seaweed Res. Utiln.,* 25(1&2): 105-107.

Address : P.G. Department of Botany, V.O.C. College, Tuticorin-628 008, Tamilnadu, India.

Abstract : Influence of SLF (Seaweed Liquid Fertilizer) treatment on recovery of drought stressed *Eleusine caracana* was studied. SLF was prepared from two brown seaweeds, *Padina pavonica* and *Sargassum plagiophyllum.* Drought stress resulted in a steep decline in in-vivo nitrate reductase activity and photosynthetic pigments *viz*., chlorophylls and, carotenoids. On rewatering, the SLF treated ragi plants recovered much faster in terms of nitrate reductase activity and photosynthetic pigments as compared to the untreated ones. The present study clearly indicated the role of SLF in alleviation of stress effects in ragi.

1341. **Kumar, V., V.R. Mohan and L. Louis Jesudass** 2005. Caloric, elemental and nutritive changes in decomposing *Sargassum ilicifolium*. *Nat. Symp. Marine Plants, Their Chemistry and Utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. p 29.

Address : P.G. Department of Botany, V.O.C. College, Tuticorin-628 008, Tamilnadu, India.

Abstract : *Sargassum ilicifolium* (Turner) C. Agardh was collected from the Red Gate end of Hare Island, Tuticorin. It was decomposed in the seawater using the nylon net 'litter bag' method and in the laboratory using freshwater and sustained aeration to accomplish aerobic decomposition. Samples were collected at weekly intervals, dried in hot air oven and powdered. The dried powder samples were analysed for caloric value, mineral elements (K, Ca, Mg and Na) and nutritive parameters like protein, carbohydrate, lipid and crude fibre, ash content and C/N ratio. In both the types of decomposition experiments, protein, nitrogen, caloric value and ash content showed increase while carbohydrate, lipid, minerals and C/N ratio a declining trend.

1342. **Kumar, V.** 2005. Recent trends in research and utilisation of seaweeds. *Nat. Symp. Marine Plants, Their Chemistry*

and Utilization. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, 23-25 June 2005. p 44-47.

Address : P.G. Department of Botany V.O. Chidambaram College, Tuticorin - 628008, Tamilnadu, India.

Abstract : Seaweeds are going to play a crucial role in the field of agriculture, aquaculture and pharmaceuticals. The word seaweed is indeed a misnomer. These macroalgae constitute one of the largest producers of biomass in the marine environment. They contribute to the biodiversity and energy economy of ocean and estuaries. They produce a wide variety of chemically active metabolites in the environment, which are being termed as biogenic compounds. These compounds have the potential to be commercially exploited.

1343. **Kumar,V., V.R. Mohan and L. Louis Jesudass** 2005. Nutritive value changes during aerobic decomposition of *Ulva reticulata* Forsskal. *Seaweed Res. Utiln.,* 27(1&2): 29-34.

Address : P.G. Department of Botany, V.O.C. College, Tuticorin-628 008, Tamilnadu, India.

Abstract : *Ulva reticulata* which was subjected to aerobic decomposition showed an increase in protein, nitrogen, ash content and caloric value and decrease in carbohydrate, lipid, organic carbon, minerals, crude fibre and C/N ratio with the progress of decomposition.

1344. **Kumar, V., V.R. Mohan and L. Louis Jesudass** 2006. Caloric, elemental and nutritive changes in decomposing *Sargassum ilicifolium. Seaweed Res. Utiln.,* 28(1): 69-74.

Address : Department of Botany, St. Xavier s College, Palayamkottai - 627 002, Tamilnadu, India.

Abstract : *Sargassum ilicifolium* was subjected to decomposition in seawater (field) and fresh water (laboratory) in order to assess the changes in caloric, elemental and nutritive contents. In both cases caloric value, protein, nitrogen and ash content showed an increment while the mineral elements (K, Ca, Mg and Na), carbohydrate, lipid, organic carbon, crude fibre and C/N ratio a decrease from the beginning of the decomposition process.

1345. **Kumaraguru, A.K.** 1989. An Island under attack. *Indian Express,* Oct. 21, 1989.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : A recent visit revealed several fisher-folk armed with crowbars and small pickaxes systematically working in groups of five or six, mining the wave-washed shore line for blocks of coral stones. There were several boys with baskets collecting small broken pieces of corals washed ashore, and there were others sieving the sand under water for broken pieces of corals. As a result of continual mining for the past several decades, the coastline of the Island has got eroded and the 'Beacon' once located on the southern tip of the Island now stands in sea water at a distance of about 200m from the shore. The mining has also resulted in the shifting of sand and silt which have got deposited on the north western tip as a long strip of sand bar changing the shape of the Island itself. Enquiries indicate that once the waters surrounding this Island had plenty of coral growth. But now nothing in the vicinity upto a depth of two to three fathoms.

1346. **Kumaraguru, A.K.** 1991. Indian coral reefs and the need for conservation. *Environ. Poll. & Resources of Land and Water.* pp. 73-81.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Coral reefs are one of the most productive ecosystems in the world. Besides their productivity, man's ability to alter the surface of the earth is rivaled, among biological organisms only by colonies of tiny coral polyps (Goreau *et al.* 1979). Coral reefs are known for their colour, sheer beauty of form and design, and the tremendous variety of life they support (Nybakken, 1988). Nearly 8% of all living organisms on the earth inhabit the oceans of which most of them are invertebrates including corals. Corals are not only highly productive with complex food web and trophic organisation (Wafar, 1986), but also have the potential to yield a variety of bioactive substances including drugs for curing diseases (Bakus, 1987; Bose, 1988). Coral reefs also act as a physical barrier and prevent catastrophes due to erosion of sea during strong and cyclonic weather by acting as baffles.

1347. **Kumaraguru, A.K., R. Chidambaranathan and S. Selvakumar** 1992. Heavy metals (Copper, Zinc and Iron) in some marine organisms around Rameswaram Island, India. *J. Ecobiol.,* 4(2): 141-144.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu,

India. E-mail: akkguru@eth.net

Abstract : Monitoring of heavy metals (copper, zinc and iron) in some representative marine organisms along the coast of Rameswararam Island in the southeast coast of India indicated moderate levels of accumulation of these metals. Iron was found to have been accumulated more than the other metals. Compared to reported levels of these metals elsewhere, waters of Rameswaram appear to be not polluted with these heavy metals.

1348. **Kumaraguru, A.K.** 1996. *In situ* observations on the underwater ecology of coral reefs and associated fauna in the Gulf of Mannar Biosphere Reserve. *Report submitted to Ministry of Environment and Forests, Government of India*. 60 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Made extensive underwater surveys of the coral reefs, for the variety of species and their distribution and diversity, surrounding all the 21 Islands in the Gulf of Mannar. In this report, we studied the associated faunal populations, their distribution, food and feeding habits, and behavioural patterns of coral associated fauna.

1349. **Kumaraguru, A.K.** 1996. Microbial pollution of coastal waters of the Pilgrim town Rameswaram due to Tourist inflow. *Report submitted to Indian Council of Medical Research, Government of India.* 36 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Agnithreetham, the bathing place was found contaminated with microbes mainly due to the bathing activities by large number of pilgrims. The microbial count was found to increase in relation to the size of congregation of pilgrims during festivals and holidays. Public amenities provided by the local municipal authorities were inadequate compared to the crowd gathering during festivals. The seawater in sewage mixing place was highly polluted due to sewage effluent dumped dirctly into the sea since there is no facility for sewage treatment in the pilgrim town Rameswaram. Accroding to BIS 1982 (Breaue of Indian Standards) for bathing water quality, TC and FC should not exceed the standard limit of total coliforms 500 MPN/100ml and fecal coliforms 100 MPN/100ml. Thus the results of the study clearly indicated that the bathing place Agnitheertham was not at all suitable for bathing. The FC/FS ratio of the water samples of Agnitheertham showed that the ratio was greater than 4 and the FC/FS ratio of sewage mixing place was 0.7.

1350. **Kumaraguru, A.K.** 1997. Ecology of ornamental fishes of export value in the Gulf of Mannar. *Report submitted to Department of Ocean Development, Government of India* (DOD/56/IDA/4/92). 55 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : There are 21 Islands in the Gulf of Mannar forming a chain along the 140 km stretch between Tuticorin and Rameswaram (Latitude 8°55' – 9°15' North and Longitude 78°0' – 79°16' East). These Islands have fringing coral reefs and patch reefs around them. Narrow fringing reefs are located mostly at a distance of 50 to 100m from the Islands. On the other hand, patch reefs arise from depths of 2 to 9 m and extend to 1 to 2 km in length with widths of as much as 50 meters. These coral reefs have a rich variety of ornamental fishes of various shapes, dimensions, colours, and designs.

1351. **Kumaraguru, A.K.** 1998. Collection of qualitative and quantitative data on ornamental fishes in the Gulf of Mannar. *Report submitted to Department of Ocean Development, Government of India* (DOD/1/CZM/1/97). 126 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Among the 21 Islands of Gulf of Mannar studied, it was observed that Nallathanni Island had the highest species density of 3.24/10 Sq.m followed by Karaichalli (2.80), Appa (2.68/10 Sq.m.), Musal (2.64/10 Sq.m.), Manoli (2.64/10 Sq.m.), Pulvunni challi (2.52/10 Sq.m.), Yaanaipar (2.52/10 Sq.m.), Pallimunai (2.44/10 Sq.m.), Vaalai (2.36/10 Sq.m.), Thalaiyari (2.36/10 Sq.m.), Mulli (2.36/10 Sq.m.), Manoliputti (2.16/10 Sq.m), Upputhanni (2.00/10 Sq.m.) and Shingle (2.00/10 Sq.m). The remaining viz., Vaan (1.96/10 Sq.m) Kaasuwar (1.76/10 Sq.m), Poomarichan (1.52/10 Sq.m), Kurusadai (1.24/10 Sq.m), Velanguchalli (0.92/10 Sq.m), Poovarasanputti (0.88/10 Sq.m) and Pullivasal (0.60/10 Sq.m) showed only moderate species density.

The study revealed that the highest Shannon-Weaver diversity Index (H' value) was observed around Pallimunai, (2.98) and Yaanaipar (2.98) in Keezhakkarai group followed by Shingle (2.86) in Mandapam group, Puluvunnichalli (2.83) in Vembar group and Musal (2.83) in Mandapam group, Appa (2.76) in Keezhakkarai group, Manoliputti (2.73) and Manoli (2.69) in Mandapam group, Karaichalli (2.64) in Tuticorin group, Nallathanni (2.58) in Vembar group, Kasuwaar (2.52) in Tuticorin group, Upputhanni (2.50) in Vembar group, Vaan (2.46) in Tuticorin group, Vaalai (2.46), Mulli (2.30) and Thalaiyari (2.30) in Keezhakkarai group. Moderate and low species diversity were observed in the following Islands viz., Poomarichan (1.60) in Mandapam group, Velanguchalli (1.40) in Tuticorin group, Kurusadai (1.24) in Mandapam group, Poovarasanputti (1.10) in Keezhakkarai group and Pullivasal (0.79) in Mandapam group. Pomacentridae was observed as the dominant family among the ornamental fishes inhabiting the coral reefs studied around the 21 Islands followed by the families Chaetodontidae, Labridae, Holocentridae, Acanthuridae and Balistidae.

1352. **Kumaraguru, A.K and K. Jayakumar** 1998. Underwater ecology of coral reefs and their associated fauna in the Gulf of Mannar. ***In*** : *Biosphere Reserve and Management in India.* (eds) R.K. Maikhuri, K.S. Rao and R.K. *Rai. Himavikas Occasional Publication,* 12: 221-226.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Legislation must be made to protect the coral reefs. Legislation without enforcement efforts gives little protection. Although Marine Parks and Biosphere reserves legislation have been introduced, occasional poaching continues. Therefore this needs immediate attention. Strict enforcement of a ban on picking of live corals should be implemented. Entry to the Islands should be strictly restricted with proper permission from the Marine Park authority and that too only for special and essential purposes such as education and research. Removal of coral stones and beach sand for construction purpose should be curtailed. Efforts should also be made to get bricks and granite stones available at subsidized rates for people in this area. Anchoring of boats over good coral cover areas should be prohibited. Fishermen are to be made aware of the need to anchor the boats only in non reef areas. Collection of aquarium fishes and live bait should be restricted to designated areas only. This would greatly help to create undisturbed breeding grounds for coral reef fishes.

1353. **Kumaraguru, A.K., R. Kannan and A. Sundaramahalingam** 1999. Monitoring coral reef environment of Gulf of Mannar- A pilot study. *Report submitted to IOC/UNESCO/GCRMN.* 109 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : The aim of this pilot study was to monitor chosen coral reef areas in the Gulf of Mannar region for their bio-physical status and reef related resource usage by people. The study was carried out during the period between September 1998 and February 1999. The purpose of the study was to generate baseline data on the bio-physical status of coral reefs and the socioeconomics of the reef related resource utilization in the Gulf of Mannar region. The information would become part of the GCRMN National Database. This would in turn contribute to the long term planning of coral monitoring in the Gulf of Mannar region in India.

1354. **Kumaraguru, A.K.** 2000. Socio-economic study of marine fishing communities in the Gulf of Mannar region. *Report submitted to Department of Ocean Development, Government of India,* March 2000, 107 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

1355. **Kumaraguru, A.K.** 2000. Coral reefs in the Gulf of Mannar and the coservation strategies required. *Ecol. Env. & Cons.,* 6(1): 1-12.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : The present paper reports the importance of Gulf of Mannar marine ecosystem in India and the importance of corals and coral reefs. Disturbance and threats to these ecosystems due to pollution, coastal development, mining, tourism, blasting and for other cultural purposes is discussed in detail. Socioeconomic dimension of the problem is discussed and conservation measures are suggested.

1356. **Kumaraguru, A.K and R. Kannan** 2001. Socio-economic issues and coral reef management in Gulf of Mannar. *Coastal Environment and Management,* pp. 146-160. (ed) S. Ramachandran, Institute of Ocean Management, Anna University. 347 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : The fishermen problems/issues can be classified into two categories such as macro level issues, and micro level issues. The macro level issues are 1) problems arising from mechanized and non-mechanised means of fishing, 2) middle-men problems, 3) coral mining, 4) marine resource depletion, and 5) alternative employment. The micro level issues are education, health care, drinking water facility, and other local problems. If the governments at the Central and State level attend to these problems the fishermen of the Gulf of Mannar region will look forward to the future with great confidence.

1357. **Kumaraguru, A.K.** 2002. Assessment of the impact of bleaching phenomenon on the corals and their recovery in the Gulf of Mannar and Palk Bay. *Report No. 3-8/99,* 105 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : After the 1998 bleaching phenomenon, the corals in the Gulf of Mannar and Palk Bay showed good recovery. The live coral cover improved from 25.74% in 1999 to 76.20% during the recovery stage-2 in 2001. The same pace of recovery was observed in the Palk Bay also. The live coral cover was 28.80% (i.e., after the bleaching phenomenon) and recovered to an extent of 64.24% during the recovery stage-2. The high resilience and the ability for rejuvenation of corals were exhibited well in the study area after the 1998 bleaching phenomenon. This was seen in the increase in live coral. However, this recovery was fast and restricted to corals which belong to the families Faviidae and Poritidae only. Recovery in the corals of the family Acroporidae was found to be very slow. The increase in live coral cover after the 1998 coral bleaching phenomenon has revealed the fact that corals can tolerate the stress of Bleaching and recover, although in a slow manner. In spite of the large scale bleaching in 2002, the corals are now recovering slowly in the Gulf of Mannar and Palk Bay. However, to study vulnerability of the species, which are affected by the bleaching phenomenon, it is essential to know quantitative and qualitative changes in the population and diversity of the coral communities. Therefore, a long term monitoring program of the coral reefs is required, which would give not only information on the status of corals but also the plans required for their sustainable management in the Gulf of Mannar and Palk Bay regions.

1358. **Kumaraguru, A.K.** 2002. Biofouling and antifouling organisms in the Gulf of Mannar. *Report submitted to Department of Ocean Development, OSTC (Annamalai)* (DOD/11-MRDF/4/11/UNI/97/P15/11-02-2002), Government of India.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : The problem of marine biofouling and its control strategies are of great economic importance to all the maritime nations of the world. Mostly barnacle fouling could raise the fuel consumption and hence the operation cost of ships by as much as 40%. Protection against these organisms calls for a knowledge of their ecology and seasonal occurrence. Altogether, 49 potential macro foulers and 2 micro foulers (algae alone) were identified from the four kinds of test panels used in the underwater biofouling panel system at Pudhumadam coast in the Gulf of Mannar. Among these, 23 belong to Hard Macro foulers (Cirriepedes, Polychaetes, Bivalves and Corals). Cirriepedes were observed as the predominant macro fouling organisms in Pudhumadam coast. About 28 Soft macro foulers (Algae, Sponges, Ascidians, Gastropods, Decapods and a Stomatopods) were identified and were found to be harmless in spite of the fact that they are enhancing the biomass by occupying more volume of any man-made underwater structure. The hydro biological status of the study area (Temperature, Salinity, pH, Dissolved Oxygen, Silicate, Nitrate, Nitrite and Inorganic Phosphate) for the entire study period indicated that they may not have any specific impact on settlement of fouling organisms. Among the settled fouling organisms, the Percentage of barnacle was observed to be high in the seaward side of the test panels during the South-west monsoon season. For antifouling study, three species of soft corals from *Sinularia* and *Lobophyton* sp were collected. The crude extracts from these organisms were tested against fouling bacterial strains. The efficacy of *Lobophyton* sp against the fouling bacterial strains was found to be higher than that of *Sinularia* sp. In the laboratory study, *sinularia* sp (#1) showed better efficacy than the other, against the II-instar stage of *Balanus amphitrite.*

1359. **Kumaraguru, A.K.** 2002. Studies on the ecology of Scleractinian corals of Palk Bay. *Report submitted to Department of Ocean Development, OSTC (Berhampur University), Government of India.* (DOD/11-MRDF/4/11/UNI/97). pp..26.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Fifty five Line Intercept Transects (LIT) were laid each month in the 11 stations of the 3 major zones of the Palk Bay, which were studied for the faunistic composition of corals. The observed coral fauna for the overall Palk Bay region were listed. Altogether, 37 species of Scleractinian corals were identified up to species level and 13 were identified up to generic level. Hence the total of 50 scleractinians of 27 genera that belonged to 11 families were identified up to March 2004. Species which have not been reported earlier were *Acropora millepora*, *Echinopora lamellosa*, *Favia stelligera*, *Favites complanata*, *Gardineroseris sp.*, *Leptoria* sp., *Lobophyllia hemprichii*, *Lobophyllia corymbosa*, *Oulophyllia* sp, *Oxypora sp.*, *Platygyra sinensis*, *Porites lobata*, *Psammocora* sp., and *Stylophora pistillata*. A thorough biophysical monitoring of corals was done to study the recovery rate of the corals after the 2002 bleaching phenomenon and it was noticed that the recovery of corals was found to be significant ($P<0.05$; $F_{2,6}=5.14,5.728$). The ambient physico-chemical parameters were regularly monitored in three stations representing the three major zones of the Palk Bay.

1360. **Kumaraguru, A.K., J.J. Wilson and N. Marimuthu** 2003. Recovery of corals from bleaching event of 2002 in Palk Bay, southeast coast of India. (Abstract only). *Nat. Sem. Reef ecosystem remediation;* SDMRI, Tuticorin-628 001, 24th to 26th Sep'2003. p. 23.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : As a result of bleaching phenomenon of 2002, the Palk Bay reefs faced severe mortality. The present biophysical status of the Palk Bay in the Southeast coast of India was examined using Line Intercept Transect Method (English *et al*, 1997). The corals of Palk Bay were studied as three zones and each zone was observed repeatedly for biophysical status of the corals. The highest overall percentage of live coral cover was recorded in the Mandapam zone (38.72%), followed by Rameswaram east zone (37.65%) and Rameswaram North zone (22.73%). Water samples were analyzed at fortnightly intervals to estimate the physico-chemical parameters. Nearly 90% of the corals were found to have recovered from the 2002-bleaching event. Acroporidae family faced severe mortality compared to other families Poritidae and Faviidae.

1361. **Kumaraguru, A.K., K. Jayakumar and C.M. Ramakritinan** 2003. Coral bleaching 2002 in the Palk Bay, southeast coast of India. *Curr. Sci.*, 85(12): 1787-1793.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : The bleaching of corals and their recovery in chosen study sites of the reefs of Palk Bay, southeast coast of India were monitored. The bleaching phenomenon occurred during the period from April to June 2002. A minimum of at least 50% and a maximum of 60% bleaching were noticed among the six different sites monitored. However, the corals started to recover quickly in August 2002 and as much as 52% recovery could be noticed. The coral-bleaching phenomenon might have occurred due to unusual rise in surface seawater temperature, which was 32°C in the peak of summer. This, confounded with the failure of the southwest monsoon winds during this period, might have exerted a stress on the corals leading to expulsion of zooxanthellae from their bodies, causing the bleaching phenomenon. Coral bleaching might affect the distribution of coral-associated animals, especially the food fishes which depend on the corals for feeding and breeding. This, in turn, can affect the livelihood of the reef resource users, particularly the fishermen in the Palk Bay region.

1362. **Kumaraguru, A.K., N. Marimuthu and J.J. Wilson** 2003. A preliminary study on macrofouling organisms in Pudhumadam (Gulf of Mannar). *Nat. Symp. Algae and Environment;* Department of Environmental Science, University of Kerala, Trivandrum- 695 581, 13th to 15th Feb'2003. p. 62.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Fouling is undesirable growth or biological accretion of organisms on surfaces which are immersed in seawater. Macro fouling involves colonization of surfaces by macroscopic plants and animals. An experimental panel system was established near Kootuparai in Pudhumadam coastal area of Gulf of Mannar. In the present study, four different varieties of test panels were used and observations on fouling species were made at fortnightly intervals. The fouling species were observed from November 2002 to January 2003. Larval forms of Prawns, Neries and certain species of Crabs were found. *Balanus reticulatus* was the dominant species found in the study.

1363. **Kumaraguru, A.K., N. Marimuthu and J.J. Wilson** 2003. An account on the intensity of macrofouling organisms in Pudhumadam coast, Gulf of Mannar. (Abstract only). *Nat. Sem. Reef ecosystem remediation;* SDMRI, Tuticorin-628 001, 24th to 26th Sep'2003. p. 23.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Biofouling due to a variety of organisms is a persistent problem in shipping and transport, off-shore oil mining, coastal power generation, naval operation etc., for many maritime countries. For a protective study against these organisms particularly macro fouling, a knowledge of their ecology and seasonal variation are necessary. In the present study, a Biofouling Panel System was created and experimented near Kootuparai (N 09° 16.246' E 78° 59.847') in Pudhumadam coast, Gulf of Mannar. Four types of test panels were used for observing the settlement and recruitment of macro fouling communities during the period November-2002 to June-2003. The major identified Cirripedes were *Balanus amphitrite* and *B. reticulatus.* The percentage of barnacles as foulers was calculated for detecting the destructive/defective portion of the test materials. *Eunice antennata* was the dominant Polychaete worm and *Pilumnus minutes* was observed as the dominant decapod. *Cymodacea* spp. and *Sargassum myriocystum* were recorded as cast ashore particles on the panels. Some unidentified tiny specimens of nudibranchs, molluscs and serpulids were also observed as foulers.

1364. **Kumaraguru, A.K., R. Kannan, A. Sundaramahalingam, M. Rajee and C.M. Ramakritinan** 2003. Socioeconomic monitoring of reef resource users in Therespuram of Tuticorin, Gulf of Mannar, India. *South Asian Anthropologist,* 3(1): 27-44.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : Therespuram fishing colony is inhabited exclusively by *Vallam* owned fishermen and labourers involved in fishing activity. Fishers in this region are economically backward, due to improper management of their earnings obtained mainly as wages through fish catching. Fishers of Therespuram are fishing, and collecting chanks. The literacy level is very less i.e., only 8 per cent. This is mainly due to the ignorance and poverty among fishers which made their children stop education even before they reach 14 years of age. One of the significant observations in this region is the exploitation of the subsistence level of fishers by middlemen. Another reason for their indebtedness might be chronic alcoholism. Vallam owners have been affected much more than the labourers engaged in fishing activities. In the present paper, fishermen's problems, alternative employment, conservation of marine resources, *etc*., have been discussed.

1365. **Kumaraguru, A.K., K. Jayakumar, J.J. Wilson and C.M. Ramakritinan** 2005. Impact of the tsunami of 26 December 2004 on the coral reef environment of Gulf of Mannar and Palk Bay in the southeast coast of India. *Curr. Sci.,* 89(10): 1729-1741.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, Tamilnadu, India. E-mail: akkguru@eth.net

Abstract : The live coral cover of 48.5% in the Gulf of Mannar was reduced to 36% after the tsunami of 26 December 2004. Corals showing partial bleaching, infestation with disease, silt-smothered live corals, recently killed corals, broken corals, upturned corals and sea grass damage were found in many places around the 21 Islands. The coral cover under stress was 6.7%, which included corals showing partial bleaching and those infested with pink line disease syndrome. The silt-smothered coral cover was 30%. Damage to corals due to tsunami was 6.7% that included recently killed corals, upturned corals and broken corals. Sea grass damage was also found in low quantities. Landscape alterations revealed that Shingle, Mulli, Valai, Thalaiyari, Upputhanni, Van, Kasuwar and Karaichalli Islands experienced more shore erosion compared to the other Islands. Uprooted trees were found in all the Islands. Corals lying closer to the shore in all the Islands were affected by sedimentation. The live coral cover of 26.7% in the Palk Bay was reduced to 19.2% after the tsunami. The coral cover under stress was 2.8%, which included those showing partial bleaching and those with infestation of pink line disease. Silt-smothered coral cover was 10.5%. Unlike the Islands in the Gulf of Mannar, there was no change in landscape structure in the Palk Bay region. Only inundation of seawater was noticed in some places. There was substantial increase in sedimentation rate after the tsunami in the Palk Bay showing 12, 54 and 13 mg/cm^2/d during Nov. 2004, Dec. 2004 and Jan. 2005 respectively.

1366. **Kumaran, P.L.** 2002. Marine mammal research in India - A review and critique of the methods. *Curr. Sci.,* 83(10): 1210.

Address : Marine Mammal Consultant, No. 1329, 20th Main Road, Anna Nagar, Chennai 600040, Tamilnadu, India. E-mail: whale@md2.vsnl.net.in

Abstract : Indian research publications on marine mammals, in most cases, are generally mediocre and misleading. Published information ranges from reports of occasional stranding to descriptions of fishery interactions. Due to non-existence of a comprehensive research programme and adequately trained research teams in India, information available is fragmentary and often of dubious scientific quality. Lack of understanding of the biology of most of the species and absence of quantitative data on the anthropogenic impacts are serious impediments to the conservation of marine mammals in India. This review attempts to identify the major gaps and provides recommendations in improving the research methodology for understanding the status of marine mammals and their conservation.

1367. **Kumaraswamy Achari, G.P.** 1968. Studies on new or little known polychaetes from the Indian seas. 2. *Micromaldane jonesi*. *J. Mar. Biol. Assoc. India*, 10(2): 269-273.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The genus *Micromaldane* is represented by two species, *Micromaldane* Mesnil (1897) from France (Atlantic coast) and *M. bispinosa* Hartman (1960) from Gardaqa (Red Sea). *M. ornithochaeta* has subsequently from North Atlantic and Irish Sea by various workers (FauveI, 1927; 1956; and Hammond, 1966), from Cape Margerie, Adelie coast Antartic as reported by Hartman (1966) and from the coast of British Columbia E. & C. (1962). Fauvel (1927) however doubted the validity of *M. ornithochaeta* since this species invariably occurs in association with other maldanids or less similar to the post-larval stages of *Nicomache trispinata* Arwi structures of its anterior and posterior extremities. The present species is described based on a good collection of mic from the Gulf of Mannar. The small tubes of fine sand grains form 'aggregate fenestrated masses' similar to those of *Saimacina dysteri*.

1368. **Kumaraswamy Achari, G.P.** 1971. Occurence of the brine-shrimp, *Artemia salina* in Karesewar Island off Tuticorin, Gulf of Mannar. *Indian J. Fish.*, 18(1&2): 196-198.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1369. **Kumaraswamy Achari, G.P.** 1988. Need for an integrated approach to planning in R & D for fishery resource development. *CMFRI Spec. Publ.*, 40: 91.

Address : Central Marine Fisheries Research Institute, Vizhinjam Research Centre, Vizhinjam, Kerala, India.

Abstract : The following topics are discussed: 1) the process of marine fisheries resource development; 2) research as the basis for planning and development; 3) problems during technology transfer; 4) personnel for resource development; 5) the role of educational institutes in developing resource management personnel; 6) planning by unit system; and 7) an integrated approach for developing a national network.

1370. **Kumaraswamy Achari, G.P.** 2003. Why Pearl Culture in India could not be Commercialized, its Scientific and Technological Problems. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 65-66.

Address : TC 16/1480, Jagathy, Trivandrum-695 014, Kerala, India.

Abstract : It is well known that farming in the sea is initiated in India in 1971 and the first cultured pearl was produced in 1973. It is also a fact that various technologies for seed production through hatchery and natural settlement, farming of pearl oysters, Nucleus implantation and pearl production is perfected at various centers of Mandapam, Tuticorin, Vizhinjam and Visakhapatanam of CMFRI and many training programmes have been conducted to develop new entrepreneurship. In spite of this it is reasonable to think why pearl culture in India could not be commercialized and what shall be the solution and approach for commercialization of pearl culture and develop it as an industry. Some of the reasons for the low returns from pearl culture are still unknown and ecological conditions of the seas around Indian coast, scarcity of the protective bays, roughness and heavy wave actions of the open sea conditions are supposed to be the reasons for the low production. Above all these, the heavy silt conditions in some of the regions were believed to be responsible for the increased mortality of the oysters. In addition to this, all the areas where pearl culture is attempted might not have the high primary production or the availability of feed for the oyster population, which might have affected the growth of the oysters and the deposition of the nacre around the nucleus. Another factor, which seriously affected the income from pearl farming, is the nature of the gadgets used for pearl farming on commercial scale. Rafts, long line system and other floating structures and racks fixed on stakes are some of the structures we use for farming pearl oysters in protected areas or in the open sea. Onshore farming is another system used for pearl culture. All these systems require heavy inputs as recurrent expenses for maintenance as well as for labour involvement. If

commercial production of pearl is to be materialized the selection of these systems based on the nature of the farm area is to be judicious and as far as possible the recurring expenses are to be cut down.

1371. **Kumaresan, S., N.V. Vinith Kumar, T. Balasubramanian and A.N. Subramanian** 1998. Trace metals (Fe, Mn, Zn and Cu) in sediments from the Gulf of Mannar region, southeast coast of India. *Indian J. Mar. Sci.*, 27(2): 256-258.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India.

Abstract : The distribution of trace metals (Fe, Mn, Zn and Cu) in the reef sediments and seagrass sediments of Islands Manauli and Hare in the Gulf of Mannar region has been monitored for a period of one year. Attempt has also been made to relate the sediment particle size with the concentrations of metals. The determined metal concentrations were in the following order: Fe>Mn>Zn>Cu. The differences between seagrass bed and coral reef bed were statistically determined in each island using ANOVA.

1372. **Kumaresan, S.** 1999. Organochlorine pesticides (HCH, DDTS) in the Gulf of Mannar Marine Biosphere Reserve, India. *Ph.D. Thesis*, Annamalai University, India, 69 pp.

1373. **Kumari, I.S., V. Umayorubhagan, A. Vijayan and M. Anbu** 2005. Marine water quality along the western coast of the Kanyakumari district: Northeast monsoon survey. *Indian J. Env. Protection*, 25(3): 267-273.

Address : S.T. Hindu College, Advanced Research Centre in Chemistry, Nagercoil - 629 002, India; Department of Chemistry, St. Jude's College, Thoothoor; Regional Research Laboratory, CSIR, Trivandrum- 695019, India.

Abstract : Continuous monitoring of pollution is a must in order to promote better living conditions around the region along with the improvement of aquatic life. This paper gives information about the marine water quality along the western coast of the Kanyakumari district, Tamil Nadu. An attempt has been made here to systematically present the recent investigations on the physico-chemical parameters of this coastal water. Eighteen seawater samples were collected from 6 different locations of the coastal stretch to explore the chemical nature. The enhanced values of the heavy metals during the month of October (northeast monsoon) can be attributed to the high river water discharge. This investigation was undertaken to generate base line data on the status of the coastal water of Kanyakumari district.

1374. **Kunda, S.K and P. Kaladharan** 2003. Agar factory discharge as fuel and manure. *Seaweed Res. Utiln.*, 25(1&2): 165-168.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Agar factory waste was tried as fuel for cooking and manure for cow pea. Seedlings of cow pea (*Vigna ungiculata*) supplied with agar factory waste powder, showed improved seedling vigour. The total length of the seedlings (85 - 87%), wet weight (194 - 329%), number of leaves (31 - 38 %) and number of root nodules (42 - 92%) increased than those of control. Out of the two treatments of basal application of agar waste powder, one time application at the time of sowing seeds registered maximum vigour over the control as well as the other treatment, which received similar quantity in three intervals. As the 'fuel cakes' prepared out of agar factory waste registered high energy content (19 %), high ash content (20 %) and high rate of combustibility (5 min and 20 sec), these 'fuel cakes' can be ideally used as fuel for cooking.

1375. **Kunjipalu, K.K.** 1990. On the results of Demersal trawling conducted from FORV Sagar Sampada in the Exclusive Economic Zone (EEZ) of India - personal observations. *Proc. First Workshop Result.* FORV Sagar Sampada 5-7 June, 1989. pp. 295-296.

1376. **Kunju, M.M.** 1978. Taxonomy and distribution of cultivable prawns. *CMFRI Spec. Publ.*, 3: 34-39.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : A knowledge of certain morphological characters is essential for the identification of prawns. These characters are shown. The main features of systematic importance are the rostrum, carapace with various spines and carinae, telson, appendages and secondary sexual characters like petasma and thelycum.

1377. **Kunju, M.M.** 1978. Growth in prawns. *CMFRI Spec. Publ.*, 3: 48-57.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : A knowledge of the pattern and rate of growth of the individuals of each species of prawn is essential

for a clear understanding of their general biology. Growth is manifested as an increase in size of the prawn, and as such is best measured in terms of its volume or weight. But, it is usually gauged from observation of its linear dimension, i.e., total length. It has been mathematically proved that there is a fairly constant relationship between total length and weight of the individuals of the species.

1378. **Kurian, M.J.** 1993. Seafood export through Tuticorin port. *Seafood Export J.,* 25(3): 2-10.

1379. **Kurian, N.P., T.N. Prakasha and F. Jose** 1997. Wave power potential of the Kanyakumari-Alappuzha sector, southwest coast of India. *Proceedings of the Second Indian National Conference on Harbour and Ocean Engineering Inchoe* 97, Thiruvananthapuram, December 7-10, pp. 234-240.

Address : Marine Sciences Division, Centre for Earth Science Studies, Thiruvananthapuram 695 031, India.

Abstract : The wave power potential of the Kanyakumari-Alappuzha sector of the southwest coast of India is studied by computations using a wave transformation model. The results show that this coastal sector can be categorised into different zones with the Thiruvananthapuram zone having the highest power followed by Kollam with moderately high values. The zone adjoining Kanyakumari, the peninsular tip shows the lowest values. From the present study it is concluded that Thengaipatnam, Poovar, Vizhinjam, Valiathura, Veli and Puthenthura along this coast have high wave power potential which could be considered for commercial exploitation. The wave power distribution along this coast is discussed in the paper with reference to the transformation processes that bring about the variability.

1380. **Kuriyan, G.K.** 1950. The fouling organisms of pearl oyster cages. *J. Bombay Nat. Hist. Soc.,* 49: 90-92.

Abstract : Pearl oysters are cultivated at the Krusadai Biological Station by the so called “Raft or hanging method” which has been so popular along the coasts of Japan. They are placed in separate wooden cubicles, covered with wire-net frames, tied to a “Raft” and anchored to the bottom of the sea. The identified biofouling communities classified as Polyzoa, Mollusca, Annelida, Crustacea, Reptantia, Tunicata and seaweeds.

1381. **Kuriyan, G.K.** 1950. Turtle fishing in the sea around Krusadai Island. *J. Bombay Nat. Hist. Soc.*,49(3):509-512.

Address : Marine Biological Station, Krusadai Island, Pamban, Gulf of Mannar, India.

Abstract : Turtle fishing has been practised for ages on the south-eastern shores of the Indian Peninsula, particularly around Krusadai Island, where it has long been conducted by non-Hindu fishermen. Hindu fishermen do not generally fish for turtles; their indifference being attributed to their religious belief that the second of the *dasavatars* of Lord Vishnu had the form of a turtle.

1382. **Kuriyan, G.K.** 1951. A note on the eggs and the first stage larva of *Hippolysmata vittata* Stimpson. *J. Bombay Nat. Hist. Soc.,* 50: 416-417.

Address : Marine Biological Station, Krusadai Island, Pamban, India.

Abstract : The brightly coloured shrimp, *Hippolysmata vittata* Stimpson was frequently seen among the fouling organisms of pearl oyster cages at Krusadai. Most of those obtained in the months from July to October were berried and in each individual specimen examined, they were between 400-500 eggs.

1383. **Kuriyan, G.K.** 1952. Notes on the attachment of marine sedantary organisms on different surfaces. *J. Zool. Soc. India,* 4, 157-172.

1384. **Kuriyan, G.K and S. Mahadevan** 1953. A note on the effect of light and the colour of the substratum on the settlement of barnacles. *J. Bombay Nat. Hist. Soc.,* 51: 522-523.

1385. **Kuriyan, G.K.** 1953. Biology of fouling in the Gulf of Mannar: a preliminary account. *Ecology,* 34: 689-692.

1386. **Kuthalingam, M.D.K., G. Luther, P. Livingston and V. Sriramchandra Murthy** 1973. Further occurrences of the whale shark, *Rhincodon typus* in the Indian coastal waters. *Indian J. Fish.,* 20(2): 646-651.

Address : Central Marine Fisheries Research Institute, Vizhinjam, Kerala, India.

Abstract : Occurrence of four specimens of whale shark, *Rhincodon typus* Smith, two males and two females, one each from Pamban and Kesavanputhanthurai, 552 cm and 517 cm total length respectively and two from Vizhinjam 393 cm and 565 cm total length are reported. This is also the first report on the smallest specimen

recorded from the Indian seas. Dermal denticles which show some variation in form from those of this species from the Atlantic are described. Dental formula has been given. The proportional ranges of a few selected body parts have been presented along with notes on variations in body colouration and the relative position of the gill clefts. Algae have been considered to be the favourite food of the species.

1387. **Kuthalingam, M.D.K., Sundararaj and V. Ramadhas** 1982. Utilization of mangrove ecosystem for aquaculture in India. *International Symposium on Utilization of Coastal Ecosystems: Planning. Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982. Atlantica*. 5(2): 68.

Address : Fisheries College and Research Intsitute, Tuticorin - 628 300, Tamilnadu, India.

Abstract : The mangrove systems have rich resources of fishes, prawns, crabs and molluscs highly suitable for various methods of fish farming. The seed materials of *Chanos chanos, Mugil* spp. *Lates calcarifer* etc. are freely available and these fishes can be cultured quite economically in net enclosures. *Penaeus indicus* and *P. monodon* are also available in plenty and there is prospect for growing them at high densities in tidal ponds either as monoculture or poly-culture and produce more than 1000 Kg/ha/yr and 3000 Kg/ha/yr respectively. Besides such utilization of natural food resources of mangrove, there is further scope to enhance the productivity by intensive means of farming. The abundance of the juveniles of *Scylla serrata* also offers better scope for culture. Among molluscs, the euryhaline species are best suited for converting the mangrove food resources into animal protein without much loss.

1388. **Kutty, M.N and G. Murugapoopathy** 1968. Diurnal activity of the prawn *Penaeus semisulcatus*. *J. Mar. Biol. Assoc. India*, 10(1): 95-98.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Several authors have reported that penaeid prawns remain active above substratum at night and stay quiet, buried in sand during the day (Fuss, 1964; Fuss and Ogren, 1966; Wickham, 1967; Hughes, 1968). Menon and Raman (1961) also suggested increased nocturnal activity in Indian penaeid prawns. Kutty (1967) pointed out the burrowing habit of *Penaeus semisculcatus* and estimated the metabolism of the buried prawn; his short term observations, however, did not indicate that *Penaeus indicus* has the burrowing habit. Burrowing methods of *Metapenaeus mastersii* have been described by Dall (1958) and those of *Penaeus duorarum* by Fuss (1964). It appears that the burrowing habits of the penaeid prawns are more or less similar. As evident, precise information on the burrowing behaviour, emergence from the substratum and activity of the Indian prawns are wanting. The authors had occasion to observe the activity rhythm of a group of penaeid prawns, *Penaeus semisulcatus* reared in the sea water aquarium of the Institute primarily for a series of experiments on metabolic adptations. The present observations, though not strictly planned, appeared to be of interest especially since much is yet to be known about the behaviour of the Indian prawns and are therefore presented here.

1389. **Kutty, M.N., H. Mohamed Kasim, R. Santhanam and N. Sukumaran** 1986. Thermal pollution of coastal waters and its effect on fish survival. *Symp. Ser. Mar. Biol. Assoc. India.* 6: 1367-1376.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Thermal discharges from power plants pollute waters and affect the survival, growth, reproduction and behaviour of fishes and shellfishes. Thermal relations of 3 euryhaline fishes, namely the milkfish (*Chanos chanos*), *Tilapia mossambica* and the mullet, *Rhinomugil corsula* were investigated. While milkfish can survive indefinitely at 40° C (acclimation 30° C) all *Tilapia* and mullet exposed, died within 37°C and 171 minutes respectively; while milkfish survives for 150 minutes at 42°C, all the other fishes tested face instantaneous death. A comparison of upper temperature tolerance of the 3 species studied indicates that the milkfish has higher tolerance than *R. corsula* and *T. mossambica* and also carps studied. One of the sublethal effects studied for and *Tilapia* only is the inhibition of swimming at the temperature extremes.

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1390. **Laidlaw, F.F.** 1904. Report on the polyclad Turbellaria collected by Professor Herdman at Ceylon in 1902. *Rep. Govt. Ceylon Pearl Oyster Fish Gulf of Mannar,* 2: 127-136.

1391. **Lakshmanan, K.K and M. Rajeshwari** 1979. Seagrasses of Krusadai Island in the Gulf of Mannar, India. 2. *Syringodium isoetifolium* (Aschers) Dandy. *Ind. J. Bot*., 2(1): 87-95.

Address : Autonomus Postgraduate Centre, University of Madras, India.

Abstract : *S. isoetifolium*, collected from Krusadai Island, Tamil Nadu, possesses a cylindrical and rhizomatous stem, long and terete leaves and adventitious roots borne in fours at each node. Anthers consist of dithecous pollen sacs, which are connected to the filament by curved bridges. A persistent epidermis with tannin, an endothecium devoid of fibrous thickenings, a retention of wall layers till maturity and the periplasmodial, 2 or more layered tapetum, derived from the eripheral sporogenous tissue exhibit the structure of the mature pollen sac. Pollen grains are filiform and 3-celled. Bitegmic, anatropous and crassinucellate ovules with a micropyle formed by the inner integument, develop linear tetrads of megaspores leading to a Polygonum type of emrbyo sac. The endosperm is nuclear. The embryo develops from the terminal cell of the 2-celled proembryo. The basal cell functions as a single large suspensor. The mature embryo is large, radially expanded with the primary organs pushed to a small lateral position. The epicotyl and cotyledon develop from the terminal tier.

1392. **Lakshmanan, K.K and M. Rajeswari** 1979. Seagrasses of Krusadai Island in the Gulf of Mannar, India III. Anatomy of the Seagrasses of Hydrocharitacea. *Symposium on histochemistry, developmental and anatomy of angiosperms*, Trichy, Tamil Nadu.

1393. **Lakshmanan, K.K., M. Rajeswari, R. Jayalakshmi and K.M. Diwakar** 1984. Mangrove forest of Krusadai Island, SE India, and its management. *Environ. Conserv.*, 11(2): 174-176.

Address : Department of Botony, Bharathiar University, Coimbatore - 641046, Tamilnadu, India.

Abstract : The Krusadai group of Islands, situated at 9°14' - 9° 15' N Lat. and 79° 10.5' – 79° 14.5'E, serve as windbreaks and help to prevent soil erosion. The most distinct of all is Krusadai Island, often described as the "Biologists Paradise" of 125 acres (50 X 6 ha). Rectangular and somewhat (inverted) boat-shaped, it is separated by 250 m of sea from the nearest point of Rameswaram Island. Acquired some 75 years ago by the government, it is now in the control of the Department of Fisheries. The mangrove vegetation and the dire need for its proper management are discussed here.

1394. **Lakshmanan, K.K and M. Rajeswari** 1985. Seagrasses in the Gulf of Mannar, India. *All India Symposium on Marine Plants, Their Biology, Chemistry and Utilization*, (*eds*) Krishnamurthy, V. and A.G. Untawale, pp. 209-214.

Address: Department of Botony, Bharathiar University, Coimbatore- 641046, Tamilnadu, India.

Abstract: Results on the phenology of 9 species of seagrasses collected in the Gulf of Mannar are presented.

1395. **Lakshmi Pillai, S., S. Rajapackiam and D. Sunderarajan** 2002. Mud crab *Scylla tranquebarica* culture in earthen pond at Tuticorin. *J. Mar. Biol. Assoc. India*, 44(1&2): 245-248.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The mud crab, *Scylla tranquebarica* was cultured in an earthen pond of 0.125 ha in the Karapad hatchery of Tuticorin Centre of CMFRI, India. They were fed on chicken waste and trash fish and harvested after 273 days of culture. Sampling of crabs was carried out every month by noting their carapace width and weight. The results show an increase in average weight from 133g at stocking to 428.5g after 275 days, with a survival of 23.8%. Low survival was mainly due to poaching as well as cannibalism. The hydrographical parameters during the period was monitored.

1396. **Lal, K.K and K. Kapur** 1988. Temperature versus biochemical oxygen demand - its significance in the quantitative and qualitative evaluation of certain livestock wastes for pisciculture. Acta Hydrochim. *Hydrobiol.*,16(1): 65-72.

Address : Tuticorin Research Centre, Central Marine Fisheries Research Institute, 90 North Beach Rd., Tuticorin-628001, Tamil Nadu, India.

Abstract : The experiments were conducted to work out the interrelationship between temperature and BOD of wastes obtained from poultry, piggery, cow and goat-sheep sheds, both individually as well as with respect to their equiproportion combination in addition to seven different poultry-piggery wastes combinations. The significance of the findings in estimating the proper loading levels and relative efficiency of these wastes, with regard to different seasons of a year, has been discussed.

1397. **Lal Mohan, R.S.** 1969. A new species of sciaenid fish *Johnius mannarensis* from the southeast coast of India. *J. Mar. Biol. Assoc. India*, 11(1&2): 320-323.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : While studying the Sciaenid fishes, a new species was observed from the trawl catches of Gulf of Mannar. It is similar to *Johnius dussumieri* Valenciennes [= *Umbrina dussumieri* (Valenciennes)] but for the ctenoid scales, shorter first dorsal fin and mental barbel. Trewavas (1964) described three sciaenid fishes from India *viz*. *Nibea russelli* (Cuvier), *Johnius dussumieri* (Valenciennes) and *Johnius macropterus* (BJeeker).

1398. **Lal Mohan, R.S.** 1970. Gonadial abnormalities in the sciaenid fish, *Pennahia aneus*. *J. Mar. Biol. Assoc. India*, 12(1&2): 163-165.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Gonadial abnormalities including hermaphroditism have been observed in many Indian fresh water and marine fishes. In marine fishes hermaphroditism was observed by Chacko and Krishnamoorthy (1949) in *Hilsa ilisha*, Prabhu and Raja (1959), Thomas and Raju (1962) in *Rastrelliger canagurta* (Cuvier), Nayak (1959) in *Polynemus heptadactylus* (Cuvier), Raju (1960) and Thomas and Raju (1962) in *Katsuwonus pelamis* (Linnaeus), Rao (1962) in *Rastrelliger canagurta* (Cuvier). Other gonadial abnormalities are reported by Thomas and Raju (1962) in *Katsuwonus pelamis*, Gnanamekalai (1962) in *Sardinella sirm*, Bensam (1964, 1969) and Dhulkhed (1966) in *Sardinella longiceps*. While working on the biology of *Pennahia aneus* (Bloch) a few abnormal gonads were observed.

1399. **Lal Mohan, R.S.** 1971. *Helcogramma shinglensis*, a new species of tripterygid fish from Gulf of Mannar with a key to the fishes of the family Tripterygidae of eastern and central Indian Ocean. *Senckenbergiana Biol.*, 52(3&5): 219-223.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : From eastern and central Indian Ocean 6 species of tripterygids are hitherto known, of which *Gillias capensis* (Gilchrist & Thompson) and *Tripterygion obtusirostre* (Klunzinger) are reported from south Africa; *Helcogramma pusillus* (Ruppell) and *H. abeli* (Klausewitz) from the Red Sea; *T. faciatum* (Weber) and *H. ellioti* (Herre) from the Indian Coast. While collecting fishes from the intertidal regions of the Shingle Island a new species of tripterygid and eight specimens of *Tripterygion fasciatum* were collected.

1400. **Lal Mohan, R.S.** 1971. Note on a case of death due to Jellyfish sting in Gulf of Mannar. *Curr. Sci.*, 40(23): 637-638.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The danger of jelly fish stings has been reported by Phisalix (1922), Pawlowsky (1927), Henderson (1945), Halstead (1957, 1959) and Barnes (1963). The venomous nature of the jelly fishes like *Chiropsalmus* sp. (sea-wasp), *Cyanea* sp. (sea-blubber), *Dactylometra* sp. (sea nettle), and the siphonophores like *Physalia* sp. (Portuguese man-of-war) has been described by Light (1914), McNeil and Pope (1943), Pope (1953), Chu and Cutress (1954), Southcott (1959) and Halstead (1965, 1969).

1401. **Lal Mohan, R.S.** 1976. Some observations on the sea cow, *Dugong Dugon* from the Gulf of Mannar and Palk Bay during 1971-75. *J. Mar. Biol. Assoc. India*, 18(2): 391-397.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Sex ratio of the mature male and female dugongs was about 1:1 and that of younger size groups was 0.6 : 1.0. The size distribution varies from year to year. The size groups 150 to 199 cm were dominant in all the years except during 1972. March, August and October were the months when most of the dugongs got entangled in the nets. Dugongs are found fairly in good numbers around the Islands Valai and Musal in the Gulf of Mannar and Devipattanam and Thondi in Palk Bay. Gulf of Mannar accounted for 76 % of the dugongs. Large size dugongs were more common in Thondi (Palk Bay).

1402. **Lal Mohan, R.S.** 1976. Two new species of sciaenid fishes *Johnius elongatus* and *Johnieops macrorhynus* from India. *Matsya*, (1): 19-25.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Two new species of sciaenid fishes *Johnius elongatus* and *Johnieops macrorhynus* are described with figures. These fishes form a fishery along the Indian coast. Their morphometric characters, standard deviation and percentage of coefficient of variations are tabulated.

1403. **Lal Mohan, R.S and V. Ghandi** 1976. Record of Pacific parrotfish *Ypsiscarus oedema* (Snyder) from Gulf of Mannar. *Indian J. Fish.*, 23(1&2): 241-243.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Ypsiscarus oedema* is recorded and described from Gulf of Mannar, India.

1404. **Lal Mohan, R.S.** 1977. A monograph for the Various Characters of the Sciaenid Fish *Pennahia aneus* (Bloch). *Indian J. Fish*., 24(1&2): 214-216.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Nomographs of four characters such as standard length, otolith length, scale length and weight are drawn in relation to total length, based on 580 specimens of the sciaenid fish *Pennahia aneus.*

1405. **Lal Mohan, R.S.** 1983. Experimental culture of Chanos in fish pens in a coastal lagoon at Mandapam. *Indian J. Fish.*, 30(2): 287-295.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Chanos* was experimentally cultured in 3 fish pens, fabricated with palmyra poles and enclosed with 20mm mesh nylon webbing, of area 2500m^2 each. The methods of construction of the pens, the hydrological conditions and general topography of the lagoon are described. *Chanos* fingerlings of length 80-146 mm were stocked in the pens, at a rate of 4000, 6000 and 8000/ha, and their rate of growth was observed. The *Chanos* fingerlings belonging to the secondary spawning, during October-November, were also stocked in a pen at a rate of 3400/ha. The stock attained a length of 260 mm, weighing 137 g, during 132 days. Constraints met with the pen culture are also discussed briefly.

1406. **Lal Mohan, R.S.** 1983. Preliminary observations on fish pen culture in a lagoon at Mandapam. *Mar. Fish. Inf. Serv. Tech. Ext. Ser*., 48: 12-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Experimental fish pen culture in Mandapam is discussed, describing the fish pens, their stocking with milkfish (*Chanos chanos*) and fish growth.

1407. **Lal Mohan, R.S.** 1985. A note on the changing catch trend in the traditional trap-fishery of Keelakarai and Rameswaram. *Indian J. Fish.*, 32(3) : 387-391.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The catch and size composition of the fish and the seasonal variation of the fishery show that the catch trend in the trap fishery has slightly changed, for the better, at both Keelakarai and Rameswaram, Tamil Nadu, India with the use of prawn peelings (wastes from the recently developed prawn industry) as bait. A brief observation on the biological aspects of *Siganus canaliculatus*, a dominant constituent at present, is also given.

1408. **Lal Mohan, R.S.** 1985. Capture of coastal birds in the Pillaimadam lagoon at Mandapam, South-East coast of India. *Proc. Symp. Endangered Marine Animals and Marine Park, MBAI*, 1: 352-354.

1409. **Lal Mohan, R.S.** 1985. Food and feeding habits of the sciaenid fish *Pennahia macrophthalmus* (Bleeker). *J. Mar. Biol. Assoc. India*, 27(1&2): 68-71.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Quantitative analysis of the food of the sciaenid fish *Pennahia macrophthalmus*, seasonal variations, food in relation to length of fish, feeding intensity and food selection are discussed. The species is a carnivore, feeding mainly on fishes and prawns.

1410. **Lal Mohan, R.S.** 1985. Recovery of a ringed sandwich tern, *Sterna sandvicensis sandvicensis* from Rameswaram Island. *Mar. Fish. Infor. Serv. T & E. Ser.*, 62: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : On 19th Sep'1983, one specimen of the Sandwich tern, *Sterna sandvicensis sandvicensis* was recovered from Kundukal point of Rameswaram with a metallic ring having a Russian inscription and a no. P.702628 on it.

1411. **Lal Mohan, R.S.** 1986. Recovery of a ringed sandwich tern, *Sterna sandvicensis sandvicensis* from Rameswaram Island, Tamilnadu. *J. Bombay. Nat. Hist. Soc.*, 83(3): 664.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Terns (*Sterna sandvicensis sandvicensis*) are known for their long intercontinental wintering migration. On 17.9.1983 a sandwich tern was recovered from Kundukal point of Rameswaram Island with a metal ring having Russian inscription and a number P. 702628 on it. This recovery, the second of the sandwich tern with a ring, confirms that the species is a common migratory bird to the Southern Peninsula.

1412. **Lal Mohan, R.S.** 1986. Wind mill produced electricity for lighting fish farm shed at Mandapam. *Mar. Fish. Infor. Serv. T & E. Ser.*, 70: 22-23.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : The cost details incurred for the assembly of wind mill is discussed in this article.

1413. **Lal Mohan, R.S.** 1986. The Krusadai Island. *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp*, pp. 26-27.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

1414. **Lal Mohan, R.S.** 1986. Fish and Fisheries of Mandapam, *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp*, pp. 32-33.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

1415. **Lal Mohan, R.S.** 1986. Birds and Catchers of Ramanathapuram coast. *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp*, pp. 42-43.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

1416. **Lal Mohan, R.S.** 1988. Research and management of Chanos fry resources of India. *CMFRI Spec. Publ.*, 40: 63.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Chanos fry is available along the southeast coast of India during the months of April-June though less numbers are reported from other parts of the country during various seasons. Along the southeast coast of India they occur in low lying areas, tidal flats and in creeks. The size ranges from 2 to 10 cm weighing 1 to 10 g. The methods of fishing, types of gear used and methods of disposal of the catch are discussed. Seasonal abundance, catch rates, transport and the rate of survival during transport are also described. Conservation measures such as regulated fishing operation, regulation of mesh size, declaration of closed season, and the notification of closed areas are discussed.

1417. **Lal Mohan, R.S.** 1988. Evaluation of large scale culture of Milkfish, *Chanos chanos*, in fish pens in a lagoon. *CMFRI Spec. Publ.*, 40: 63-64.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Field trials were conducted from 1981 to 1986 on the culture of milk fish in large fish pens made of nylon webbing in the Pillaimadam Lagoon, near Mandapam. *Chanos* seed of length 75-145 mm weighing 4-18 g were stocked at various rates and reared. Production ranging from 220 to 450 kg/ha was obtained without giving artificial feed. Details of cost of pens and income from pens are discussed. The main advantage of the system is the availability of the water area and the seed. The constraints of the system such as damage to the webbing due to barnacles, predation by birds, poaching and unfavourable weather conditions are discussed.

1418. **Lal Mohan, R.S.** 1988. Development of polythene film lined ponds for the culture of prawns and fishes. *CMFRI Spec. Publ.*, 40: 64-65.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Prawns and fishes were cultured in polythene film lined ponds in the sea shore of Calicut from 1976 to 1981 obtaining valuable data on growth, survival and production rate. The salient features of construction of ponds, maintenance and the constraints faced are discussed. The main advantage of the system is the extensive areas of seashore along the coast and availability of seed of commercially important prawns and fishes in the surf area. High rate of survival and growth were also reported. The constraints are the high cost of polythene sheet, fuel for pumping seawater and the laws regarding the utilisation of seashore by the individuals for farming.

1419. **Lal Mohan, R.S.** 1988. Research needs for the better management of dolphins and dugong resources of India. *CMFRI Spec. Publ.*, 40: 98-99.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : The marine mammals which form a part of fishery bycatch are represented by dolphins and dugong. The smaller cetaceans that are caught along the Indian coast are *Stenella longirostris*, *Delphinus delphis*, *Sousa chinensis* and *Tursiops truncates*. The dugongs are caught in the Gulf of Mannar and Palk Bay. Annually about 250 dolphins get entangled in the gill nets along the Indian coast. About 25 dugongs are caught in the Gulf of Mannar and Palk Bay.

1420. **Lal Mohan, R.S.** 1990. Chanos fry resources of India. *CMFRI Bulletin*, 44(2): 435-438.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Chanos fry occur along the south east coast of India in fairly large numbers during the months of March-June and October-November. Its abundance distribution and seasonal variation are discussed. Conservation measures such as regulated fishing and mesh regulations are suggested. Causes for the decrease of Chanos fry abundance are also brought to focus. Measures to be taken to protect the fry resources are highlighted.

1421. **Lal Mohan, R.S.** 1990. Evaluation of culture of Milk Fish, *Chanos chanos* in fish pens in a shallow lagoon at Mandapam, India. *CMFRI Bulletin*, 44(2): 438-442.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Culture of milk fish in net enclosures in the Pillaimadam lagoon near Mandapam is described. Erection of the net enclosure maintenance results obtained from culture operations, constraints and improvement in the system are discussed. The feasibility of extension of the pen culture to the rural areas is analyzed. The results of the trials conducted by the fishermen are also examined.

1422. **Lal Mohan, R.S.** 1991. Research needs for the better management of Dolphins and Dugongs of Indian coast. *CMFRI Bulletin*, 44(3): 662-667.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Taxonomy, age and growth, length range, reproductive biology, population parameters, seasons of occurrence and by-catch of dolphins and dugongs are discussed. The research needs and areas requiring urgent attention are brought to focus. Suggestions are made for designing gill nets that can be rejected by dolphins and preventing them from getting entangled. Safeguarding the habitat of dolphins and dugongs from degradation is suggested.

1423. **Lal Mohan, R.S.** 1992. Observations on the whales *Balaenoptera edeni*, *B. musculus* and *Megaptera novaeangliae* washed ashore along the Indian coast with a note on their osteology. *J. Mar. Biol. Assoc.India*, 34(1&2) : 253-255.

Address : Central Marine Fisheries Research Institute, West Hill, Calicut 673 005, Kerala, India.

Abstract : The Baleen whales *Balaenoptera edeni*, *B. musculus* and *Megaptera novaeangliae* were reported from the Indian Coast. The skull of a *B. edeni* washed ashore in Dhanuskodi Island in the Gulf of Mannar and that of *M. novaeangliae* from the Malabar-Coast were studied. The identity of *B. edeni* was confirmed based on the study of its nasal bones. Biological significance of the occurrence of whales washed ashore along the Indian Coast is also discussed.

1424. **Lal Mohan, R.S.** 2000. The sea cow, *Dugong dugon* of India. *Golden Jubilee Celebrations Souvenir, 2000. Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp.22-24.

Address : Conservation of Nature Trust, 43C, Water Tank Road, Nagercoil-1, Tamilnadu, India.

Abstract : The seacows or the dugongs are distributed in the Indo-Pacific region between longitudes 32°E and 170°W, latitudes 35° and 40°N. There are five population namely, East Australian, North Australian, Andaman-Malay Peninsula, Thailand and South China, South Indian and Sri Lanka, East African, Red Sea and Persian Gulf. Dugong has a wide distribution in the tropical Indo-Pacific region. They are recorded from East Africa, Mafia Island, Kenya, Red Sea, Persian Gulf, Gulf of Mannar, Palk Bay, Sri Lanka, Andaman Island, Burmese Coast, Merqui Archepelago upto New Caledonia and Philippines Island. At present the dugongs are found in good numbers in the coast of Australia but becoming depleted in other places.

1425. **Laxminarayana, A and M.N. Kutty** 1982. Oxygen consumption, ammonium excretion and random activity in *Penaeus semisulcatus*, *Macrobrachium malcolmsoni* and *Paratelphusa hydrodomus* with reference to ambient oxygen. *Proc. Symp. Aquaculture,* 1: 117-122.

1426. **Lazarus, S and Jacob Jerold Joel** 1979. The pelagic fisheries resources of Kanyakumari district, Tamil Nadu, South India. *Seafood Export J.*, 11(5): 9-28.

Address : Central Marine Fisheries Research Institute, Research Centre, Vizhinjam, Kerala, India.

Abstract : A description is given of the pelagic fishery resources of the areas, which includes a description of the areas themselves, the major species caught, seasonal and regional variations, and processing and distribution. Existing facilities for catching, processing, and education are described and further requirements are outlined. Data are presented, relating mainly to the 1969 through 1971 catches.

1427. **Lingakumar, K., R. Jeyaprakash, C. Manimuthu, A. Haribaskar** 2002. *Gracilaria edulis* - An effective alternative source as a growth regulator for legume crops. *Seaweed Res. Utiln.*, 24(1): 117-123.

Address : Centre for Research and Post Graduate Studies in Botany, Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi- 626 124, Tamilnadu, India.

Abstract : Seaweeds are among the important marine living resources with tremendous commercial applications. The effect of crude extract of *Gracilaria edulis* was studied on the growth and biochemical composition of legume crops such as *Vigna unguiculata* L. and *Phaseolus mungo* L. Seaweed extract was added to soil bed in three different concentrations (0.5%, 1% and 3% w /v). *Vigna* seedlings showed best response at 0.5% and 1% concentrations of seaweed extract in almost all the growth parameters. Similarly, a significant increase in the content of photosynthetic pigments, free aminoacid, leaf soluble protein and starch was observed. In the case of Phaseolus, 0.5% concentration proved beneficial. The level of anti-oxidant enzymes such as catalase and peroxidase varies with the crop species. It was concluded that a differential response in the crops to the crude seaweed extract treatment was noticed. Inspite of these differential responses, *Gracilaria* was considered to be an effective biofertilizer in legume crops.

1428. **Lingakumar, K., D. Balasubramanian, S.K.G. Sundar, R. Jeyaprakash and M. Jeyakumar** 2006. Effect of *Ulva lactuca* crude extract on growth and biochemical characteristics in *Cyamopsis tetragonoloba* L. and *Phaseolus mungo* L. *Seaweed Res. Utiln.*, 28(1): 75-80.

Address : Centre for Research and Post Graduate Studies in Botany, Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi - 626 124, Tamilnadu, India.

Abstract : Seaweeds are among the important marine living resources with tremendous commercial application. In the recent times, seaweed extracts have been used as fertilizers. These extracts are commonly known as seaweed liquid fertilizer (SLF). The effect of crude *Ulva lactuca* extract was studied on the growth of crops viz, *Phaseolus mungo* (L.) and *Cyamopsis tetragonoloba* (L.). The effect of this crude seaweed extract was studied on the leaf area, photosynthetic pigment composition and biochemical characteristics upto 20 days of growth with an interval of 5 days. Seaweed extract was added to the soil bed in three different concentrations of 0.5%, 1% and 5% (w/v). *Phaseoulus and Cyamopsis* seedlings showed positive response at 0.5% concentration of crude seaweed extract. The application of *Ulva lactuca* extract was found to promote overall growth pigment synthesis and enhance the synthesis of biochemical constituents such as soluble protein and starch. The use of *Ulva lactuca* proved to bean efficient alternative to the conventional chemical fertilizers.

1429. **Lipton, A.P.** 1993. *Cryptocaryon irritans* (Protozoa: Ciliata) infection among aquarium-held marine ornamental fish and its control. *Curr. Sci.*, 65(7): 571-572.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Ornamental fishes belonging to seven genera maintained in the marine aquarium in Mandapam were

infected by the ciliate *Cryptocaryon irritans*, reported for the first time from India. In the affected fishes numerous whitish pustules were noticed on the body. The percentage mortality ranged from 4 to 100%. Bath treatment using 2 ppm chloramphenicol, followed by 5 ppm of copper sulphate after 6 h, controlled and eradicated the ciliates effectively. Hydrological and other possible environmental factors for the onset and spread of ciliate infection are discussed.

1430. **Lipton, A.P., S. Krishna Pillai and P. Thillairajan** 1994. Observation on the culture of green mussel in Pillaimadam salt water lagoon, near Mandapam. *Mar. Fish. Infor. Serv. T & E Ser.,* 127: 8-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Experiments on the culture of green mussel and results on the growth of mussel in the bag culture method are discussed.

1431. **Lipton, A.P and J.R. Ramalingam** 1994. Skin of rays - A new commodity for export market. *Mar. Fish. Infor. Serv. T & E Ser.,* 127: 13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The ray skin export is a newly established endeavour for the fisherfolk of Ramanathapuram coast of Tamilnadu. The commercial value and tanning are discussed.

1432. **Lipton, A.P., A.D. Diwan, A. Regunathan and C. Kasinathan** 1995. Frequent strandings of Dolphins and Whales along the Gulf of Mannar coast. *Mar. Fish. Infor. Serv. T & E. Ser.,* 138: 11-14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In this report, observations on the occurrences of carcasses of dolphins and whales along the Gulf of Mannar during September 1994 to January 1995 are given.

1433. **Lipton, A.P.** 1995. An appraisal of a semi-intensive prawn farm at Kanjirankudi, Ramnad district. *Mar. Fish. Infor. Serv. T & E. Ser.,* 139: 13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The farm is located near the mouth of a creek and has good water exchange facilities. The ponds are in two parellel rows with supply canal running in between them.

1434. **Lipton, A.P., P. Thillairajan, M. Bose, J.R. Ramalingam and K. Jayabalan** 1996. Large scale exploitation of sacred chank *Xancus pyrum* using modified trawl net along Rameswaram coast, Tamil Nadu. *Mar. Fish. Infor. Serv. T & E Ser.,* 143: 17-19.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The length and MSD-wise distribution of *Xancus pyrum* at Rameswaram coast is discussed in this article.

1435. **Lipton, A.P and M. Selvakku** 2001. Tagging and recapture experiments in the Indian sacred chank, *Turbinella pyrum* along the Gulf of Mannar and Palk Bay, India. *Phuket Mar. Biol. Cent. Spec. Publ.,* 25(1): 51-55.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Concomitant to the heavy demand of the sacred chank, *Turbinella pyrum*, several methods of large-scale exploitation, including bottom trawling, take place in the Palk Bay and Gulf of Mannar region, leading to depletion of chank resources. The natural growth of the chank is not known. Tagging and recapture experiments were therefore conducted. Chanks were brought to the laboratory, reared in a flow-through system, and conditioned before tagging with 'Letro' labels attached to shells with Araldite. The measured and tagged chanks were released at specific sites in Gulf of Mannar and Palk Bay. Tagging and recapture data from 1994 to 1997 showed that in the natural habitat the increase of average Maximum Shell Diameter (MSD) ranged from 6.6 to 7.5 mm. Out of 1046 chanks tagged, the recovery ranged from 8.7 to 11.5 %.

1436. **Lipton, A.P and J. Selvin** 2003. *Vibrio alginolyticus* associated with white spot disease of *Penaeus monodon*. *Dis. Aquat. Org.,* 57(1&2): 147-150.

Address : Department of Biotechnology, Malankara Catholic College, Mariagiri, Kaliakavilai, 629153, Kanyakumari District, Tamilnadu, India. E-mail: selvinj@rediffmail.com

Abstract : In February 2000, white spot disease outbreaks occurred among cultured *Penaeus monodon* in extensive shrimp farms on the southwest coast of India. Bacteria were isolated from infected shrimp that showed reddish body coloration and white spots in the cuticle. The isolates were screened on thiosulfate citrate bile salt sucrose (TCBS) agar plates for the selection of *Vibrio* species. The primary isolate (QS7) was characterized as *V. alginolyticus* based on morphological, biochemical and physiological characteristics. Antibiotic sensitivity tests of QS7 indicated that the isolate was highly sensitive to chloramphenicol, ciprofloxacin, nalidixic acid and streptomycin. Pathogenicity tests confirmed that the isolate was virulent for *P. monodon*. Based on the lethal dose (LD_{50}) value (5 x 10^6 cfu per shrimp), it was inferred that shrimp weakened by white spot syndrome virus would succumb to secondary infection by QS7.

1437. **Lipton, A.P., S.K. Subhash, R. Paul Raj and A. Anitha Rani** 2003. Influence of Environmental Factors and Microbial Load on the Spat Settlement of Pearl Oyster, *Pinctada fucata. 1st Indian Pearl Congress & Exposition,* 5th to 8th February 2003. pp. 52-54.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The successful development of hatchery technology for production of pearl oyster *Pinctada fucata* spat in 1981 at CMFRI is considered as an important milestone in the progress of research and development of molluscan shellfish culture in India. The pearl oyster was spawned in the laboratory and the larvae were successfully reared to spat settling under tropical conditions. However, variations of larval growth within and between different rearing conditions with mortality of larvae or spat were recorded. Though bacteria and protozoa infect the weak and dying larvae systematic investigations on diseases were not carried out. The environmental and other factors responsible for the lower survival rate of larvae have to be monitored so as to devise suitable disease management strategies. This paper highlights some of the observations carried out at the Pearl oyster hatchery of Mandapam Regional Centre of CMFRI, Mandapam, during October to December 2000 and from August to October 2002. In the pearl oyster hatchery, oysters collected from the Gulf of Mannar were stocked in dark interior FRP tanks, arranged in parallel rows. The dark interior coloration was intended to enhance the larval settlement. All the tanks had separate draining system that drains into a main canal. Induced spawning by thermal stimulation was adopted. After 24 hours of spawning, the 'D' - shaped larvae *(Veliger)* hatched out. In the first two experiments, these larvae were stocked in troughs of 30 litres capacity at a stocking density of 1 larva/ml. Totally 6 troughs were maintained. Micro alga, *Isochrysis galbana* was given as feed @ 15, 000 cells/ml/day. Water exchange was done on alternate days. Hydrological parameters such as dissolved oxygen content; temperature and pH were monitored once in two days. Salinity, H_2S, BOD (5 days), ammonia, nitrate and nitrite were monitored once in a week from the water samples collected from both the troughs and culture tanks. In the third and fourth set of experiments, the water quality and microbial load in feed and larvae were evaluated as such in the larval rearing tanks.

1438. **Liudeblad, B.** 1990. Small-scale *Gracilaria* culture and agar processing - Some economic issues. *Gracilaria production and utilization in the Bay of Bengal. Seminar papers: Session II small-scale Agarophyte processing. pp 58-64.*

Address : Bay of Bengal Programme, PO Box 1054, Madras - 600 018, Tamilnadu, India.

Abstract : An economic model has been established for seaweed farming and agar extraction at the village level. The experience gained by the BOBP pilot farms near Mandapam, Tamil Nadu, India, provides the quantitative data. At a production level of 800 kg dry weight of *Gracilaria edulis* per plot, it is concluded that an agar-selling price of Rs.125 per kg is required, assuming a 1.5% yield of agar, for the project to be profitable. If seaweed production falls to 500 kg, an agar price of Rs.150 per kg is needed, together with an agar yield of 16%. The model shows that the project may still be profitable after fencing each plot to prevent grazing by rabbit fish.

1439. **Livingston, P., M. Sivadas and M. Badrudeen** 1988. Marine Fish Calendar: Mandapam. *Mar. Fish. Infor. Serv. T & E. Ser.*, 90: 1-12.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Over 12 important groups of fishes constitute the commercial fisheries of Mandapam and Rameswaram region and they are discussed in this article.

1440. **Loviah, J.G.** 1980. Respiratory surface area (*Gill area*) of the hill stream fish *Garra mullya* (Sykes). *Indian J. Fish.*, 27(1&2): 172-176.

Address : Department of Zoology, Scott Christian College, Nagercoil, Tamilnadu, India.

Abstract : Average gill area per unit body weight in *Garra mullya* is 159.2 mm^2/g body weight. Weight specific gill area is higher in younger groups and becomes almost constant in higher body weights. In *G. mullya* number of secondary lamellae/mm from is fairly large. Gill area is correlated to its habitat.

1441. **Luis, A.J and H. Kawamura** 2000. A numerical study of dynamics for sea surface cooling near the Indian tip during winter monsoon. *Proceedings of the Fifth Pacific Ocean Remote Sensing Conference* PORSEC, 5-8 December 2000. Dona Paula, Goa, India. NIO. 1: 434-438.

Address : Tohoku University Center for Atmospheric and Oceanic Studies, Faculty of Science, Sendai 980-8578 Japan; E-mail: luis@ocean.caos.tohoku.ac.jp

Abstract : The SST-cooling dynamics during a gap-wind event that occurred during the 1997 winter monsoon are investigated using the Princeton Ocean Model (POM). The model domain is from 3°-10° N and 73°-81° E, with a spatial resolution of 9 km and with 15-sigma levels in the vertical. The model is fitted with realistic bottom topography and is forced with the daily-mean wind stress derived from the NASA Scatterometer and heat flux from the NCEP/NCAR reanalysis data. The results of a 14-day simulation are addressed. The spatial and temporal simulated-SST patterns agree well with the satellite (Advanced Very High Resolution Radiometer) SST. During the first 7 days, the SST cooling is initiated by the Ekman dynamics, *i.e*., the offshore Ekman transport from the west coast of Sri Lanka (WCSL) is largely compensated by an alongshore low-SST flow from the Gulf of Mannar (GM) and partly by upwelling near the WCSL. After 7 days, the large Ekman transport from the WCSL converges with a warm Arabian-Sea flow on the continental shelf of the IT and promotes diapycnal mixing; this enhances vertical heat diffusion and weakens the density stratification, as a consequence of which patches of warm SST emerge. The characteristic shelf topography of the IT is an important determinant in the evolution of circulation in the GM. The SST cooling near the WCSL is further enhanced by diffusion of surface heat after day 7.

1442. **Luis, A.J and H. Kawamura** 2000. Wintertime wind forcing and sea surface cooling near the South India tip observed using NSCAT and AVHRR. *Remote Sensing of Environment*, 73(1): 55-64.

Address : Centre for Atmospheric and Oceanic Studies, Facility of Science, Tohoku University, 980-8578, Sendai, Japan.

Abstract : This report addresses a case of topographic air-sea interaction in the Gulf of Mannar, near the Indian tip, for the winter monsoon of 1996-1997. Using high spatial resolution NASA- Scatterometer (NSCAT) wind data, a 1° x 1° region of strong wind is identified in the Gulf during the peak of the winter monsoon. The characteristic topography of South India and Sri Lanka and their orientation to the monsoon wind tend to channel this strong wind. Air-sea heat flux analyses, using the NSCAT wind and the European Center for Medium-Range Weather Forecast objective analyses surface data, reveal that the strong winter monsoon bursts cause large latent heat loss (180 W/m^2) from a wind-fetch region centered on 7.5° N, 77.5° E during January. Weak air-sea temperature gradients result in weak sensible heat loss (<15 W/m^2) from the ocean. The ocean response to this forcing is examined using weekly and monthly mean satellite-derived sea surface temperature (SST) maps; these indicate a sea surface cooling of about 1°C along the axis of the wind flow. A by-product of this cooling is an emergence of a SST front along the periphery of the strong wind-stress region. Time-series analyses of the surface meteorology reveal that this forcing has a periodicity of about 15 days, with a peak during the last week of December. Wind stress curl derived from, the NSCAT wind data exhibits high negative values (anticyclonic Ekman pumping) on a 2-week time scale, concomitant with strong wind bursts. The features observed in the Gulf of Mannar are similar to those reported from some other locations.

1443. **Luis, A.J and H. Kawamura** 2001. Characteristics of atmospheric forcing and SST cooling events in the Gulf of Mannar during winter monsoon. *Remote Sens. Environ*., 77(2): 139-148.

Address : Centre for Atmospheric/Oceanic Studies, Faculty of Science,Tohoku, University, Sendai 980-8578, Japan.

Abstract : This work addresses the analysis of winter monsoon forcing and sea surface temperature (SST) cooling events in the Gulf of Mannar, which is situated between the southeast of the Indian tip and northwest of Sri Lanka, using a 7-year data set derived from satellite sensors. The surface forcing consists of wind stress and turbulent heat flux, which were estimated through the TOGA/COARE algorithm using Special Sensor Microwave Imager (SSM/I) wind, Advanced Very High Resolution Radiometer (AVHRR) SST, and surface atmospheric conditions derived from National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) reanalyses data. Net heat flux was derived by combining the turbulent heat flux with net short- and long-wave radiation from the NCEP/ NCAR reanalysis data set. SST cooling was monitored by using 9-km

spatial resolution pathfinder SST that was derived from the AVHRR. The 7-year weekly mean maps of wind stress, net heat flux, and SST indicate that SST cooling is locally influenced by surface forcing in- and offshore of the Gulf of Mannar. A time series of these parameters near the Indian tip reveal that the strong wind stress and high surface heat loss, which are punctuated in time varying from 15 days to more than a month, occur every winter and lower SST by 1.5°C. The occurrence of such a phenomenon is referred to as an event in this work. The bell-shaped events, which have a periodicity of 15 days with a maximum wind stress around Day 8, occur every winter and are characterized by the SST cooling of less than a degree. The features of these events are studied by using the statistical correlation and composite technique. It is inferred that the SST cooling is strongly correlated with the surface forcing.

1444. **Luis, A.J and H. Kawamura** 2002. Dynamics and mechanism for sea surface cooling near the Indian tip during winter monsoon. *J. Geophysical Research C: Oceans*, 107(11): 8-1.
Address : Center for Atmospheric/ Oceanic Studies, Faculty of Science, Tohoku University, Sendai 980-8578, Japan.
Abstract : Winter time sea surface temperature (SST) cooling south of the Indian tip (hereafter tip) is investigated during a 14 day gap wind event (21 January to 3 February 1997) using satellite data and the three-dimensional, primitive equation, sigma coordinate Princeton Ocean Model (POM). The advanced very high resolution radiometer SST reveals surface cooling of 1.5°C over the 14 day period near west of Sri Lanka. A spatial-mean time series of surface forcing west of Sri Lanka indicate a bell-shaped pattern, which is characterized by maximum wind stress and outgoing heat flux (sum of turbulent heat flux and net surface long-wave radiation) of 0.12 N/m^2 and 450 W/m^2, respectively, on 27 January. POM simulation is performed with realistic bottom topography, with seasonal stratification, and with daily mean surface forcing derived from NASA scatterometer (NSCAT) winds and National Centers for Environmental Prediction (NCEP)/National Center for Atmospheric Research (NCAR) meteorological variables. During 21 - 28 January, Ekman dynamics together with positive wind stress curl promote SST cooling along the west coast of Sri Lanka. Thereafter irregular and shallow topography near the tip promotes diapycnal mixing, and the characteristic surface circulation significantly influences the evolution of the SST pattern along the periphery of the tip. An anticyclonic circulation evolves in the Gulf of Mannar under the influence of local negative wind stress curl after 27 January. Examination of a zonal section of density and vertical heat diffusion reveals that the initial stratification in the vicinity of the tip weakens because of diapycnal mixing and vertical diffusion of the surface heat. The mixed layer heat budget near the west of Sri Lanka and south of the tip reveals that the surface heat depletion dictates SST changes throughout the event. From our earlier works [Luis and Kawamura, 2000, 2001] and from the results of the present investigation it is inferred that the wintertime SST cooling in the vicinity of the tip is a case of topography monsoon ocean interaction.

1445. **Luther, G.** 1959. On an abnormal egg of the turtle, *Lepidochelys olivacea* with observations on hatching of the eggs. *J. Mar. Biol. Assoc. India*, 1(2): 261.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : An abnormal egg, more or less dumb-bell shaped was noticed in a batch of about 120 turtle eggs collected from the beach at Vedalai near Mandapam (Gulf of Mannar) on 28-10-1959. On subsequent hatching it was found that they were of *Lepidochelys olivacea olivacea* (Esch.). The two eggs in union were unequal, measuring 36 mm and 33 mm in diameter and 26 mm at the place of union the long axis being 72 mm. The normal eggs are spherical 40 - 41 mm in diameter.

1446. **Luther, G.** 1961. On an apparently specific type of abnormality in the white-spotted shovel nose ray. *Rhynchobatus djiddensis. J. Mar. Biol. Assoc. India*, 3(1&2): 198-203.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Setna and Sarangdhar (1948) described a shark-like stage in the embryonic development of *R. djiddensis* at 45 mm length. This corresponds to the 10^{th} stage described by Melouk (1949) in the same species at 42 mm length. The embryo at this stage has the head swollen and soft with two stud-like eyes laterally and a downwardly projected short blunt triangular soft snout; a branchial crest, on either side, above the lateral row of gill slits with the external branchial filaments and forming a 'rostral anlage' at the mid line of the forehead; anterior base of pectoral behind 5^{th} gill opening with the anterior and posterior lobes free from body; all fins developed in their respective adult positions-dorsals nearly semi-circular, caudal lunate and pelvics reniform in their shapes. The appearance of the adult shape is reported as 95 mm length. During the course of its further development the branchial filaments are absorbed, body pigmentation, scales and tubercles are developed and the foetus is reported to be more or less a perfect replica of the parent at 437 mm length except for the presence of the yolk-sac.

1447. **Luther, G.** 1962. The food habits of *Liza macrolepis* (Smith) and *Mugil cephalus* Linnaeus (Mugilidae) *Indian J. Fish.,* 9(1&2): 604-626.

1448. **Luther, G.** 1963. Some observations on the biology of *Liza macrolepis* (Smith) and *Mugil cephalus* Linneus (Mugilidae) with notes on the fishery of grey mullets near Mandapam. *Indian J. Fish.,* 10(1&2): 642-666.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Some observations on the biology of the grey mullets, *Liza macrolepis* (Smith) and *Mugil cephalus* Linnaeus from Palk Bay and the lagoon near Mandapam have been made during the period, April 1958 to December 1960. The length-weight relationship of *L. macrolepis* has been found to be $W= 0.00002222\ L^{2.8750}$ and that of *M. cephalus*. $W= 0.00001950\ L^{3.0274}$. The fluctuations in the relative condition factor have been studied for both the species.

1449. **Luther, G.** 1966. On the little known fish *Chirocentrus nudus* from the Indian seas, and its comparison with *Chirocentrus dorab*. *J. Mar. Biol. Assoc. India,* 8(1): 193-201.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The occurrence of a second species, *C. nudus* Swainson, along with *C. dorab* (Forskal), in the Indian Seas has been re-established by the present study. Out of several morphological, morphometric and meristic characters analysed to distinguish the two species, three characters, viz., the relative proportion of pectoral fin length and depth at orbit in standard length, and the colour of dorsal fin have been found to be most reliable.

1450. **Luther, G.** 1967. The Grey Mullets. *Souvenir 20th Anniversary CMFRI,* 70-74.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The grey mullets comprising the family Mugilidae are a common sight in the coastal waters and estuaries of the tropical and subtropical zones of all seas. They are known to ascend frequently into the fresh water zone of rivers. The main food of the mullets restrict them to shallow waters for feeding and presumably explain their abundance in estuaries and lagoons where such food reach their greatest density. Mullets in general are hardy fish, capable of living in extreme conditions of environment. They tolerate wide variation in salinity ranging from that of freshwater to brine water (92 ppt), and temperature ranging from 3-4°C to 40°C. They are known to survive in oxygen levels as low as 0.5 ppm. On account of these properties the grey mullets are probably one of the most important of all salt water fishes for farming in fresh and saline waters. They are extensively cultivated in several countries of the Indo-Pacific region, in Israel and in Egypt to augment the food supplies. Due to their good flavour and high nutritive value, mullets form one of the best table fishes.

1451. **Luther, G.** 1968. *Ulua mandibularis* (Macleay) (Carangidae pisces) A new record from the Indian seas. *Indian J. Fish.,* 15(1&2): 180-187.

Address : Central Marine Fisheries Research Institute, Vizhingam, Trivandrum, Kerala, India.

Abstract : The paper reports for the first time the occurrence of *Ulua mandibularis* in the Indian seas. A detailed description of the species is given including several important and additional characters. The changes in body form, in the soft dorsal fin length and in the dentition with growth of fish are described and illustrated. A study of the descriptions of *U. mandibularis* (Macleay) and *U. richardsoni* Jordan and Snyder in the light of the present observations reveals them to be synonymous, the latter being the junior synonym.

1452. **Luther, G.** 1973. The dorab fishery resources of India. *Proc. Symp. on Living Resources of seas around India.* pp. 445-454.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Two species of dorab, *Chirocentrus nudus* and *C. dorab* contribute to the commercial fishery along the east and west coasts of India. Their contribution of about 8,000 tonnes to the annual total marine fish catch forms about 1%. Madras State alone contributes to about half the annual total dorab catch of India, and Andhra Pradesh and Maharashtra contributing to 19% and 12% respectively come next. In Madras State, Andhra Pradesh and Orissa and Bengal dorab holds a place in their fisheries contributing to nearly 2-3% of the States total fish catch. The Palk Bay and the Gulf of Mannar contribute to a major portion of dorab catch of the Madras State. Some details about the dorab fishery resources of the Palk Bay and the Gulf of Mannar around Rameswaram Island are presented in the paper. Reference is also made to *Scomberomorus* spp., *Tachysurus* spp. and a variety of other fishes caught along with dorab. The dorab catch of the Island has shown a sharp increase during the

course of the past 15 years. This is primarily due to settlement of enterprising fishermen in the Island from other places along the Gulf of Mannar, who launched into more offshore waters employing nylon drift nets on more sea-worthy boats. It is possible that with increased efforts the dorab catch could be stepped up in States where it is now low.

1453. **Luther, G.** 1973. The Grey mullet fishery resources of India. *Proc. Symp. on Living Resources of seas around India.* pp. 455-460.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Thirteen species of grey mullets could be well recognised to be occurring in India. Of these, 8 species contribute to the commercial catches. They are, *Mugil cephalus,* M. *cunnesius, Liza macrolepis, L. parsia,* L. *tude, Ellochelon vaigiensis, Valamugil scheli* and *Rhinomugil corsula.* The other known species are *L. carinatus,* V. *buchanani, Sicamugil cascasia, Plicomugil labiosus* and *Crenimugil crenilabis.* Mullets are caught along the seacoast, in the lagoons and the adjoining brackish-water lakes, and in the estuaries. As they are caught almost throughout the year, they are a valuable source of food-fish during the off season of the other commercial fisheries. Since mullets in general are hardy fish they are best suited for fish farming through which could be obtained better increments in growth and a ready source of fish. Although reports are available about the mullet fishery resources from the sea on an all-India basis, similar information for the brackish-waters is lacking. Therefore an attempt has been made to estimate the brackish-water and total mullet fishery resources of India. Information on the availability of fry and fingerlings has been given.

1454. **Luther, G.** 1977. New characters for consideration in the taxonomic appraisal of grey mullets. *J. Mar. Biol. Assoc. India,* 19(1): 1-9.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A study of some osteological characters, namely, the parapophysical stay on the trunk vertebrata, second vertebral processes, basioccipital processes, and post-zygapophysial hooks, as basic characteristics for the generic appraisal of grey mullets has revealed that these parameters can be used to separate the genera Liza, Valamugil and Ellochelon. The existence of these genera is questioned by different workers. The generic status of these three genera in relation to the genus Mugil is outlined. A new genus Osteomugil is created to accommodate *M. cunnesius* Valenciennes. The possibility that *L. strongylocephalus, L. engeli* and *M. kelaartii* could belong to the mew genus is pointed our. The number and form of pyloric caeca provide additional help in the identification of certain species of mullets. It is suggested that species differing from others of the same genus, by having well developed adipose eyelids, be given a subgeneric status and that end of maxilla be considered as 'exposed' when the mouth is closed, only when the "maxillary notch" is closer to the angle of the mouth. It is also proposed that precedence be given to osteological characters over diversity in the mouth parts, in the taxonomic appraisal of grey mullets.

1455. **Luther, G.** 1982. Length-weight relationship of the fishes of the genus Chirocentrus cuvier. *J. Mar. Biol. Assoc. India,* 24(1&2): 105-111.

Address : Central Marine Fisheries Research Institute, Waltair, Andhrapradesh, India.

Abstract : *Chirocentrus nudus* and *C. dorab* from Palk Bay and Gulf of Mannar around Rameswaram Island were examined for this study. The regressions obtained for the length-weight relationships of males and female from the two localities were compared by analysis of covariance. The rate of growth of juvenile is different from that of adult for *C. nudus*, but it is the same in both for *C. dorab*. Consistent with its relatively slender body form *C. dorab* weights much less than *C. nudus, C. dorab* does not show significant difference in weight between sexes or localities. For *C. nudus*, however, male is heavier than female and fish from Palk Bay is heavier than that from the Gulf of Mannar. The latter could be due to the difference observed in the physiological state of the fish in the two localities.

1456. **Luther, G and S.K. Dharma Raja.** 1982. Population studies on the fishes of the genus *Chirocentrus* Cuvier. *J. Mar. Biol. Assoc. India,* 24(1&2): 118-123.

Address : Central Marine Fisheries Research Institute, Waltair, Andhrapradesh, India.

Abstract : Four important morphometric characters namely, head length, predorsal distance, depth of body and pectoral fin length have been analysed in respect of the two species of *Chirocentrus* namely, *C. nudus* and *C. dorab* from the Palk Bay and the Gulf of Mannar around the Rameswaram Island. The method of regression was used and comparisons were made using the analysis of covariance to find out the significant difference in the regressions between the sexes and localities. The significance of the difference was tested at 1% level of probability.

The results indicate that in the case of *C. nudus* the pectoral fin is longer in male than in female and that each species of *Chirocentrus* occurring in the two localities could belong to the same population.

1457. **Luther, G.** 1985. Age and growth of the fishes of the genus *Chirocentrus* cuvier. *J. Mar. Biol. Assoc. India,* 27 (1 & 2) : 50-67.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Sexual difference in the rate of linear growth, female growing faster than male, was observed in the fishes of the genus *Chirocentrus*, namely, *C. nudus* and *C. dorab*. These two species form a fishery around the Rameswaram Island. The following results relate to *C. nudus* which has been studied in some detail. A close agreement has been found between the average lengths of fish calculated by length frequency method and by back-calculation of the lengths to the successive hyaline zones in the otoliths. The respective lengths to caudal fork (LCF) in cm at completion of 1-13 years of age, as derived from the von Bertalanffy growth equation, those of male being given in parenthesis are: 16.0 (17.5), 26.5 (25.0), 35.5 (31.5), 44.0 (37.0), 51.0 (41.5), 57.0 (46.0), 62.0 (50.0), 66.5 (53.5), 70.5 (56.5), 74.0 (59.5), 77.0 (62.0), 79.5 (64.5) and 82.0 (66.0). Fish of 4-6 years of age, which are well past the size at first maturity in both sexes, form bulk of the catches in the drift net fishery around the Island. Consistent and significant difference in the site at first maturity between sexes as well as in the sex ratios in the broad length groups, or between juveniles and adults have been found to serve as a good indication for the existence of sexual difference in the rate of linear growth.

1458. **Luther, G.** 1985. Food and feeding habits of the two species of Chirocentrus from Mandapam. *Indian J. Fish.,* 32(4): 439-446.

Address: Central Marine Fisheries Research Institute, Waltair, Andhrapradesh, India.

Abstract : The two species of Chirocentrus, *C. nudus* and *C. dorab* , examined from the Palk Bay and Gulf of Mannar, appear to be diurnal predators preying mostly on fishes, depending for predation perhaps on vision. They seem to ingest the prey as a whole, swallowing its head first. When young, they feed mainly on the postlarvae and juveniles of Stolephorous and Sardinella and on Acetes , but, as adult they change over to adult sardines and other clupeoids. Though both the species belong to the same trophic level, *C. nudus* seems to avoid competition by feeding on relatively larger-sized prey, which they are able to do with the help of their larger mouth and stronger teeth.

1459. **Luther, G.** 1986. Studies on the biology and fishery of the fishes of the Genus *Chirocentrus* curvier IV Reproduction, pp.439-514. ***In*** : *Recent advances in Marine Biology*, (ed.) *P.S.B.R. James. Today and Tomorrow, New Delhi,* 1986: 591 pp.

Address : Central Marine Fisheries Research Institute, Waltair, Andhrapradesh, India.

1460. **Luther, G and Y. Appana Sastry** 1993. Occurrence of spawners, juveniles and young fish in relation to the fishery seasons of some major fishery resources of India - A preliminary study. *Mar. Fish. Infor. Serv. T & E. Ser.,* 122: 1-8.

Address : Central Marine Fisheries Research Institute, Visakhapatnam, Andhrapradesh, India.

Abstract : This article deals with the main fishery seasons and their coincidence with spawning, juvenile fishery and young fish fishery seasons at various centers of Indian coastal regions including Tuticorin coast of Tamil Nadu.

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1461. **Madhu, S.R.** 1987. We are hungry only for seaweeds. *Bay of Bengal News*, 28: 1-8.

1462. **Mahadevan, S.** 1958. Report on the "Kaaral" (*Leiognathus* spp.) and (*Gaza minuta*) Fishery of Rameswaram Island in the Gulf of Mannar and Palk Bay. *Proc. Indian Soc. Cong. Assn. 45th Session.*

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

1463. **Mahadevan, S.** 1961. The pearl fish *Carapus margartiferae*, a new record for the Indian waters. *J. Mar. Biol. Assoc. India*, 3(1&2): 204-208.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In a recent communication (Mahadevan 1959) attention was drawn to an interesting association of the pearl fish *Fierasfer homei* (Richardson) with the wing mussel *Pteria* sp., found in the Gulf of Mannar off Tuticorin. A re-examination of the pearl fish showed that the position of the vent is at the base of a line just behind pectoral origin and the origin of the dorsal is in a line above the middle of pectoral. Further, other distinguishing characters of this fish described elsewhere in this account justified the earlier doubts (Mahadevan *op. cit.)* of the likelihood of its coming under *Carapus* (Syn : *Fierasfer) margaritiferae* (Rendahl), a brief account of which is given by de Beaufort (1951) based on specimens collected from Pulu Punga, Pulu Missa, coast of Flores and Cape Jaubert N.W. Australia, mostly in association with the wing mussel or sometimes with a holothurian. Smith (1955), while reviewing the family Carapidae has mentioned the occurrence of *C. margaritiferae* in South African waters also where three specimens, 75-93 mm in length, were taken from inside clams at Durban. The data on two specimens of 63.5 and 85.0 mm examined by the present author indicate differences in some of the characteristics as compared with the South African form described by Smith. In order to facilitate comparison of the Indian form with others occurring elsewhere a detailed description of the material in hand is given below.

1464. **Mahadevan, S and K. Nagappan Nayar** 1965. Underwater ecological observations in the Gulf of Mannar, Off Tuticorin. I. Association between a fish (Gnathanodon) and a sea snake. *J. Mar. Biol. Assoc. India*, 7(1):197-199.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : While surveying the fauna and flora of the sea bottom off Tuticorin with the help of self-contained underwater breathing apparatus (SCUBA) the authors had observed on many occasions a juvenile carangid, *Gnathanodon speciosus* (Forskal) flanking a sea-snake which also had yellow body with black annuli round its body i.e. the same pattern of body colouration as that of the fish. The authors are not aware of any account of a fish associated with the sea snake and therefore it is felt that observations on this instance would be of some interest.

1465. **Mahadevan, S and K. Nagappan Nayar** 1965. Underwater ecological observations in the Gulf of Mannar, off Tuticorin. III. On the emperor bream *Lutjanus sebae* found with *Pterois*. *J. Mar. Biol. Assoc. India*, 7(2): 454-455.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : During the dives made on rocky beds, several hundreds of small and large fishes were noticed inhabiting the rocky area lying between 8°35'N.-8°55'N. Lat. to 78° l0'E.-78°25'E. Long. up to 26 metres depth. Surprisingly, with the sole exception of an occasional *Lutjanus sebae* (Cuvier) not one species of *Lutjanus* of commercial importance was seen anywhere in the area explored. The deeper rocky areas (between 40-60 metres depth) seem to be rich in lutjanids as evidenced by the catches landed by local fishermen by hook and line.

1466. **Mahadevan, S and K. Nagappan Nayar** 1965. Note on the habitat and distribution of the file-fish along the Tuticorin coast. *J. Mar. Biol. Assoc. India*, 7(2): 476-477.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Phyllophorus (Phyllophorella) parvipedes* Clark is reported for the first time from the Indian Seas. A detailed description of the same is given.

1467. **Mahadevan, S and K. Nagappan Nayar** 1966. Underwater ecological observations in the Gulf of Mannar, Off Tuticorin. VI. On the habitat, movements and breeding habitats of the chank, *Xancus pyrum*. *J. Mar. Biol. Assoc. India*, 8(1): 1-6.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : While carrying out the underwater survey of the sea bottom off the coast of Tuticorin the habitat and movements of chanks, their copulating habits and the process of spawning were carefully observed by the present authors for the first time.

1468. **Mahadevan, S and K. Nagappan Nayar** 1967. Underwater ecological observations in the Gulf of Mannar of Tuticorin. *J. Mar. Biol. Assoc. India,* 9(1): 147-163.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Results of underwater observations made to study the physical and biological conditions of the sea-floor in the Gulf of Mannar between Lat. 8°35' N.- 8°55' N. and Long. 78° 10' E- 78°25' E. are given. Two series of rocky substrata are evident at depth range 9-14 m and 17-25 m respectively. The bottom of flat rock type with plenty of fissures and crevices, is suitable for oyster settlement. The general fauna and flora found over the rocky bottom are listed. Faunistic features of the rocky bottom appear to be same throughout except for peculiarities like the abundance of one or the other fauna, here and there. Chank fishing grounds have been delineated. Pearl oyster population has not been noticed. The possible role of starfish, *Modiolus* spp., octopus and fishes in the destruction of pearl oysters is discussed.

1469. **Mahadevan, S.** 1971. Fishing for pearls in India. *Seafood Export. J*., 3(3): 11-23.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The pearl oysters in Indian waters find an ideal habitat in the Gulf of Mannar on the southeast coast of India where the submarine plateau of the inshore area is dotted with extensive patches of the flat rock made of dead, consolidated corals lying within 10 to 25 m depth at a distance of 11 to 16 km from shore.

1470. **Mahadevan, S and K. Nagappan Nayar** 1972. Distribution of coral reefs in the Gulf of Mannar and Palk Bay and their exploitation and utilization. *Proc. Symp. corals and coral reefs, MBAI.* pp. 181-190.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Running parallel to the shore in the Gulf of Mannar along the Indian coast are situated 21 islands of limited extent between Lat. 8° 47' N – Long. 78° 12' E and Lat. 9° 15' N – Long. 79° 14' E. These islands are extensive in the depth and quantity of the coral reefs around them. In addition to these islands, coral reefs exist also around the Rameswaram Island, the largest island in this series, which is all but contiguous with the mainland but for a short span of 2 km from Thonithurai to Pamban. Here the reefs start from NNE of Rameswaram shore and run around Devil's Point parallel to the shore and extend up to Mandapam in Palk Bay where they end. The corals of these localities are being quarried for industrial purposes. The Tuticorin type of boats with a small crew of fishermen operate for breaking the corals during the months of October to May in the Gulf of Mannar and May to September in the Palk Bay. The bulk of the stones quarried now are from the islands north of Nallatanni Tivu. The collection and utilisation of coral stones in the carbide industry and in the lime manufacture are detailed and the economics of the coral stone fishermen are given. The annual rate of removal of coral stones at the present level of exploitation seems to warrant a detailed survey of the exploitable coral resources in the area now exploited and the enforcement of a scheme for rational exploitation of the coral stones.

1471. **Mahadevan, S and K. Nagappan Nayar** 1973. Pearl oyster resources of India. *Proc. Symp. on Living Resources of seas around India.* pp. 659-671.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Of the 6 species of *Pinctada* Roding (Piteridae) viz., *Pinctada fucata* (Gould), *P. margaritifera* (Linn., *P. chemnitzi* (Philippi), *P. anomioides* (Recve,) *P. sugillata* (Reeve) and *P. atropurpurea* (Dunker), the first named species is the common pearl oyster of India, occurring on the pearl backs off Tuticorin coast in the Gulf of Mannar on the rocky ridges extending all along the coast of the gulf at depths of 15 m-25m. They are occasionally found in the Palk Bay also in shallower waters lying in loose clusters over a bottom of coarse sand covered with a matrix of dead shells. In the Gulf of Kutch they are found on the intertidal. The pearl fishery in the Gulf of Mannar is unpredictable and it is a question of utilizing the natural resource as and when the pearl oyster spat settle down and grow. It is difficult to have effective control over the conditions affecting the settlement and growth of the pearl oyster in the natural beds because of their occurrence in the open sea. For the purpose of conducting an organized fishery, the population of fishable oysters should be determined with accuracy. The existing method of estimation of population, the knowledge of the grounds and the method of fishing require reorientation. To this end a thorough survey of the areas of oyster settlement was undertaken for a period of 3 years and the grounds charted, for the first time, by means of direct under-water observation by SCUBA. The

outlook for pearl fisheries in the next few years is rather bleak at present. The success and failure of the pearl fisheries of the past and the futile attempts made over a number of years to watch for the possible settlement of the pearl oyster spat show that the only alternative to put India in the map of pearl producing nations is to resort to pearl culture practices.

1472. **Mahadevan, S and K. Nagappan Nayar** 1974. Ecology of Pearl oyster and chank beds. *CMFRI Bulletin*, 25: 106-121.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The Gulf of Mannar and the Palk Bay zones of the southeast coast of India, the Halar coast of the Gulf of Kutch especially the reefs of Sachana, Salaya, Piroton, Ajad etc., and a narrow strip in the extreme southwest coast of India from Colachel to Trivandrum are all places where either the chanks or the pearl oysters or both occur in fairly large numbers. In addition to the above, chanks occur along the Coromandal coast upto Madras although this stretch is of minor importance. In some places in Andamans also chanks occur in limited quantities. Of all the places the most productive areas, as far as the pearl oysters are concerned, are located in the Gulf of Mannar and very rich chank beds exist both in the Gulf of Mannar and in the Palk Bay. Naturally much attention has been focussed on these two regions to study the fisheries and ecology of these two commercially important molluscs as evidenced by the works of Hornell (1914,1916, 1922a), and Mahadevan and Nagappan Nayar (1966, 1967, 1968). Very little is known about the other areas except for Hornell's report (1909) on the marine biology of the Okhamandal coast of Kathiawar.

1473. **Mahadevan, S and K. Nagappan Nayar** 1976. Underwater observations on the settlement of spat of pearl oyster on the paars off Tuticorin. *Indian J. Fish.*, 23(1&2): 105-110.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A periodic underwater survey on the pearl bank during the three years from 1970 to 1972 has shown that it is inadvisable to depend totally on the wild oyster beds for collection of seed for raising pearl-oyster farms on a commercial basis. The spat fall on the paars is irregular and subject to great quantitative fluctuation. Increasing *Modiolus* settlement causes severe damage to the oyster bed from year to year. But, there exists a vast scope for collecting the spat by means of artificial spat collections.

1474. **Mahadevan, S., K. Nagappan Nayar and P. Muthiah** 1980. Oyster farming. *Mar. Fish. Inf. Serv. T & E. Ser.* 26: 1-3.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An account is given of culture of the edible oyster (*Crassostrea madrasensis*) in India, describing the system used at Tuticorin. Spat collection, postspat collection period, and erecting racks for growing oysters are detailed, considering future prospects for the industry.

1475. **Mahadevan, S and K. Nagappan Nayar** 1982. SCUBA diving investigations and training. *Mar. Fish. Infor. Serv. T & E. Ser.*, 42: 1-8.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A Five month training program was conducted (from December to April) to study the coral ecosystem and underwater creatures. Moreover, the knowledge of diving equipments and their applications were also imparted.

1476. **Mahadevan, S.** 1983. Overview of fish and shellfish diseases. Problem and their control in mariculture. Symp. on Coastal Aquaculture, Cochin (India), 12-14 Jan 1980. Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. *Part 2: Molluscan culture.* MBAI, Cochin, India, 6: 659-664.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Documenting symptoms, isolating pathogens, and studying them, developing preventive and curative measures are all some of the works that are to be looked into in addition to studying disease vectors, environmental factors predisposing an organism to vulnerability or favour disease resistance. Thus there is a strong case for starting fish pathology division to tackle the above problems in India where little work has been done so far in progress on marine fish and shellfish diseases.

1477. **Mahadevan, S and D.C.V. Easterson.** 1983. Topographical features of areas surveyed. *CMFRI Bulletin*, 34: 10-25.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Details are given of the topographical features of the areas covered during a survey of the mariculture potential of the Andaman and Nicobar Islands.

1478. **Mahadevan, S and K. Nagappan Nayar** 1983. National Marine Parks (Gulf of Mannar). *J. Mar. Biol. Assoc. India,* 25(1&2): 71-77.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : There is an immediate necessity for the conservation of marine flora and fauna in the Islands of Gulf of Mannar. The situation as it is today needs the establishment of a National Marine Park in the area. A survey of 20 Islands during 1977-81 revealed the extensive destruction of fauna and flora by human interference. The Island system is unique in that it serves as a habitat for many endangered species like the marine turtles, the dugong and the ptychoderan Balanoglossus. Extensive destruction of the fringing coral reefs around Islands is noted and it is imperative that this destruction should be totally stopped. The paper outlines measures for the establishment of a viable National Marine Park system in this area and also indicates the need for a national policy for establishing Marine Parks elsewhere along the coast.

1479. **Mahadevan, S.** 1985. Fin fish culture. *Mar. Fish. Infor. Serv. T & E. Ser.,* 62: 1-6.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : During 1960s. CMFRI formulated projects and experiments on fin-fish culture. From these experiments, varying results regarding the production capability have been obtained for different locations and for different methods of culture.

1480. **Mahadevan, S and K. Nagappan Nayar** 1987. Ecology of Oyster beds. *CMFRI Bulletin,* 38: 7-13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The oysters of the world are grouped into one family Ostreidae. Within this family are 3 groups or genera *viz., Ostrea, Crassostrea* and *Pycnodonta.* The genus *Ostrea* which is widespread through most part of the world is generally considered to be adapted to clear waters with little sediment and high salinity. *Crassostrea* exist in estuaries where the silt load is high and salinity variable and generally low.

1481. **Mahadevan, S.** 1987. Oyster resources of India. *CMFRI Bulletin,* 38: 14-16.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : An account is given of information available on the oyster resources of India. Exploitation of the following species is considered according to various regions of the country: *Crassostrea madrasensis, C. gryphoides, C. rivularis* and *Saccostrea cucullata*.

1482. **Mahadevan, S.** 1987. Annotated bibliography on pearl oysters of Indian coast. *CMFRI Bulletin,* 39: 122-136.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Some 165 references in the field of pearl oysters in India are cited, in order to make available a synopsis of information gathered by pearl oyster experts on various aspects concerned with pearl fishery management, pearl oyster distribution, ecology of the pearl beds, biology and reproduction and culture of pearls.

1483. **Mahadevan, S.** 1988. On management and development of shellfish resources. *CMFRI Bulletin,* 42(1): 1-5.

Address : Central Marine Fisheries Research Station, Cochin - 682 018, India.

Abstract : This paper is intended to review the present status of the molluscan resources of our country other than cephalopods and the existing management practices and suggest measures for an effective integrated approach to help in increasing the tempo of exploitation where it is in a low profile and recommend measures for conservation in such cases and areas which need a hard look. Management should be conceived and understood not as a constraint upon natural exploitation but as an essential tool for the sound, sustained development of fisheries. Hence, management is an integral part of the developmental process.

1484. **Mahadevan, S., P. Sam Bennet, K.M.S. Ameer Hamsa and H. Mohamed Kasim** 1988. Marine fish calendar. 6. Tuticorin. *Mar. Fish. Inf. Serv. T & E.. Ser.* 84: 1-8.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Information is presented regarding the important families, groups and species of fish involved in the Tuticorin area. Details given for each group include the vernacular name, popular English name and gearwise annual landings together with percentage composition in the total landings by the same gear. Data are also included concerning the relative composition, local names, length range, depth of capture, size at first maturity and spawning seasons.

1485. **Mahadevan Pillai, P.K.** 1971. Juvenile stages of a filefish assigned to *Paramonacanthus choirocephalus. Indian J. Fish.,* 18(1&2): 184-186.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A brief description of two juvenile stages of a file-fish is given. A close study of their fin ray counts and the arrangement of spinnules on the dorsal spine revealed their nearness to *Paramonacanthus choirocephalus* (Bleeker). Similarities exhibited by these specimens to other allied species are discussed.

1486. **Mahadevan Pillai, P.K.** 1972. On the landing of a whale shark, *Rhincodon typus* at Tuticorin. *J. Mar. Biol. Assoc. India*, 14(1): 408-409.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

1487. **Mahadevan Pillai, P.K.** 1976. A note on the food and feeding habits of the ribbonfish, *Trichiurus lepturus*. *Indian J. Fish*., 21(2): 597-600.

Address : Central Marine Fisheries Research Institute, Field Centre, Chavakkad, Kerala, India.

Abstract : The food and feeding habits of *T.lepturus* obtained from the trawler catches off Tuticorin (Gulf of Mannar) during the years 1967, 1968 and 1970 have been presented. The intensity of feeding during the different months of the year and the percentage occurrence of various items of food in different size groups of *T.lepturus* have been described.

1488. **Mahadevan Pillai, P.K., S.G. Vincent and K. Ramadoss** 1977. Observations on the early juvenile stages of *Johnius carutta*, Bloch, *Pervager tomentosus* (Linnaeus) and on a post larva of *Pegasus volitans* (Linnaeus). *J. Mar. Biol. Assoc. India*, 19(1): 73-77.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : Observation made on early *Johnius carutta*, Bloch juvenile stages of a sciaenid, *Johnius carutta*, Bloch and a file-fish assigned to *Pervager tomentosus* (Linnaeus) are described. A brief account on a single post larva of *Pegasus volitans* (Linnaeus) measuring 6mm is also included due to the nature of its abnormal pigmentation.

1489. **Mahadevan Pillai, P.K., N. Jayabalan, M. Srinath and S. Subramani** 1983. The catch trend of the commecial trawl fisheries off Rameswaram. *Mar. Fish. Inf. Serv. T & E. Ser.*, 48: 17-19.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An account is given of catch details of some commercially important fish landed during trawling off Rameswaram during 1980-81; monthly catch trends and catch compositions are included.

1490. **Mahadevan Pillai, P.K., G. Balakrishnan and K. Alagaraja** 1994. Present Status of marine Fisheries of Tamil Nadu and Pondichery. *Mar. Fish. Infor. Serv. T & E. Ser.*, 129: 1-12.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The marine fish landings in Tamilnadu during the period 1980-89 compared with all India catch in tonnes are given.

1491. **Mahalakshmi, S.** 2002. Nutrient distribution in the coastal waters of Rameswaram, Thoothukudi and Pudhumadam in the southeast coast of India. *M.Phil., Dissertation* Madurai Kamaraj University, 106 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, India.

Abstract : The marine ecosystems have great ecological and economic importance; but human activities exert a negative pressure on them. The present study was to assess the water quality in Rameswaram, Thoothukudi and Pudhumadam. Six different stations were selected 3 in Rameswaram, 2 stations in Thoothukudi, and one station in Pudhumadam a small fishing village that was considered as control. The stations selected for the study

were Station-I Agnitheertham, Station-2 Opposite to south tower of Ramanathaswamy temple, Station-3 Boat jetty, Station-4 Thirespuram, Thoothukudi, Station-5 Fishing harbour, Thoothukudi, Station-6 Pudhumadam, a village near Uchipuli. Water samples were collected from the above stations at fortnightly intervals between April 2002 and September 2002. The physico-chemical parameters such as Temperature (°C), pH, Dissolved oxygen (ppm), Salinity (ppt), and nutrients such as Nitrate (ppb), Phosphate (ppb) and Silicate (ppb) were analysed using Standard methods. The maximum temperature of 33.8°C was obtained in station 2, opposite to south tower of Ramanathaswamy temple, Rameswaram, during the 2nd half of July 2002. The maximum pH value was recorded as 8.06 ± 0.03 during the 2nd half of June 2002 in station 1, Agnitheertham. The highest Dissolved oxygen value obtained was 4.75 ± 0.11 ppm during the 1st half of April 2002 in station 5 Thirespuram, Thoothukudi. The maximum salinity value of 30.82 ± 0.27ppt was noted in station 3, Boat jetty, Rameswaram, during the 2nd half of July 2002.

1492. **Mahalingam, R and K. Gopinath** 1987. Ecological conservation of seagrass beds in the Gulf of Mannar, India. *Environ. Conserv.*, 14(3): 265-268.

Address : Department of Chemical Engineering, Indian Institute of Technology, Madras 600 036, India.

Abstract : Seagrasses, the marine flowering plants which are restricted to saline habitats, are represented by 6 genera and 9 species in the Gulf of Mannar, India - out of the 12 genera and 49 species that are reported by Hartog (1970) to constitute the world-wide distribution. The 6 genera and 9 species recorded from the Gulf of Mannar are: *Halodule uninervis, Cymodocea serrulata, C. rotundata, Syringodium isoetifolium, Enhalus acoroides, Thalassia hemprichii, Halophila ovalis, H. ovata,* and *H. stipulacea*.

1493. **Mahesh Kumar, B.** 1997. Heavy metals in some environmental samples around a few industrial locations of Tuticorin coast. *M.Phil., Dissertation,* Madurai Kamaraj University, 77 p.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, India.

Abstract : The present study has given an account of concentrations of different heavy metals accumulated in water around some industries, sediments of water pools, terrestrial soils, terrestrial plants, seaweeds, and marsh plants. Samples were taken from different industrial sites and domestic sewage dump sites. All these sites were located on the southeast coast of the Bay of Bengal between coastal towns Tuticorin and Thiruchendur. The concentration of metals varied depending upon the nature of industrial effluents.

1494. **Mahesh Kumar, B and A.K. Kumaraguru** 2001. Heavy metals in some environmental samples around a few industrial locations of Tuticorin Coast. *Ecol. Environ. Conserv.*, 7(4): 379-385.

Address : Department of Plant Science, School of Biological Sciences, Madurai Kamaraj University, Tamilnadu, Madurai-625 021, India.

Abstract : Due to rapid industrialization and urbanization, our environment has been polluted by toxic metals, inorganic salts, pesticides, etc., through the discharge of industrial and sewage effluents. The present study monitored some heavy metals in the ambient environment of selected industrial and sewage effluents discharge locations around Tuticorin Coast, Gulf of Mannar, India. Samples of water, sediment, soil, and plant, (both aquatic and terrestrial), were collected in and around some industrial sites. A relatively less polluted area near Mandapam was selected as control site. The concentration of the metals varied depending upon the Industrial effluent. The overall study indicated that, among all the metal the concentrations lead was relatively high and zinc was low in collected samples, because lead compound has been used in a wide variety of Industrial applications.

1495. **Maheswaran, K., V.S. Manoj and P.N. Joshi** 2003. Selection and Identification of Nucleus for the Production of Pearls. *1st Indian Pearl Congress & Exposition,* 5th to 8th February, 2003. pp. 99-100.

Address : Central Institute of Fisheries Technology, Cochin-682 029, India.

Abstract : Quality of Pearl is judged by a variety of factors such as shape, luster, size, colour, surface clarity and weight. Round pearls are the most treasured and the most difficult to cultivate. It is very rare to find a perfectly round pearl. The rounder the pearl, however, the more valuable it is. Luster is the inner glow; it's the shine that beams from within the pearl. The deeper the luster, more precious and expensive the pearl. Larger pearls, which are more difficult to cultivate, are scarcer and command higher prices. Cultured pearls can be classified into 6 basic colours such as black, pink, white, cream, gold and a three some of blue, grey or silver. Pearls come in a variety of colours; depending upon the type of mollusc and the water composition. Pearls are grown in an oyster and are organic gems, they are almost never flawless. Some imperfections are to be expected during the natural formation process, but too many flaws diminish the value of the gem. Heavier weight means that thick nacre has

accrued. The genuine and imitation pearls should also be judged with the help of prescribed methods. Nucleus is one of the most important items used in the process of cultivating pearls. It is the base on which the nacre forms and can often dictate the quality of the finished pearl. The nucleus must meet the parameters as ready availability, low relative cost, thick profile and white base colour and composition similar to mussel shell. Different nucleus materials have been used in pearling, both natural and synthetic, but shell material is predominantly the material used for round pearls. Round pearls, where the nucleus remains must have a comparable coefficient of expansion to the nacre.

1496. **Maheswaran, P.A., G. Rajesh, C. Revichandran and K.K.C. Nair** 2000. Upwelling and associated hydrography along the west coast of India during southwest monsoon, 1999. *Proc. Fifth Pacific Ocean Remote Sensing Conference*, 5-8 December 2000. Dona Paula, Goa, India NIO 2000 vol. 2, pp. 873-878.

Address : National Institute of Oceanography Regional Centre, Cochin - 682 018, India; E-mail: mahes@niokochi.org

Abstract : During May 1999 twenty-five hydrographic stations were studied, covering the waters of the west coast of India from 8° N to 13° N as a part of Marine Research - Living Resources (MR-LR) programme. The inference on upwelling and related hydrography is discussed. Analysis of wind field and hydrography indicated active upwelling along the southwest coast of India. The sea surface temperature near the coast was lower by 1.7°C (off Kanyakumari), 1.4°C (off Cochin) and 1.2°C (off Mangalore) from the farthest stations, indicating the presence of upwelled water near the coast. Well defined thermal, saline and density fronts were visible. Relatively high offshore transport was observed off Kanyakumari. Signatures of coastal under current were prominent which deepens, as moving towards north. Analysis of hydrographic characteristics reveals the presence of cool upwelled water by May itself. Strong signals of upwelling were observed off Kanyakumari, relatively less off Cochin and weak off Mangalore indicating the propagation of this seasonal phenomenon towards north with time.

1497. **Maheswari, K., P. Ganesan, R. Jeya Shakila and G. Jeyasekaran** 2003. Isolation and identification of marine bacteria inhibitory to human bacterial pathogens from sea grass of Tuticorin waters. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. 69 pp.

Address : Department of Fish Processing Technology, Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Marine bacteria exhibiting antibacterial activity against human bacterial pathogens were isolated from two species of sea grass of Tuticorin waters, *viz.*, *Chaetomorpha antenninae* and *Enhalies acorroides* by cross streak and double agar overlay methods. Of the bacteria isolated from the sea grasses, the incidence of pigmented bacteria was 0.88 %. Among the pigmented bacteria, 50% of the isolates were found to exhibit antibacterial activity against human pathogens. Two isolates showed higher antagonistic activity with an inhibition zone of >18mm for *Salmonella typhimurium*, *E. coli* and *Listeria monocytogenes*, but their activity was less towards *Staphylococcus aureus.* The inhibitory effect of the two bacterial metabolites was moderate against most of the human pathogens, except on *Listeria monocytogenes*, which was completely resistant. The two antagonistic marine bacteria were identified as *Flavobacterium* and *Alteromonas.* These bacteria and their metabolites may be used for the pharmacological industry in the production of new antibacterial compounds.

1498. **Maheswarudu, G., N. Neelakanta Pillai, P. Vedavyasa Rao, P.E. Sampson Manickam, M.R. Arputharaj** 1990. Seed production of the green tiger prawn *Penaeus semisulcatus* in a non-circulatory and non-aerated outdoor tank. *J. Mar. Biol. Assoc. India*, 32(1&2): 1-4.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu. India.

Abstract : The results of the experiments on rearing of the larvae and postlarvae of the green tiger prawn *Penaeus semisulcatus* in outdoor cement tanks following the Community Culture Method are presented. 687, 637 active nauplii obtained from five spawners (133 mm-175 mm) were reared in the seawater fertilized with different chemicals and the larvae fed with mixed phytoplankton and compounded diet. The postlarvae attained a modal size of 16-20 mm (range 11-30 mm) in 33 days. 97,789 postlarvae were harvested and released into the Pillaimadam coastal salt water lagoon at Mandapam. The overall survival rate from nauplius to PL was 14.2%. No aeration was provided to the water in the rearing tanks.

1499. **Maheswarudu, G.** 2000. Shrimp culture during 1998-2000 at marine fish farm, Regional Centre of CMFRI, Mandapam Camp. *Golden Jubilee Celebrations Souvenir 2000, Mandapam R.C of CMFRI, Mandapam Camp*, pp. 36-39.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu. India.

Abstract : With the introduction of trawlers in the Palk Bay and Gulf of Mannar during the 1960s under Indo-Norwegian Project exploitation of shrimp began and it has reached commercial scale during the 1970s as many private entrepreneurs initiated trawl fishing. The annual shrimp landings ranged from 1,000 to 2,000 tonnes during the beginning of 1,990s in the Mandapam region. In the 1,960s *Metapenaeus affinis* was the dominant species followed by *Penaeus semisulcatus.* Gradually *M. affinis* was replaced by *P. semisulcatus* and by the 1,970s *P. semisulcatus* was dominant species of shrimp fishery in this region. As shrimp catches are promising and fetching lucrative income effort has gradually increased and the catch of *P. semisulcatus* has reached maximum sustainable level, and further increase in fishing effort by trawlers would lead to depletion of shrimp stock. The other source to augment the shrimp production is to adopt culture practice all along the coastal areas and to establish ranch fishery in the sea by releasing hatchery raised seed in large scale.

1500. **Mahyavanshi, I.N., A.J. Patel, A.A. Vyas and V.J. Mohile** 1988. On banana prawn (*Penaeus merguiensis*) seed production. *CMFRI Spec. Publ.,* 40: 52.

Address : Gujarat Fisheries and Aquatic Sciences Research Institute, Okha, Gujarat, India.

Abstract : A prawn hatchery was established at Gujarat Fisheries Aquatic Sciences Research Institute, Okha in 1980. A local species, the banana prawn *Penaeus merguiensis* was selected for seed production. During the first two years no postlarvae developed. In the third year, with the success in culture of *Chaetoceros* sp. and *Artemia salina* for feeding the larvae, 30% survival rate of larvae was observed. Subsequently the survival rate increased up to 86% in the following years (1985 and 86). The technique has since been perfected to produce prawn seeds averaging 50% survival rate. Seed can be supplied up to 20-25 lakhs PL-10 per year from this small hatchery.

1501. **Mal, T.K and K. Subbaramaiah** 1989. Yield and physical properties of agar in the reproductive phases of *Gracilaria edulis* (Gmel.) Silva. *Phykos,* 28(1&2): 260-266.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam, 623519, Tamilnadu, India.

Abstract : *Gracilaria edulis* Silva plants were collected from Thonithurai in the Gulf of Mannar [India] (Lat. 9° 17' N and Long. 79° 11' E) during January and June 1988. Some were separated into tetrasporic and cystocarpic plants and the rest were analysed for the composition of the tetrasporic, cystocarpic and vegetative plants constituting the natural population. Agar was extracted from the tetrasporic and cystocarpic plants and also from the natural mixed population. Yield and gel strength varied significantly among the reproductive phases and between the seasons, although gelling and melting temperatures showed no differences. Higher agar yield with lower gel strength was recorded in the tetrasporic plants as compared to the cystocarpic plants collected during January, whereas the gel strength of the tetrasporic plants showed higher value than that of the cystocarpic plants collected in the month of June. The possible role of this study for *G. edulis* in its mariculture is discussed.

1502. **Mal, T.K and K. Subbaramaiah** 1990. Diurnal periodicity of carpospore shedding in the red algae *Gracilaria edulis* (Gmel.) Silva (Rhodophyta). *Indian J. Mar. Sci.,* 19(1): 63-65.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, India.

Abstract : Diurnal periodicity of carpospore shedding of Gracilaria edulis was studied form Mar.-May 1989. Occurrence of a diurnal rhythm with a peak shedding time varying from 1900 to 0100 hrs was recorded. The spore shedding capacity varied between 1,696 and 6,715 cystocarp/d and 72928 and 590920/g plant/d. The study suggests an ideal time from 1900-0100 hrs for bulk collection of carpospores for mass cultivation.

1503. **Mal, T.K and K. Subbaramaiah** 1990. Morphological variation in *Gracilaria edulis* (Gmel.) Silva from the Mandapam Region, India. *Proc. Indian Acad. Sci. Plant Sci.,* 100(6): 383-392.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, India.

Abstract : *Gracilaria edulis* is represented by different morphological forms in the Mandapam Region of Tamil Nadu, India. The morphological variation of selected characters was analyzed and quantified. Characters included basal branch constriction, branch endings, branch attenuation, stoutness of the thallus, angle of divergence of branches, branching index, sizes of medullary, subcortical and cortical cells, and gradation of cell size from cortex to medulla. All the characters showed continuous variation; however, branching index and branch

attenuation showed significant negative correlation between them.

1504. **Malarvizhi, R.** 2000. Microbial quality of coastal waters in the Gulf of Mannar. *M.Phil., Dissertation,* Madurai Kamaraj University. 90 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, India.

Abstract : The present investigation dealt with the study of water quality in coastal water of Gulf of Mannar. Physico-chemical and microbial analyses were done to determine the water quality. Nearly, 30 samples were collected from the Gulf of Mannar from five selected sites. Samples were collected at fortnightly intervals from different areas of study for a period of three months. The present study was aimed to assess the physico-chemical and microbial characteristics of the coastal waters in the Gulf of Mannar. The physico-chemical parameters such as Temperature, *p*H, Salinity and Dissolved Oxygen were estimated and Microbial analysis was done using standard methods. On analysing the physico-chemical parameters in the selected areas such as Mandapam (Jetty and Near Tamilnadu Hotel) and Keelakkarai (Light House location and sewage mixing place), which were compared with Sayalkudi (Mundhal) area as control. It was found that there were characteristic variations in these selected sites.

1505. **Malathi, J., S. Selvasekarapandian, G.M. Brahmanandhan, D. Khanna, V. Meenakshisundaram and R.Mathiyarsu** 2005. Study of radionuclide distribution around Kudankulam nuclear power plant site (Agastheeswaram taluk of Kanyakumari district, India). *Radiation Protection Dosimetry*, 113(4): 415-420.

Address : Solid State and Radiation Physics Laboratory, Department of Physics, Bharathiar University, Coimbatore 641046, Tamilnadu, India; Health and Safety Research Division, Indira Gandhi Center for Atomic Research, Kalpakkam, 603102, Tamilnadu, India.

Abstract : The activity concentration of primordial radionuclides ^{238}U, ^{232}Th and ^{40}K have been measured in the sand samples of Agastheeswaram taluk of Kanyakumari district using gamma-ray spectrometer. The average activity of ^{232}Th, ^{238}U and ^{40}K are found to be 5,787.1, 1,082.9 Bq. kg^{-1} and BDL, respectively. The total average absorbed dose rate owing to the presence of ^{232}Th, ^{238}U and ^{40}K is found to be 3,900.4 nGy. h^{-1}. The annual effective dose is 4.7 mSv. y^{-1} and the results are discussed in this paper.

1506. **Mallik, T.K.** 1983. Shelf sediments and mineral distribution patterns off Mandapam, Palk Bay. *Indian J. Mar. Sci.*, 12(4): 203-208.

Address : Offshore Mineral Exploration and Marine Geology Division, Geological Survey of India, Calcutta, India.

Abstract : Grain size variation and heavy minerals of offshore and beach samples from Palk Bay, India, were studied. Offshore sediments consist of sand, silt clay and their admixtures, corals and algae. Most of the samples have 3 major types. Fluctuating energy condition is reflected by sorting differences. Probable sediment transport direction is towards the South and South-West offshore sediments have a primary mode around 1.5 to 2.0. Beach samples with good concentration of black sands are polymodal and indicate mixing from multiple sediment sources. Heavy mineral assemblage suggests contribution from high and low rank metamorphic rocks and igneous rocks of the adjacent area. The area can be divided into 4 mineralogic provinces depending on the mineral assemblage.

1507. **Malu Pillay, C.** 1962. A survey of the maritime meteorology and physico-chemical conditions of the Indian pearl banks off Tuticorin in the Gulf of Mannar from December 1958 to May 1959. *Madras. J.Fish.*, 1(1): 77-95.

Address : Marine Biological Station, Tuticorin, India.

Abstract : The Indian Pearl Banks of the Central Divisions of the Gulf of Mannar lie between 8°-55' and 8°-20' N. Lat and 78°-10' and 78°-25' E Long, corresponding with the productive pearl bank region on the opposite Ceylon Coast. Systematic information on the meteorology and hydrography of the pearl banks are not available.

1508. **Malu Pillay, C.** 1962. A review of the physico-chemical conditions of the pearl banks and chank beds of Tuticorin in the Gulf of Mannar during April 1960- March 1961. *Madras. J. Fish.*, 1(1): 96-101.

Address : Marine Biological Station, Tuticorin, India.

Abstract : The pearl-banks and chank beds off Tuticorin in the Gulf of Mannar are productive of valuable shell fishes. The Thollayiram par and the other pearl banks adjacent to it have yielded since 1955 an annual harvest of about 10 million oysters of remarkable pearl-content. From the chank beds about 1-1.2 million chanks are fished.

However, no systematic information on the environmental conditions existing in these beds are available except for a few observations by Chacko and Malu Pillay (1956 and 1957).

1509. **Mammen, T.A.** 1965. On a collection of hydroids from South India III Family Plumularidae. *J. Mar. Biol. Assoc. India*, 7(1): 291-324.

Address : Marine Biological Laboratory, Trivandrum-7, Kerala, India.

Abstract : Hydroids were collected from selected stations along the east and west coasts of south India. The collection includes 64 species belonging to 40 genera. Of these 27 species are new to the Indian region; 14 species, 1 variety and 1 race are, new to science. The gonosome of 10 species are described here for the first time. Relevant discussions on affinities of specimens or homology of organs are given in respect of each species.

1510. **Mammen, T.A.** 1988. Management and conservation of marine fisheries resources. *CMFRI Spec. Publ.*, 40: 93.

Address : Tropical Fisheries Consultant Service, New Delhi 110 032, India.

Abstract : The present understanding of the term fishery management includes, besides conservation (avoiding over-fishing), other aspects like avoiding under-fishing of stocks, meting out social equity and affording consumer protection. Mathematical models developed, based on experience in temperate waters, are of doubtful applicability in the tropical waters. Moreover, in a populous country like India, employment, economic and social aspects are the dominant considerations. In India, while fish production has increased, the unit production of both mechanised and nonmechanised sectors has dropped to about 40%, but the higher price of fish, both in the export and domestic market, is sustaining the fishing industry.

1511. **Manavalaramanujam, R. and G. Sundana Rajulu** 1982. First record of chitin from a sipunculan worm. *Sci. Cult.*, 48(8): 297-298.

Address : Department of Zoology, Bharathiar University, Coimbatore-641 041, Tamil Nadu, India.

Abstract : Specimens of *Cloeosiphon aspergillus* were collected from dead corals in the vicinity of Krusadai Island (Gulf of Mannar). The introvert from 10 large worms were severed and treated. Presence of chitin in the hooks was confirmed by X-ray diffraction studies, which reveal characters specific for beta -chitin. In the present investigation also the beta -chitin found in the hooks is seen associated with the neighbouring collagen-type introvert cuticle.

1512. **Manickaraja, M.** 1999. Heavy landings of the reticulate crab at Tharuvaikulam, Southeast coast of India. *Mar. Fish. Infor. Serv. T & E. Ser.*, 163: 13.

Address : Central Marine Fisheries Research Institute, Tuticorin- 628 001, Tamilnadu, India.

Abstract : The details of catch of *Portunus pelagicus* from bottom set gillnets in shallows and deeper areas during March 1999 are discussed.

1513. **Manickaraja, M.** 2004. Lobster fishery by a modified bottom set gill net at Kayalpattanam. *Mar. Infor. Serv., T&E Ser.*, 181: 7-8.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Lobster fishery is a traditional avocation throughout the year in Kayalpattanam, south of Tuticorin in Gulf of Mannar. Lobsters are fished by bottom set gill nets with 85 mm mesh size. Each boat with inboard engine of 10 to 15 HP, carries 2 to 3 bundles of nets and the length of a net varies from 90 to 120 m. There will be 4 to 5 fishermen in a boat. The fishermen leave the shore around 14.00 hrs, leave the nets at a depth of 4 to 6m and return to the shore. The fishermen go the next day at 04.00 hrs and collect the bundles of nets along with lobsters and return to the shore around 10.00 hrs.

1514. **Manickaraja, M and T.S. Balasubramanian** 2004. Innovative method of processing crabs at landing center. *Mar. Infor. Serv., T&E Ser.*, 182: 13-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Mid nineties had witnessed a sudden spurt in the crab export trade due to good demand in the foreign market. Hence a sizable number of fisherfolk diverted their fishing effort for crab fishery. Better catch of crabs urged the processors to adopt indigenous processing technology. Such a technology was encountered at Vellapatty, a fishing hamlet situated 15 km north of Tuticorin. Both Vellapatty and Tharuvaikulam, north of Tuticorin are well known for crab fishery along Tuticorin coast in Gulf of Mannar.

1515. **Manikandavelu, D and V. Ramadhas** 1991. Seasonal variations of nutrients in a mangrove bordered brackishwater biotope in Tuticorin Bay. *Indian J. Ecol.,* 18(1): 54-58.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Ecological characteristics of a mangrove bordered brackishwater situated near Thermal Power Station of Tuticorin revealed the dominance of ammonia among the nitrogenous nutrients. Available nitrogen (NO^-_3-N + NO^-_2-N + NH_3N) and phosphate levels were higher than those reported for other Indian mangrove waters. Dissolved silicon showed highly significant negative correlation ($P<0.01$) with salinity.

1516. **Manikandavelu, D., Neethiselvan, G. Jagatheesan and K. Sundarsanam** 1992. Use of fermented ensilage based diet in enhancing the growth of common carp (*Cyprinus carpio* var. communis). *Fish. Technol.,* 29(2): 111-113.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Three isoprotein feeds containing 25% protein namely, rice bran and groundnut oil cake (control); rice bran and fish meal; rice bran, fish meal and fermented fish ensilage were used in the feeding experiments. After 45 days of feeding trial in water recirculatory system, growth was considerably higher in fishes fed with ensilage based diet than the control and diet based on fishmeal.

1517. **Manikandavelu, D and V. Ramadhas** 1994. Bioproduction dynamics of a mangal bordered brackish water in Tuticorin coast. *Indian J. Mar. Sci.,* 23: 108-109.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A survey in Tuticorin mangal region near Thermal power plant has been carried out for a period of one year for assessing its productivity. The mean gross and net photosynthsisis of this system were 299.7 and 134.333 $mgC.m^{-3}h^{-1}$, respectively. The ratio of net photosynthesis to gross photosynthesis varied between 0.17 and 0.77. Chlorophyll-a showed a biomodal distribution and the highest recorded was to the tune of 42.59 $mg.l^{-1}$ primary production and Chlorphyll *a* values recorded in this bitope indicatied its biological fertility.

1518. **Manimaran, B and V. Ramadhas** 1989. Phosphorus enrichment in Tuticorin coastal water (South India). *VIII Int. Ocean Disposal Symp., Dubrovnik (Yugoslavia), 9-13 Oct 1989.* p.64.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A study was carried out on the seasonal variation of the different chemical species of phosphorus in four different stations fixed in the semi-enclosed sewage polluted fishing harbour area of Tuticorin. In the interior region of the Tuticorin fishing harbour and in the coastal zone, sedimentary organic phosphorus had highly significant ($P < 0.01$) positive correlation with total sedimentary phosphorus. The anticipated increment in organic carbon synthesis due to the total quantity of phosphorus discharged was to the tune of 1,300 tonnes C y^{-1}. However, sewage phosphorus did not trigger red tide in the bay and favoured fisheries elsewhere due to the effect of coastal water currents.

1519. **Manimaran, B., V. Ramadhas and R. Santhanam** 1997. Role of sewage phosphorus in coastal water energy production. *Oceans Conference Record (IEEE).* 2: 1326-1329.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The quantity and speciation of phosphorus in a sewage originating from Tuticorin town and discharging the contents in fishing harbor area are studied. Four prominent peaks are observed in the distribution of total phosphorus and during most of the months the concentration remained 4 mgP/1. The anticipated hike in primary energy synthesis is around $3,900\times10^7$ Kcal with all the three sewage of Tuticorin discharge comparable quantity of wastewater. The extra fish production due to sewage phosphorus is calculated as 132.60 tons/yr. The surplus production of energy due to the boosted fishery potential is around 132.6×10^6 Kcal/yr.

1520. **Manimaran, B., V. Ramadhas and R. Santhanam** 2000. Role of sewage phosphorus in coastal water bioenergy production. *Indian J. Mar. Sci.,* 29(4): 341-343.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A study was carried out on the quantity and speciation of phosphorus in a sewage originating from Tuticorin town and discharging the contents in the Fishing Harbour area. Four prominent peaks were observed in the distribution of total phosphorus and during most of the months the concentration remained above 4 mgP/l.

The annual mean contribution of total soluble phosphorus (86.73%) to total phosphorus was higher than that of particulate phosphorus (13.27%). Since all the chemical species of phosphorus are eventually converted into biologically utilisable form, the anticipated increment in energy production calculated from the stoichiometric composition of plankton [$(CH_2O)106(NH_3)16H_3PO_4$] was to the tune of 1300 tonnes C/yr. Assuming that all the three sewages of Tuticorin discharge comparable quantity of wastewater, the anticipated hike in primary energy synthesis was around 3900×10^7 kcal. Considering three trophic levels from phytoplankton production to fish production the extra fish production due to sewage phosphorus was calculated as 132.60 tons/year. According to Winberg's transformation, the surplus production of bioenergy due to be boosted fishery potential was around 132.6×10^6 kcal/year.

1521. **Manimaran, B., V. Ramadhas and R. Santhanam** 2001. Metal pollution in Tuticorin coastal waters due to flyash of Thermal Power Plant. *National seminar on marine and coastal ecosystems: coral and mangrove - problems and management strategies, 26-27, Sept 2001, Tuticorin,* p.46-47.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

1522. **Manimaran, G., A.A. Ravindran, K. Nathakirimurugan and P.T. Roychacko** 2005. High wave activity of the Tamilnadu coast is due to aftershocks induced seiching effects. *J. Geol. Soc. India*, 66(6): 766-768.

Abstract : Recently the seashores of Chennai, Ennoor, Thiruvotriyar, Cuddalore and Kanyakumari (India) were lashed by high waves during the period from the late night of the full moon day on 19th to 22nd August 2005. The usual height of low tide and high tide waves observed along the coast are always between 0.2 m and 0.7 m respectively. During the high wave activity waves rose to the height of 1.0 to 1.3 m along the Tamil Nadu coast, unlike tsunami which rose to heights between 1.5 to 3 m. After the December 2004 tsunamigenic Sumatra earthquake, the subsequent train of aftershocks resulted in the agitation of seawater so as to form oscillatory waves known as seiches. Such oscillations in seawater generated at Sumatra-Andaman region were reaching the coastal regions of Tamil Nadu after one or two days as seiches.

1523. **Manivannan, V., V. Kumar, V. Ragothaman and S.M. Hussain** 1996. Calcium carbonate - A major factor in controlling foraminiferal population in the Gulf of Mannar, off Tuticorin, Tamilnadu, pp.381-385.

1524. **Manjusha, M.** 1997. Geochemistry of coral reefs, seagrass beds and adjacent areas of Gulf of Mannar. *M.Sc. Dissertation*, Annamalai University, India, 46 pp.

1525. **Mantri, V.A.** 2004. Rediscovery of *Caulerpa lentillifera*: A potential food alga from Samiani Island, West coast of India. *Curr. Sci.,* 87(10): 1321-1322.

Address : Marine Algae and Marine Environment Discipline, Central Salt and Marine Chemicals Research Institute, Gijubhai Badheka Marg, Bhavnagar 364 002 India; E-mail: salt@csir.res.in

Abstract : During the current seaweed biodiversity assessment programme, an interesting marine alga *Caulerpa lentillifera* J. Agardh (Caulerpales, Caulerpaceae) was collected from Samiani Island (22°29.3'N; 69°05.2'E). This Island is situated at the mouth of the Gulf of Kutch, about 2.5 nautical miles northwest of Port Okha, west coast of India and is not much explored for its marine algal wealth. *C. lentillifera* is a tropical food alga and has been extensively cultivated in the Philippines and Japan, with annual harvest of about 5,600 tons fresh weight. The first report of this alga from Indian waters was that of Chacko *et al*. from Krusadai Island, Gulf of Mannar under the name *C. longistipitata* (Web. Van Bosse) Sved. Since then, this species has remained elusive even though extensive marine algal surveys have been undertaken at its site of first report and elsewhere in India. The present report is of special significance, since this commercially important seaweed has been recorded again from Indian waters nearly after half a century.

1526. **Maria Ignatiammal, T.** 2005. Nitrogen fixing azospirillum from coastal mangroves of South India and their possible utility as marine biofertlisers. *Ph.D. Thesis*. Manonmaniam Sundaranar University, Tirunelveli.

Address : Centre for Marine Science and Technology, Rajakkamangalam, 629502, Kanyakumari District, Tamilnadu, India.

1527. **Marichamy, R.** 1976. A note on the length-weight relationship and relative condition in *Herklotsichthys punctatus* (Ruppel). *Indian J. Fish.,* 21(2): 582-584.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An analysis of the length-weight data of *H. punctatus* shows no significant difference between the sexes in the regression coefficient which is found to be very close to 3.0. The relative condition in females appears to be influenced both by the feeding intensity and the onset of maturity whereas in males an improvement in the condition factor coincides with the attainment of maturity.

1528. **Marichamy, R and P. Siraimeetan** 1979. Hydrobiological studies in the coastal waters of Tuticorin, Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 21(1&2): 67-76.

Address: Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract: Hydrological and meteorological features in relation to the distribution of zooplankton of Tuticorin coast in the Gulf of Mannar are described. Seasonal variations in the surface temperature and salinity show similarity in general trends. A bimodal cycle in the distribution of these major factors was noticed. An increasing trend in the dissolved oxygen content was observed during post monsoon months. The relation between pH and oxygen appeared to be inverse. The annual cycle of production of plankton in the region was found to be dicyclic. Copepods and chaetognaths reached their maximum when the salinity was low. Copepods and lucifer showed an inverse relationship when the latter dominated the plankton. Poor percentages of copepods and lucifer were noticed when molluscan larvae and fish eggs constituted high percentages.

1529. **Marichamy, R., G. Venkataraman, K.M.S. Ameer Hamsa, P. Nammalwar, S. Shanmugan and P. Bensam** 1979. Culture of fishes in cages and pens along the coastal waters of India. *International workshop on pen and cage culture of fish*, 11-22 February, Tigbauan, Philippines. IDRC, Ottawa-Canada SEAFDEC, Tigbauan Philippines. *Aquaculture*- Dep. pp. 41-44.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of culture attempts of milkfish, *Chanos chanos, Mugil* spp., prawn *Penaeus indicus* and crab *Scylla serrata* in enclosures of bamboo splits (thatti), fixed in shallow inshore waters at Tuticorin, are summarized.

1530. **Marichamy, R and S. Rajapackiam.** 1982. The culture of milkfish, mullet and prawn in an experimental marine fish farm at Tuticorin. *Proceedings of the symposium on coastal aquaculture*, held at Cochin from January 12 to 18, 1980. *Part-1: Prawn culture*. MBAI, Cochin, India, 6: 256-265.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Preliminary experiments were carried out in fish farm of salt pan reservoir for polyculture of *Chanos chanos*, *Mugil cephalus* and *Penaeus indicus* . The seeds were collected from nearby estuarine areas and stocked at different intensities. The important problem facing the experiment was the prevalence of competitors and the maintenance of quality of water. Of the three varieties cultured, mullet appeared to grow well with better survival rate resulting in an increased rate of production. Marketable size at 31 cm was attained in a period of 9 months. A marked difference in the rate of growth and production of the species under culture was well noticed in three sets of experiments carried out during 1977-1979. The estimated rate of production in polyculture increased from 499 kg to 731 kg/ha/year in the present status.

1531. **Marichamy, R and S. Rajapackiam** 1984. Culture of larvae of *Scylla serrata. Mar. Fish. Inf. Serv. T & E. Ser.*, 58: 13-15.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A description is given of a system for the mass rearing of mud crab (*Scylla serrata*) in coastal ponds in Tuticorin Bay.

1532. **Marichamy, R., M.E. Rajapandian and A. Srinivasan** 1984. The stranding of rorqual whale *Balaenoptera musculus* (Linnaeus) in the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 26(1&2):168-170.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The note embodies observations on the stranding of a rorqual whale *Balaenoptera musculus* measuring 6.35 m in total length in the shallow waters off Ovari, Tamil Nadu, India, on 20-12-1976. This is the first recorded instance of stranding of this species alive along this coast. General morphological features are given. Instances of strandings in other parts of the country are also listed.

1533. **Marichamy, R., C.P. Gopinathan and P. Siraimeetan** 1985. Studies on primary and secondary production in relation to hydrography in the inshore waters of Tuticorin. *J. Mar. Biol. Assoc. India*, 27(1&2): 129-137.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of hydrobiological investigations conducted in the inshore waters off Tuticorin, Tamil Nadu, India during 1983-84 are presented. The primary production, as estimated, indicated 3 distinct peak periods, the first during January-March, the second during June-August and the third during October-December. The trend of secondary production closely followed that of primary production. Zooplankton were found to be abundant during May-September and again a short secondary peak was noticed during November-January. The occurrence of different zooplankton showed a definite seasonal fluctuation. The physico-chemical properties of the seawater showed variations in space and time. A general picture of the environmental conditions of the inshore area are discussed.

1534. **Marichamy, R and J. Motha** 1986. Prospects of prawn culture in salt pan areas. *Mar. Fish. Inf. Serv. T & E. Ser.*, 70: 1-7.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An account is given of activities conducted in Tamil Nadu regarding the possibilities of prawn culture in the salt pan areas. The location, construction and preparation of ponds are described and culture experiments with *Penaeus indicus* are outlined, detailing stocking operations, farm management, growth assessments, harvesting and production, and marketing and economic aspects. Present efforts in the saltpan area indicate the culture of prawns to be a profitable venture, although possibilities exist for improvement of the systems.

1535. **Marichamy, R., M. Manickaraja and S. Rajapackiam** 1986. Culture of the mud crab *Scylla serrata* in Tuticorin Bay. *Proc. Symp. Coastal Aquaculture, 4*: 1176-1182.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The present paper comprises the results obtained in the experimental culture of the mud crab *Scylla serrata* in different types of cages in shallow bay of Tuticorin during 1978-79. The seeds were collected from estuarine area along creeks with its coastal mangrove swamps and impoundments and intertidal flats in and around Tuticorin. The young crabs were reared first in basket type cages made of cane splits for 2-3 months. Box type cages made of soft wooden planks, each comprising 8-10 compartments and metal framed synthetic twine mesh cages with compartment were preferred for culturing the grown up crabs. The crabs were fed with trash fish, clam meat and gutted wastes of the fish market. The growth rate of mud crabs in the existing environments appeared to be good as a good number of the stock moult frequently at an interval of 25-50 days. They were observed to reach marketable size through four-five moults in a period of 9-10 months. Eye stalk ablation accelerated the growth rate in young crabs and promoted gonadal maturation in adult crabs. Breeding behaviour of this species was observed and discussed in brief.

1536. **Marichamy, R.** 1987. Culture of finfishes along the coast of Tamil nadu. *Mar. Fish. Infor. Serv. T & E.Ser.*,75: 5-11.

Address : Central Marine Fisheries Research Institute, Tuitcorin - 628 001, Tamilnadu, India.

Abstract : This study reveals the results of fish culture experiments carried out along the coast of Tamilnadu.

1537. **Marichamy, R.** 1987. Prawn farming in the tidal flat of Kallar Estuary. *J. Mar. Biol. Assoc. India*, 29(1&2):63-68.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Prawn farming is gaining importance on the southeast coast of India and a derelict area along the edge of Kallar River at Veppalodai, Tamil Nadu, has been developed into productive culture ponds. Potential grounds for the collection of euryhaline species have been identified in the tidal inlets along the Gulf of Mannar. Culture is done in 2 seasons in a year. Juvenile prawn *Penaeus indicus* of modal size 25-35 mm obtained from the wild and stocked in August 1985 grew to marketable size of 138 mm in 5 months and those stocked in February 1986 were harvested from July onwards. A difference in the growth rate was noticed in two different sets of experiments and the causes attributed mostly to the environmental features of the culture ground. Better survival and production are obtained in the summer crop. Supplementary feed was given in the form of pelletized feed and trash fishes. Production rate was 530-1200 kg/ha/crop although salinity ranged from 31-48 ppt.

1538. **Marichamy, R and S. Rajapackiam** 1988. Management of prawn culture practices in Tuticorin area. *CMFRI Spec. Publ.*, 40: 48-49.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Prospects of prawn culture are discussed in relation to the available resoruces of land, water and prawn seed as well as the recent developments made in the area. The results of prawn culture experiments were highly influenced by the stocking intensity and hydrological features of the culture site. Best result in growth and production was recorded when the stocking rate was kept at 75,000-80,000/ha. A total production of 7,258 kg of *Penaeus indicus* was attained from 4 ponds of a total area of 3.2 ha by raising 2-3 crops in a period of 21 months and fetched a gross income of Rs. 2,62,733.

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1539. **Marichamy, R., D.C.V. Easterson, D. Kandasamy, H. Mohamed Kasim and S. Rajapackiam** 1988. Effect of mercury effluents on marine bivalves. *CMFRI Bulletin,* 42(2): 410-413.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : High concentration of mercury and acidity have been noticed in the effluents of Dhrangadra Chemical Works and Plastic Resins and Chemical Centre near Kayalpatnam, south of Tuticorin. The bar mouth of the polluted lagoon is opened during November-January and the discharges of heavy metal toxicants in the open sea is of great concern in the management of marine and nearby ecosystems. Seawater in the industrial coastal area contains mercury in the range 18-70 µg/ml. Marine organisms such as bivalves have a particularly high capability for concentrating heavy metals. Investigations have been carried out on the survival of two important bivalves of the region *Crassostrea madrasensis* and *Mesodesma glabratum* of different size groups by abruptly exposing, to different concentrations from sharp lethal to non lethal concentrations of the industrial effluents. Samples of these two species have also been exposed to different sublethal concentrations for varying durations to study the uptake and rate of accumulation of mercury in the tissues of the bivalves. The results of the observations are discussed. The study provides information as to when exactly the bivalves are brought under stress and for planning preventive measures to protect the valuable resources.

1540. **Marichamy R and S. Rajapackiam** 1990. Development of Prawn culture in Tuticorin area. *CMFRI Bulletin,* 44(2): 328-336.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The coastal zone along Tuticorin in Chidambaranar District of Tamilnadu affords suitable environment for the occurrence, survival, growth and production of commercially valuable prawns. The prospects of prawn culture are discussed in relation to the available resources of land, water and wild seeds as well as the recent developments made in the area. Growth and production of *Penaeus indicus* cultured in the saltpan area near Tuticorin during 1985-87 are presented. The results of prawn culture experiments were highly influenced by the stocking density and also the hydrological features of the culture site. Best result in growth (27 mm/4.2 g/ month) and production (1,347 kg/ha/crop) was recorded when the stocking was kept at 75,000-80,000/ha. The maximum production of 1.600-1,700 kg/ha/crop was attained in high stocking density, but the period of culture was more. A total production of 10.407.5 Kg of *Penaeus indicus* was attained from 7 ponds of a total area of 4.2 ha by raising 2-3 crops in a period of 25 months and fetched a gross income of Rs. 3,90,161/-. The results of the experiments are highly encouraging for the fast development of semi-intensive farming in the area. Various problems encountered in the development of prawn farming and suggestions for better management practices are highlighted. Information covering the suitable areas for the development of coastal farm, economics of culture, culture operations, the sources of financial and technical aids available in this profitable venture is presented.

1541. **Marichamy, R., C.P. Gopinathan and P. Siraimeetan** 1990. Studies on Plankton Production in the Inshore Waters of Tuticorin. *Proc. on the 2nd Indian Fish. Forum*, dated 27th to 31st May'90. pp. 257-260.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The results of hydro-biological investigations with special reference to plankton production in the inshore areas off Tuticorin for the period 1976 to 1985 have been presented. The primary production revealed three distinct peaks during the years, 1982-85, the first in January-April, the second in June - August and the third October -December. The annual cycle of zooplankton production was dicyclic with slight variations throughout the period of study. Components of zooplankton showed definite seasonal fluctuations. Occurrence of fish eggs and larvae in increased percentages during March, June, July and September-October indicated the spawning seasons in this area. The distribution of bivalve and gastropod larvae exhibits two distinct modes during February-March and October-December, revealing the breeding season of this group. The environmental conditions of the inshore area relating to primary and secondary production are briefly discussed.

1542. **Marichamy, R., A.A. Jayaprakash, N. Ramamoorthy and M. Bose** 1992. Seasonal landings of oil sardine *Sardinella longiceps* at Rameswaram, Pamban & Mandapam areas. *Mar. Fish. Infor. Serv. T & E. Ser.,* 117: 9-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Unusual and unprecedented landings of oil sardine, *Sardinella longiceps* were noticed at Rameswaram and Pamban were noticed. The crafts and gears used, area of operation, etc., are discussed.

1543. **Marichamy, R.** 1996. Mud crab culture and hatchery. *CMFRI Bulletin,* 48: 103-107.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The capture, culture and trade of mudcrab are of increasing importance in the coastal areas of the Indo-Pacific region. Mud crab is considered as a very expensive seafood delicacy all over the world. Widespread interest exists in crab fattening in the countries bordering Bay of Bengal. It is feared that the intensive and indiscriminate fishing of this marine crab and the absence of any management measures may cause a decline in the population. Its reproductive capacity is high. It is possible to culture them in specially designed coastal ponds, pens and cages. Experiments conducted in certain parts of brackish water regions in India have shown high prospects of commercial culture. The availability of vast stretch of suitable land, tropical climate, local collection of cultivable species and the low cost labour, the potential for development of mud crab farming in India are considered most favourable. Most of the countries including India have reported on the declining trend in mudcrab resources and stimulated aquaculture ventures in order to increase the production for export market. It is imperative to develop this valuable resource by proper management including the promotion of culture activities. Indiscriminate fishing of juvenile crabs are going on in most of the commercial fishing grounds. These juveniles can be used for further fattening in ponds. The Central Marine Fisheries Research Institute has made pioneering efforts in this aspect of study and accomplished a record of works both in field culture of mud crab and production of seeds in hatchery system in the early years of 1980. This Institute plays a consultative role to develop and demonstrate new techniques to the interested entrepreneurs. A good number of shrimp farmers have converted their ponds suitably for crab culture and it is profitably practiced in Andhra Pradesh and Tamil Nadu.

1544. **Marichamy, R., D.B. James, H. Mohamed Kasim, M. Rajamani, V.S. Rengaswamy, K.M.S. Ameer Hamsa, T.S. Balasubramanian, M.M. Raja, S. Rajapackiam and G. Arumugam** 1998. Major and minor fishing harbours of India: The Fisheries Harbour and fishery at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.,* 153: 17-22.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The year-wise landing of prawns and lobsters and the catch composition of sharks, rays and skates are discussed in this paper.

1545. **Marichamy, R and S. Rajapackiam** 1999. Commercial farming of mud crab in coastal ponds at Tuticorin. *Proc. on the 4th Indian Fish. Forum,* dated 24th to 28th Nov'1996. pp. 215-218.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Mud crab farming is fast developing in shrimp ponds as diversified and alternative system of culture by the entrepreneurs. The resource potentials of seed and feed are highlighted. Fourteen ponds were converted for production of mud crab. Monoculture, Polyculture and fattening methods are described. Production results of these trials vary from 1,020-2,440 kg/ha/crop, revealing the scope to improve high yield. Fattening of water crabs in a period of 7-8 weeks fetched an attractive revenue. Technology for production of gravid female which fetch a premium price in export trade was evolved. A high profit was realised in polyculture trials with milkfish as compatible species. Feed consists of low cost trash fish and gutted wastes of squid, rays and chick. The hydrological and environmental conditions were conducive and its requirements are discussed. The growth, survival and production results vary according to the size and number of seed stocked.

1546. **Marichamy, R., H. Mohamed Kasim, K.M.S. Ameer Hamsa and S. Rajapackiam** 1999. Age and growth of *Himantura bleekeri* (Blyth) and fishery for Rays off Tuticorin. *Proc. on the 4th Indian Fish. Forum,* dated 24th to 28th Nov'1996. pp. 397-399.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An estimated annual average total catch of 900.9 t of rays were landed at Tuticorin during 1991-92 to 1995-96. The small mechanised trawlers landed 778.8 t at the catch rate of 24.2 kg/unit, which constituted 3.3% of the total catch by trawlers and the bottom-set gill nets landed 122.1 t at the catch rate of 73.9 kg/unit which formed 69.7% of the total catch by bottom set gill nets. The abundance of rays in the trawling grounds

increased from April to reach a peak in September and then fluctuated. Such a definite trend was not seen in the abundance of rays in the grounds of bottom set gillnets and in general the abundance of rays was good in almost all the months. As many as nine and odd species supported the fishery and in both the gears *Himantura bleekeri* was the dominant species recording 34.1% in trawlnet and 34.5% in bottom-set gillnets and the second dominant species was *H. allmak*. The sexwise age and growth of *H. bleekeri* is studied from length frequency data collected from trawl and bottom-set gill net landings.

1547. **Marichamy, R., H. Mohmed Kasim, V.S. Rengasamy, K.M.S. Ameer Hamsa and S. Rajapackiam** 2000. Culture of seabass, *Lates calcarifer*. ***In***: *Marine Fisheries Research and Management,* V.N. Pillai and N.G. Menon (eds.), CMFRI, Kochi. pp. 818-825.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies on the growth of *Lates calcarifer* cultured in coastal ponds and net cages in the three different places at Tuticorin showed an increase of 16.2-23.2 mm/ 18.6-53.2 g/ month at Karapad, 21.1-29.8mm/19.3-36.3 g/ month at Veppaalodai in coastal ponds and 21.6-32.4mm/ 31.4-55.0 g/ month in a net cage in the Tuticorin Bay. The growth in Karapad pond, where supplementary feed was provided was better than in Veppalodai pond. The highest growth rate was obtained in net cage culture at Tuticorin Bay. Length-frequency analysis of samples from commercial catch reveal a faster growth in the wild than in the culture systems. The better growth in the brackish water culture and in the wild is attributed to the lower salinity and better live feed availability in brackish water. In the pond system, the growth can be improved by maintaining proper water exchange so as to maintain the salinity equivalent to open sea / bay / brackish waters and by providing supplementary feed.

1548. **Marimuthu, N., J.J. Wilson, B. Muthuraman, S. Magesh and A.K. Kumaraguru** 2004. Algae as biofoulers in Pudhumadam coastal waters in the Gulf of Mannar. *Seaweed Res. Utiln.*, 26(1&2): 41-46.

Address : Centre for Marine and Coastal Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai, 625021, India; E-mail: marinemari@hotmail.com

Abstract : Protection against fouling organisms calls for a knowledge of their ecology and seasonal variation. Towards this, a biofouling panel system was constructed at Pudhumadam coast, Tamil Nadu, India, comprising of four types of test panels for observing the settlement and recruitment of fouling communities during the period from November 2002 to November 2003 and the algal species as foulers were recorded. *Polysiphonia unguiformis* and *Sphacelaria* sp. appeared as the dominants. *Lobophora variegata, Chlorodesmis hildebrandtii* and *Cladophora vagabunda* were also recorded on the panels. *Sargassum myriocystum, S. ilicifolium, S. plagiophyllum, S. wightii, S. cristaefolium* and *Cymodocea serrulata* formed the cast-ashore organisms on the panels.

1549. **Marimuthu, N., J.J. Wilson and A.K. Kumaraguru** 2005. Encrusting form of corals as biofoulers in coastal waters of Gulf of Mannar, Southeast coast of India. *J. Mar. Biol. Assoc. India,* 47(1): 88-91.

Address : Centre for Marine and Coastal Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai 625 021 India; E-mail: marinemari@hotmail.com

Abstract : Encrusting form of coral *Montipora* sp., belonging to the family Acroporidae, was found to settle on vertically submerged biofouling test panels installed at Pudhumadam coastal waters in the Gulf of Mannar. No other types of corals were found to settle on these test panels. The recruitment and growth of the coral occurred during March and November. Only 2% of the total number of test panels showed coral attachmnent. A range of 7-15% of the surface area of the panels was covered by the coral growth. Out of four different types of test panels employed, the one which was made of concrete, showed no coral settlement.

1550. **Marimuthu, N., J.J. Wilson and A.K. Kumaraguru** 2005. Teira batfish, *Platax teira* (Forsskal, 1775) in Pudhumadam coastal waters, drifted due to the tsunami of 26 December 2004. *Curr. Sci.,* 89(8): 1310-1312.

Address : Centre for Marine and Coastal Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai-625 021, India. E-mail: akkguru@eth.net

Abstract : The teira batfish, *Platax teira*, which are normally found in waters around the Islands in the Gulf of Mannar have drifted due to the tsunami of 26 December 2004. The batfish were found around the Underwater Biofouling Panel System erected near the coastal town of Pudhumadam. They were found at a depth of 3 m. The fish had yellowish silvery body with a black bar running across the eye. The total length of the fish was 12.16 cm and the standard length was 10 cm. The fin span, dorsal to pelvic, was the maximum with 29.73 cm. The body depth was 8.10 cm. The standard length was about 1.2 times that of the body depth. The dislocation of fishes by

natural causes such as the tsunami may have either beneficial effect or deleterious effect on the fish population depending on the region to which they are dislocated.

1551. **Markham, C.R.** 1864. The Tinnevelly Pearl Banks. *Intellectual Obsr.,* 4: 418-426.

1552. **Markham, J.C**. 1980. A new species of Dicropleon and new records of three other species of bopyrid isopods from the Indian Ocean. *Bull. Mar. Sci*., 30(3): 623-633.

Address : Arch Cape Mar. Lab., Arch Cape, OR 97102, USA.

Abstract : Specimens of 4 species of Indian Ocean bopyrids providing either new host and distributional records or resolution of systematic problems are dealt with. A specimen from the Gulf of Mannar previously recorded under the name of *Hemiarthrus* (?) sp., is described as *Dicropleon processae* sp. nov. It infests the shrimp *Processa aequimana*, *Aporobopyrus ryukyuensis* and *Aporobopyrina lamellata* are recorded from Karachi, Pakistan, where they infest new porcellanid hosts, *Petrolisthes boscii* and *P. rufescens* respectively. *Megacepon choprai* is recorded from Samat Sakhan, Thailand, infesting a new host, the grapsid crab *Sesarma mederi*; the male of *M. choprai* is described for the first time.

1553. **Maruthamuthu, S., J. Tagore, G.A. Thivakaran and R. Kasinathan** 1987. Shell shape variation and habitat characteristics of *Littorina undulata* (Gray, 1839) from Mandapam Waters, east coast of India. *Indian J. Mar. Sci.,* 16(3): 158-160.

Address : Central Electro Chemical Research Institute, Karaikudi - 623006, Tamilnadu, India.

Abstract : Shell size, shape and lip thickness of *L. undulata* were studied. High percentages of the larger shells, smaller shells and medium shells were collected respectively from low water, high water and mid water mark. In high water mark, mean shell height was low compared to mid water and low water mark. High percentage (20.52%) of damaged shells was observed in low water mark when compared to mid water and high water mark. Abundance of damaged shells and high value of lip thickness were observed in C type shells, while low values were observed in type A. These shell characteristics were correlated with age and habitat features.

1554. **Maruthamuthu, S., M. Eashwar, S.T. Manickam, S. Ambalavanan and B. Venkatachari** 1990. Corrosion-biofouling characteristics of copper in Tuticorin Harbour waters. *Bull. Electrochem.,* 6(4): 444-445.

Address : Offshore Platform and Marine Electrochemical Centre, Central Electro Chemical Research Institute Unit, Harbour Area, Tuticorin 628 004, India.

Abstract : Results of 18 months immersion studies of copper in Tuticorin Harbour, Tamilnadu, India are presented. The corrosion-biofouling relationship is discussed based on the results of the present study and of already available data in literature.

1555. **Maruthamuthu, S., M. Eashwar, S. Manickam, S. Ambalavanan, G. Venkatachari and K. Balakrishnan** 1990. Marine fouling on test panels and in-service structural steel in Tuticorin Harbour. *Indian J. Mar. Sci.,* 19(1): 68-70.

Address : Central Electro Chemical Research Institute, Offshore Platform and Electrochemical Centre, Harbour Area, Tuticorin 628 004, Tamilnadu, India.

Abstract : Barnacles, molluscs and ascidians were the major foulants in Tuticorin Harbour (Tamil Nadu, India). The annual fouling load reached about 5 kg/m^2 on aluminum test panels. Marine growth, principally by molluscs, was more on steel liners and thickness values exceeded 2.5 cm. Of the 42 sessile spp sampled, *Balanus tintinnabulum* and *Crassostrea cristagalli* produced the most corrosion damage to underwater steel structures.

1556. **Maruthamuthu, S., M. Eashwar, S.T. Manickam, S. Ambalavanan, G. Venkatachari and K. Balakrishnan** 1993. Corrosion and biofouling in Tuticorin Harbour. *Corrosion Prevention & Control*, 40(1): 6-10.

Address : Offshore Platform and Marine Electrochemical Centre, Central Electro Chemical Research Institute Unit, Harbour Area, Tuticorin - 628 004, Tamilnadu, India.

Abstract : A range of metals and alloys were tested for their resistance to corrosion and tendency to become biofouled. A maximum load of 6kg/m^2/yr was observed on titanium. Barnacles, molluscs, ascidians and serpulids were the major foulants, and all passive alloys became fouled readily. A specific type of crevice corrosion of stainless steel was noted beneath the shells of *Crassostrea cristagalli*. Whereas the performance of most metals and alloys was found not to be significantly altered by the harbour environment, copper was badly affected by characteristic localized attacks along the borders of test panels.

1557. **Maruthanayagam, C and P. Subramanian** 1999. Hydrological and zooplankton biomass variation in Palk Bay and Gulf of Mannar along the east coast of India. *J. Mar. Biol. Assoc. India*, 41(1&2): 7-18.

Address : Department of Animal Science, Bharathidasan University Thiruchirappalli, Tamil Nadu, India.

Abstract : Data on the hydrological factors and zooplankton biomass variations, salinity, dissolved oxygen and nutrient salts in the inshore waters of the Palk Bay and Gulf of Mannar (three different stations) during the period November 1993 to October 1995 are presented. The total biomass, total plankton volume and number of zooplankton showed little variation between the stations. The Station I is slightly rich in terms of both volume and number of zooplankton followed by the stations III and II. The atmospheric temperature of the three stations fluctuated between 28° C and 23° C, the surface water temperature was always little lower than the atmospheric temperature. Salinity showed a regular seasonal cycle, DO content maximum and minimum values fall on monsoon and summer months respectively. The maximum rainfall of 330 mm in stations I and II and 240 mm in stations III was recorded during monsoon months. A high TDS concentration in station I coincided with northeast monsoon and at station II and III with southwest monsoon. The nutrient load was high during the northeast monsoon in the Stations I and II, but in the station III it was during southwest monsoon the maximum nutrient load was observed when compared to the other stations.

1558. **Maruthanayagam, C and P. Subramanian** 1999. Bio-chemical variation of zooplankton population. *J. Mar. Biol. Assoc. India*, 41(1&2): 111-115.

Address : Department of Animal Science, Bharathidasan University Trichy, Tamil Nadu, India.

Abstract : Studies on protein, carbohydrate and lipid content in the 15 different zooplankton groups imply that these substances may have an important role in the marine ecosystem. The bio-chemical compounds of zooplankton showed a higher level of protein and lipid content when compared to carbohydrate level (protein>lipid>carbohydrate). The protein and lipid levels exert a good reciprocal relationship. Among the zooplankton *Sagitta enflata* species has high protein content (74.3%) followed by *Acrocalanus* sp. (73%) but in the case of Cnidaria (25.1%) and Ctenophore (25.3%) low protein levels were observed. The implications of the above biochemical results are discussed.

1559. **Maruthanayagam, C and P. Subramanian** 2000. Diversity of copepods in Palk Bay and Gulf of Mannar along the southeast coast of India. *Seshaiyana*, 8(2): 13-14.

Address : Department of Zoology, A.V.C. College, Mayiladuthurai-609305, Tamilnadu, India.

Abstract : Copepods are lower crustaceans occurring in both marine and freshwater habitats. They occur both in the Planktonic realm and in the benthic environment. They vary greatly in size (mostly 1-4 mm long), occur in enormous numbers and have an widespread distribution. Copepods constitute one of the most dominant taxa of marine plankton. They play an important role in the food chain of the marine ecosystem.

1560. **Maruthanayagam, C., C. Senthil Kumar and P. Subramanian** 2001. Seasonal variation of protozoans in Palk Bay and Gulf of Mannar along the southeast coast of India. *J. Mar. Biol. Assoc. India*, 43(1&2): 186-189.

Address : Department of Zoology, AVC College, Mayiladuthurai-609 305, Tamilnadu, India.

Abstract : Regular fortnightly zooplankton sample collection was made for two years from November 1993 to October 1995 in the Palk Bay (Station l) and Gulf of Mannar (Station II & III) along the southeast coast of India. Among the zooplankton sample particularly protozoa diversity was identified. Their primary peak was observed at the middle of summer (Station 1) and premonsoon (Station II and III) months. The temperature and salinity and monsoonal factors mostly influenced the occurrence of protozoans, the results are interpreted and probable reasons discussed.

1561. **Mary Bai, M.** 1978. The anatomy and histology of the digestive system of *Holothuria scabra* Joger. *J. Mar. Biol. Assoc. India*, 20(1&2): 22-31.

Address : Sri Avinashilingam Home Science College, Coimbatore - 641 011, Tamilnadu, India.

Abstract : *H. scabra* a common species occurring along the east coast of India, was collected from Pamban and around Krusadi Island and studied for anatomy and histology of its digestive system. The results obtained from this study will help in understanding the regeneration of organs and will also provide information on the comparative and functional anatomy of the digestive system in holothurians.

1562. **Mary Bai, M.** 1994. Studies on regeneration in the holothurian *Holothuria scabra*. *CMFRI Bulletin*, 46: 44-50.

Address : Zoological Survey of India, Southern Regional station, Madras-600 028, Tamilnadu, India.

Abstract : The histological studies made on regeneration of *Holothuria (Metriatyla) scabra* revealed that the alimentary canal regenerates as a thickening from the original mesentery through mitotic proliferation. The presence of groups of morula cells at the anterior and posterior remnants, during regeneration suggests their possible role in the process of wound healing. The circular muscle is formed by the de-differentiation and reorganization of the circular muscle fibres that are already present. The haemal rudiment is formed within three days as a projection of the mesenterial thickening. The respiratory tree originates as a solid rudimentary protrubarance from the ruptured end of the respiratory tree. The rate of regeneration, in all the tissues studied, seems to be more rapid when compared to that of temperate forms.

1563. **Mary Elizabeth Gnanambal, K., C. Chellaram and Jamila Patterson** 2003. Antibacterial activity of a reef associated gastropod, *Trochus radiatus. Nat. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 68.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Whole body extracts of *Trochus radiatus* obtained with solvents like Acetone, Ethyl acetate and Dichloromethane were screened for their antibacterial activity using agar well diffusion technique. All the extracts exhibited clear zones of inhibition for 7 of the 9 human pathogens tested. The extracts from 50% Ethyl acetate + 50% Dichloromethane showed prominence in inhibiting the growth of *Enterobacter aerogenes, Staphylococcus aureus* and *E. coli.* Also, all the extracts showed activity against 4 of the 5 fish pathogens tested. Maximum zone of inhibition was observed against *Proteus mirabilis* for the extracts of all the solvents except Acetone. The Minimal Inhibitory Concentration (MIC) of the extracts was found to be 0.07mg /ml for *Staphylococcus aureus, Enterobacter aerogenes* and *Proteus mirabilis and* 0.15 mg / ml for *Serratia marcescens.*

1564. **Mary Elizabeth Gnanambal, K., C. Chellaram and J.K. Patterson Edward** 2005. Isolation of antagonistic marine bacteria from the surface of the gorgonian corals at Tuticorin, southeast coast of india. *Indian J. Mar. Sci.,* 34(3) 316-319.

Address : Sugandhi Devadason Marine Research Institute, 44, Beach Road, Tuticorin - 628 001, Tamilnadu, Inida.

Abstract : Culturable heterotrophilic bacteria present on the surface of two gorgonian corals, *Subergorgia suberosa* and *Junceella juncea* were isolated and the number of pigmented and non-pigmented strains was noted. The antagonistic effect of the marine isolates was tested against 8 human pathogens and 7 fish pathogens. It was observed that 82% (289) of the isolated bacterial strains were found to be non-pigmented and 61% (214) were identified as Gram-negative. Only 13% (46) of the isolated bacteria were found to be antagonistic against both human and fish pathogens. 74% (34) of the producer strains were found to be non-pigmented, however, mild antagonistic activity was found to be exhibited also by the pigmented strains. Percentage of Gram-negative strains showing activity was found to be 68% (145). All the indicator strains tested were inhibited by at least 10 of the antagonistic marine bacteria. A higher degree of inhibition was conferred by 3 of the isolates (G_{110}, G_{111} and G_{113}) with maximum zones of inhibition against *Escherichia coli* (5.5 mm) by the strain G_{113}. The strains showing higher degree of inhibition against human pathogens (G_{110}, G_{111} and G_{113}) showed potent inhibition against the fish pathogens too with maximum inhibition against *Proteus mirabilis* (5mm) by the strain G_{110}. The symbiotic bacteria present on the surfaces of these gorgonian corals may yield novel metabolites.

1565. **Mary Elizabeth Gnanambal, K and Jamila Patterson** 2006. Insecticidal properties of *Halophila stipulacea. Seaweed Res. Utiln.,* 28(1): 159-163.

Address : Sugandhi Devadason Marine Research Institute, 44, Beach Road, Tuticorin - 628 001, Tamilnadu, Inida.

Abstract : The crude extracts of the seagrass *Halophila stipulacea* were evaluated for their insecticidal properties against a rice weevil *Sitophilus oryzae.* In the present study, it was found that 100% mortality was obtained by the extracts obtained with acetone at a concentration of 500 mg. None of the extracts obtained with other solvents were able to cause 100% mortality to the test animals. However, the extract obtained with hexane was able to induce 76.6% mortality followed by methyl ether (63.3%), toluene (60%) and ethyl acetate (53.3%) at a concentration of 1000 mg. One-way ANOVA results showed that there was a significant variation between the efficiency of the extracts obtained with different solvents at 1 % level. The ED_{50} values of the extracts obtained with acetone was found to be lower (9.89 mg) than those obtained with hexane (52.190 mg), toluene (312.05 mg)

and ethyl acetate (884.32 mg) indicating that the acetone extracts were efficient in causing mortalities at lower concentrations. It is clear from the present study that the acetone extracts of *Halophila stipulacea* were efficient to cause mortalities to *Sitophilus oryzae* even at lower concentrations indicating that these extracts may be used as insecticidal agents. This preliminary screening of insecticidal activity can be utilised in future for the development of novel biologically active compounds that could replace the existing chemical insecticides.

1566. **Mary Manisseri, K and C. Manimaran** 1981. On the fishery of the Indian white prawn *Penaeus indicus* H.Milne Edwards along the Tinnevelly coast, Tamil Nadu, India. *Indian J. Fish*., 28(1&2): 208-216.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The fishery is seasonal, June-July to October-November. The total landings of prawns by mechanised vessels in 1978 was estimated at 539 t, of which nearly 63.4% was large-sized *Penaeus indicus*. The species occurs in the adjacent waters of Punnaikkayal also, as a round-the-year fishery of lesser magnitude. The modal sizes of *P. indicus* from the Manappad fishing grounds ranged from 151-155 mm to 171-175 mm for males and 151-155 mm to 196-200 mm for females. Stages of maturity indicated intense spawning activities in this fishing ground. The fishing season coincides with the southwest monsoon, when there is a seasonal fishery, exclusively constituted by large sizes of the same species, in the adjacent waters of the Kanyakumari District on the southwest coast. A comparative study of the various features of the fishery of *P. indicus* in these two areas indicates the possibility of recruitment of the species to the Manappad fishery from the stock off Kanyakumari, which, in turn, is probably recruited from the Kerala coast at the time of intense physico-chemical changes in the marine environment, brought about by the south-west monsoon.

1567. **Mary Manisseri, K.** 1982. On the fishery of juveniles of *Penaeus semisulcatus* along the Tinnevelly coast, Tamil Nadu. *Indian J. Fish.*, 29(1&2): 20-28.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Penaeus semisulcatus* de Haan contributes to a considerable fishery on the southeast coast of India, particularly in the Gulf of Mannar. Juveniles occur in large concentrations in the shallow inshore sea, between Pattannamarudur and Tuticorin, covering a coastline of approximately 20 km. They are fished throughout the year by an indigenous gear known as "Ola Valai" operated in the waters within 2 m depth; landing approximately 57 tonnes in 1978-79. The peak abundance was in November-January and June-July. The size ranged from 40 mm to 150 mm total length, majority measuring < 100 mm, indicating that this area is a nursery ground of the species.

1568. **Mary Manisseri, K.** 1982. On the location of a nursery ground of *Penaeus semisulcatus* de Haan along the Tirunelveli coast, Tamil Nadu. *Proceedings of the symposium on coastal aquaculture*, held at Cochin from January 12 to 18, 1980. *Part-1: Prawn culture*. Marine Biological Assoc. of India, Cochin, India. 6: 415.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During the course of investigations on the *Penaeus semisulcatus* fishery resources of the Tirunelveli coast, a natural ground where the juveniles of the species occurred in large concentration was located in the shallow inshore sea, between Pattanamaruthur and Tuticorin, covering a coastline of about 20 km. The ground is characterised by sandy bottom with rocky patches and corals covered with a thick growth of seaweeds. The juveniles from this area are fished throughout the year by an indigenous gear known as "Ola Valai" operated in the shallow waters within 2 m depth. In 1978-79 a total quantity of 57 tonnes was caught from this region. The peak abundance was in November-January and June-July. The size ranged from 40 mm to 150 mm total length, majority measuring less than 100 mm. The possibility of utilising the area for seed collection of the species for developing intensive culture practices are discussed.

1569. **Mary Manisseri, K.** 1986. On the fishery of *Penaeus semisulcatus* and its distribution in relation to depth along Tinnevelly coast, southern India. *Indian J. Fish.*, 33(4): 402-412.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies on the total landings in relation to the effort expended in the fishery indicate that off Tinnevelly coast the resource of *Penaeus semisulcatus*, the main stay of the local prawn fishery, is under exploited. Breeding and recruitment into the fishery though take place more or less round the year, the breeding is more intense during July-October, December and February and the recruitment during November and February. *P. semisulcatus*, is fished from three grounds along this coast, namely off Pattanamarudur- Tuticorin, Punnaikkayal and Manappad ranging respectively in depth from 0 to 2 m, 8 to 20 m and 15 to 30 m. From the size distribution, the juveniles

appear to prefer shallow waters whereas the adults prefer deeper areas. The mean sizes of males and females in the shallow-water fishery are found to be 89.1 mm and 90.5 mm respectively. But the dominant modes of males and females in the fishery at Punnaikkayal varied respectively between 110 mm and 150 mm and 120 mm and 180 mm and at Manappad between 140 mm and 160 mm and 160 mm and 210 mm. That the prawns in maturing stages are found thus always in the deeper fishing grounds and never in the shallow-water fisheries indicate that the species move to the deeper waters for breeding.

1570. **Mary Manisseri, K.** 1988. The seasonal fishery for *Penaeus indicus* along the southwest and southeast coasts of India. *Proc. First Indian Fisheries Forum*, December 4-8, 1987, Mangalore, Karnataka. (ed) M.M. Joseph. pp. 169-171.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, Kerala, India.

Abstract : Fishery for *Penaeus indicus* along the Trivandrum-Kanyakumari and Manappad coasts is seasonal, commencing by May-June and closing by October-November. Annual landing of the species ranged from 559 t to 1,204 t during 1981-86. The fishery commences by the onset of the southwest monsoon, and is constituted by large-sized prawns (modes 151-155 mm to 171-175 mm in males and 196-200 mm in females). The high percentage (48%) of maturing and mature prawns indicates a breeding population contributing to the fishery. Occurrence of *P. indicus* population in sequence along the fishing centres of the southwest and southeast coasts suggests probable migration of the prawn from the former to the latter coast during the fishing season. This confirms the presently believed migratory behaviour of the species.

1571. **Mary Manisseri, K.** 1992. On the fishery of juveniles of *Penaeus semisulcatus* along the Tinnevelly coast, Tamil Nadu. *Indian J. Fish.*, 29(1&2): 20-28.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Penaeus semisulcatus* de Haan contributes to a considerable fishery on the southeast coast of India, particularly in the Gulf of Mannar. Juveniles occur in large concentrations in the shallow inshore sea, between Pattanamarudur and Tuticorin, covering a coastline of approximately 20 km. They are fished throughout the year by an indigenous gear known as “Ola Valai” operated in the waters within 2 m depth; landing approximately 57 tonnes in 1978-79. The peak abundance was in November-January and June-July. The size ranged from 40 mm to 150 mm total length, majority measuring < 100 mm, indicating that this area is a nursery ground of the species.

1572. **Mathevan Pillai, M.** 2000. Sediment dwelling diatoms of the Kanyakumari coast. *Seshaiyana*, 8(2): 14-15.

Address : Department of Botony, S.T. Hindu College, Nagercoil, Tamilnadu, India.

Abstract : Phytoplankton are the major constituents of the food-web in the marine coastal ecosystems. Among these, the micro algal species found living firmly attached to the surfaces of sand grains are referred to as episammon (Round, 1965). Epipelon refers to those species that are found on the surfaces of the sediments showing up and down movements in the interstitial water. These micro phytobenthic organisms especially diatoms play a vital role in establishing the food-chain relationships between different groups of organisms in the marine ecosystem. This paper deals with the sediment dwelling diatoms of the Kanyakumari waters situated on the (Lat. 8° 03' - 8° 35' N; Long. 77° 05' - 77° 36' E) east coast of India. The bottom in the near shore area is generally sandy but rocky grounds are also present.

1573. **Mathew, G.** 1997. Lessons learnt: Marketing of rack-dried anchovies in Kanyakumari. *PHF News*. 12: 20-21.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Details are given of activities conducted in the framework of the Post Harvest Fisheries Project in order to market rack-dried anchovies in Kanyakumari, India. The project sought to promote the use of drying racks as a possible solution to the physical and value losses sustained by fishermen in the district through sand drying of anchovies. Activities were proceeding with success until collapse of the anchovy fishery in 1994; landings plunged and never recovered. However, there was one positive outcome in that a small niche market was created for the product. Some private traders have entered into contracts directly with the fishermen who supplied the project; these traders procure small quantities of the dried product for sale in the Kerala market.

1574. **Mathew, G.** 2003. Perches. ***In*** : *Status of Exploited Marine Fishery Resources of India.* (eds.) Mohan Joseph and A.A. Jeyaprakash, CMFRI. pp. 102-109.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Perches are generally large sized Perciform fishes belonging to the families Serranidae, Lutjanidae and Lethrinidae, commonly called rock cods, snappers and pigface breams respectively. Perches occur all along the Indian coast. Most of the species belonging to this group inhabit the rocky grounds and the coral reef areas, while a few prefer the seagrass beds and muddy and sandy bottoms. They are particularly abundant in the rocky and coral grounds off Kerala, off Tamil Nadu, Gulf of Mannar, Gulf of Kutch, off Paradeep and in the Andaman Seas. These larger perches constitute roughly 2% of the total marine fish production in the country with an average annual landing of 28,800 t during 1990-2000 period. As per the estimates by the Government of India, the potential of all perches within the 50 m-depth zone is about 1,14,000 t and that beyond 50 m is 1,25,000 t. Most of the fishing grounds being not amenable to trawling operations, the major perches are exploited mainly by other gears like hooks and lines, traps and the drift net. The experimental and exploratory fishing carried out by various agencies like the Central Marine Fisheries Research Institute, the Fishery Survey of India and the erstwhile Indo-Norwegian Project provided valuable information on the abundance and distribution of the major perches in the Indian EEZ. Almost the entire array of species are excellent food fishes and in great demand in the export market, both in the live and frozen form. Of late, these are gaining importance for commercial mariculture in various countries including India.

1575. **Mathew, J and S. Kulasekarapandian** 1993. Population biology and ecology of Artemia from salinas of the southeast coast of India. *CMFRI Spec. Publ.,* 56: 126-128.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The population characteristics of Artemia and the effect of different environmental parameters on the different stages of Artemia in a salina at Tuticorin, southeast coast of India, are studied.

1576. **Mathew, K.J., T.S. Naomi, G. Antony, D. Vincent, R. Anilkumar and K. Solomon** 1990. Studies on zooplankton biomass and secondary and tertiary production of the EEZ of India. *Proc. First Workshop on scientific results of FORV Sagar Sampada,* 5th to 7th June, 1989, Cochin. (ed) K.J. Mathew. pp. 59-69.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The zooplankton collected from 1,113 stations occupied in the EEZ of India and contiguous seas during the cruises 1-44 of FORV Sagar Sampada during 1985-88 has been analysed for spatial distribution, monthly and seasonal abundance and diurnal variations. In general it has been found that the waters off the west coast were more productive. Pockets of very high density of over 1,000 cc of zooplankton per 1,000 m^3 of water were observed off Cochin and Mangalore. Fairly high density areas were frequently encountered all along the shelf area off the west coast especially the Wadge Bank area, the Gulf of Mannar, off Cochin, Mangalore, Goa and along the Gujarat Coast. In the oceanic area of the eastern Arabian Sea also high density areas were frequently met with. Off the east coast, high density areas were noticed north of Madras and off Kakinada. East of Andaman and around Nicobar Island, there were restricted areas of zooplankton abundance.

1577. **Mathew, P., P.V. Prabhu and K. Gopakumar** 1990. Prospects of agar industry in India. *Gracilaria production and utilization in the Bay of Bengal. Seminar papers: Session II small-scale Agarophyte processing. pp 58-64.*

Address : Central Institute of Fisheries Technology, Wellingdon Island, Matsyapuri PO., Cochin, 682029, India.

Abstract : This paper summarizes the status of previous and present work on utilization of agarophytes for agar extraction in India. Present national agar production does not meet demand. Standards are given for food and pharmaceutical grades. Physical properties of 1.5% agar are tabulated for *Gelidiella acerosa, Gracilaria edulis* and *G. verrucosa*. Yields range from 12 to 55% and gel strength varies between 15 and 300 g/cm^2 depending on species.

1578. **McKinney, J.F and E.A. Lachner** 1978. A New Species of Gobiid Fish, *Callogobius stellatus*, from Flores Island, Indonesia (Teleostei: Gobiidae). *Proc. Biol. Soc. Wash.,* 91(3): 715-723.

Address : U.S. Army Corps of Engineers, Professional Building, Suite C. Route 3, Kilmasnock, VA 22482, USA.

Abstract : *Callogobius stellatus*, a new species of the fish family Gobiidae, is described from Flores Island, Indonesia. *C. stellatus* is most closely related to *C. mannarensis* Rangarajan which is known only from the Gulf of Mannar, southern India. These two species differ from all other members of the genus in having a reduced sensory pore system consisting only of the nasal, anterior otic and intertemporal pores, a vertebral number of almost always 11 precaudal and 15 caudal vertebrae and a characteristic color pattern consisting of body saddles, a pectoral ocellus, a dark, oblique cheek mark and a large dark, wedge-like mark on the caudal fin. *C. stellatus*

differs from *C. mannarensis* mainly in its coloration, such as the dark, oblique cheek bar not extending to opercle and not joining with dark saddle on nape, a large, dark oval-shaped spot on fleshy base of pectoral fin, a distinct saddle on mid-trunk, and a pale to light basi-caudal bar that is not divided mid-laterally by the dark caudal mark.

1579. **Meenakshi, V.K.** 2000. *Ecteinascidia venui* sp. nov. a colonial ascidian (Perophoridae) from Tuticorin, southeast coast of India. *Indian J. Mar. Sci*., 29(1): 83-85.

Address : Department of Zoology, A.P.C. Mahalaxmi College for Women, Tuticorin, 628002, Tamil Nadu, India.

Abstract : A new species of colonial ascidian, *Ecteinascidia venui* sp. nov. collected from Tuticorin water is described in detail. This species differs from the other *Ecteinascidia* species reported from India in the presence of apertures on the upper anterior end of the body, absence of transverse muscles between apertures and no secondary gut loop. Relationships between *Ecteinascidia diaphanis* and *Ecteinascidia thurstoni* are provided.

1580. **Menon, A.G.K.** 1988. Marine national parks and conservation of fisheries resources.*CMFRI Spec. Publ.*, 40 : 108.

Address : Zoological Survey of India, Madras, Tamilnadu, India.

Abstract : IUCN and WWF have now launched a World Conservation Programme of the Oceans. The objective of the programme is the conservation of all marine forms of life. The urgent need for the establishment of Marine National Parks along the India coastline for the purpose of conservation of Indian Fisheries resources is highlighted.

1581. **Menon, A.G.K.** 1991. Marine National park and conservation of fisheries resources. *CMFRI Bulletin*, 44(3): 668-672.

Address : Zoological Survey of India, Madras, Tamilnadu, India.

Abstract : Industrial development often takes priority over other sectors in developing countries. In the process, problems like pollution of air, water, growth of slums, lack of sanitary facilities and other environmental hazards greatly increase, reaching uncontrollable proportions. In the industrial development, in the sphere of both Fisheries and Tourism, mistakes of development are common. It is high time that we pay some attention to the proper planning and development of the seafood export industries along our fine fishing coast. Similarly the other economic activities of sea, in particular the exploitation of the bed and coastal zones in the west coast for oil, have increased in recent years to such an extent that the detrimental effects on the ecological balance in some habitats are no longer minor. IUCN and WWF have now launched a World Conservation Programme of the Oceans. The objective of the programme is the conservation of all marine forms of life. The urgent need for the establishment of Marine National Parks along the Indian coastline for the purpose of conservation of our Fisheries resources is highlighted in the paper. On the east coast of India on the Tamilnadu coast, the fauna and flora of the Palk Bay and the Gulf of Mannar are the richest in India. The Krusadai Island with the nearby Pullivasal and Shingle Islands and their reefs with the surrounding waters are proposed to be set aside as the Marine Park Research station. The string of sixteen coral Islands stretching south and west of Krusadai Island should be declared as a Coral Reserve and the stretch of beaches west of Mandapam up to Thondi on the Palk Bay and to Valinokkam on the Gulf of Mannar side can be developed as excellent beach resorts.

1582. **Menon, M.G.K.** 1936. Scyphamedusae of Krusadai Island. *Bull. Madras Govt. Mus. New. Ser. (Nat. Hist.)*, 3(1): 1-28.

1583. **Mergner, H and G. Scheer** 1974. The physiographic zonation and the ecological conditions of some South Indian and Ceylon coral reefs. *Proc. 2nd Int. Coral Reef Symp. Brisbane,* 2: 3-30.

1584. **Merrylal James, C.** 1973. New distributional records of species of the sub-family Asteropinae (Ostracoda) from Indian Seas. *J. Mar. Biol. Assoc. India,* 15(2): 604-615.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The plankton samples obtained during the cruises of R.V. Varuna along the west coast of India, Gulf of Mannar and the Laccadive Sea have brought to light the occurrence of 4 species of ostracods, *Diasterope bisetosa* Poulsen, *Parasterope nana* Poulsen, *Synasterope oculata* (Brady) and *Asteropina nodulifera* Poulsen belonging to the sub-family Asteropinae. Being new records for the Indian Seas, they are described and illustrated here.

1585. **Merrylal James, C.** 1978. Feeding larval and juvenile prawns in culture operations. *CMFRI Spec. Publ.*, 3:85-88.

Address : Prawn Culture Laboratory, Narakkal, Kerala, India.

Abstract : Adult prawns consume a variety of food items, although their preferences vary from species to species, based on which the prawns may be categorized broadly into herbivorous, carnivorous and omnivorous. However, often a species or even a single individual may show overlapping feeding habits depending on the availability of food. Prawn culture, Prawn larval feed, Prawn larva food and feeding habits.

1586. **Michael, M.S., M. Pushpavanam, G. Subramanian and K. Balakrishnan** 1999. Corrosion resistance of electrodeposited Zinc alloys: A marine exposure study. *Bull. Electrochem*., 15(5&6): 205-207.

Address : Central Electrochemical Research Institute, Karaikudi - 630 006, Tamilnadu, India; Marine Corrosion Testing Centre, Mandapam Camp- 623 520, Tamilnadu, India; Alagappa University, Karaikudi - 630003, Tamilnadu, India.

Abstract : Considerable efforts are being made to improve the life of galvanised steel substrates. Electrodeposited zinc alloy containing nickel or cobalt play a significant role in this aspect and most of the galvanising industries abroad have switched over to these modified processes. In addition to offering increased service life they are considered as viable alternative to poisonous cadmium deposits also. Not withstanding the extensive corrosion testing of these coating under simulative conditions in the laboratory, an elaborate programme of a field testing these superiority over conventional zinc deposit both in the passivated and un-passivated conditions was performed for 18 months under severe tropical marine conditions at Mandapam Camp. The results confirm that zinc 15% nickel alloy deposit are superior and zinc 1% cobalt deposit are much better than zinc deposits with respect to their corrosion resistance.

1587. **Michael Antony, M., G. Jeyasekaran, R. Jeya Shakila and S.A. Shanmugam** 2002. Biochemical quality of raw shrimps processed in seafood processing plants located in Tuticorin region of Tamil Nadu, India. *J. Food Sci. Technol.*, 39(6): 698-701.

Address : Department of Fish Processing Technology, Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Biochemical quality of raw shrimps collected from three seafood-processing plants located in Tuticorin region of Tamil Nadu, India was examined. The average moisture, protein, fat and ash contents of raw shrimps were 72.92±0.37%, 21.04±0.47%, 2.35±0.06% and 3.18±0.08%, respectively, on wet weight basis. The TMA-N contents of about 75% of shrimp samples collected from the processing plants were found to have less than 5 mg%. The TVB-N contents of all the shrimp samples examined were below 30 mg%. Though 60% of shrimp samples collected had an indole content of 3.1 µg/100 g, none of the samples tested had an indole level above the rejection limit of 25µg/100 g. The shrimp samples scored an overall sensory score of above 7 out of 10.

1588. **Michael Antony, M., G. Jeyasekaran and R. Jeya Shakila** 2004. Quality of shrimps landed in different fish landing centers of Tuticorin, Tamil Nadu. *Fish. Technol.,* 41(2): 127-132.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A comparative study on the quality of shrimps landed in four fish landing centers (Therespuram, Punnakayal, Tuticorin fishing harbour and Tharuvaikulam) of Tuticorin region, Tamil Nadu, India was investigated. The shrimps collected from the landing centers scored an overall sensory score of > 7.0 out of 10.0. Most of the shrimps (80%) collected had TMA-N content more than 5 mg%. TVB-N content of only 40% of the shrimps exceeded the limit of 30 mg%. Indole was higher than 3.l µg/100g in all the samples, but within 25 µg/100g. The total bacterial load of 75% of shrimps were within the acceptable level of 10^5 cfu/g. Total and faecal coliforms and *E. coli* counts of shrimps of Therespuram were quite high. *Staphylococcus aureus* counts were high in shrimps of Punnakayal. *Vibrio parahaemolyticus* counts were almost similar in all the samples. *V. cholerae*, *Salmonellae* and *Listeria monocytogenes* were absent in all the shrimp samples examined. The shrimps landed in Tharuvaikulam had a better quality when compared to the shrimps landed in the other three fish landing centers.

1589. **Mini, K.G and M. Srinath** 2003. Trawl fishery of Tamil Nadu (1985-2000): An appraisal. *Mar. Fish. Infor. Serv., T&E Ser.*, 175: 1-5.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Tamilnadu, with a coastline of about 1000 km and continental shelf area of 41,412 sq. km., gives

excellent scope for fishing throughout the year. During the past three decades fishing activity has increased throughout the state. The resources are presently exploited by traditional crafts and mechanized fishing boats. Continued technological advances in fishing fleet has increased fishing efficiency and fishing intensity. Changes in the pattern and mode of fishing operations such as multi day fishing has necessitated an appraisal of the trawl fishery of Tamilnadu during the last fifteen years. Data on catch and effort of trawl net during 1985-2000 are analyzed for interpretation and to suggest management options.

1590. **Mishra D.C., V. Vijaya Kumar and R.P. Rajasekhar** 2006. Analysis of airborne magnetic and gravity anomalies of peninsular shield, India integrated with seismic and magnetotelluric results and gravity anomalies of Madagascar, Sri Lanka and East Antarctica. *Gondwana Research* DOI:10.1016/j.gr.2005.11.014 (*Article in Press Available online 3 May 2006*).

Address : National Geophysical Research Institute, Hyderabad, 500 007, Andhrapradesh, India.

Abstract : Modelling of gravity and airborne magnetic data integrated with seismic studies suggest that the linear gravity and magnetic anomalies associated with Moyar Bhavani Shear Zone (MBSZ) and Palghat Cauvery Shear Zone (PCSZ) are caused by high density and high susceptibility rocks in upper crust which may represent mafic lower crustal rocks. This along with thick crust (44-45 kID) under the Southern Granulite Terrain (SGT) indicates collision of Dharwar craton towards north and SGT towards south with N-S directed compression during 2.6-2.5 Ga. This collision may be related to contemporary collision northwards between Eastern MadagascarWestern Dharwar Craton (WDC) and Eastern Dharwar Craton (EDC). Arcuate shaped N and S-verging thrusts, MBSZ-Mettur Shear and PCSZ-Gangavalli Shear, respectively across Cauvery Shear zone system (CSZ) in SGT also suggest that the WDC, EDC and SGT might have collided almost simultaneously during 2.6-2.5 Ga due to NW-SE directed compressional forces with CSZ as central core complex in plate tectonics paradigm preserving rocks of oceanic affinity. Gravity anomalies of schist belts of WDC suggest marginal and intra arc basin setting. The gravity highs of EGFB along east coast of India and regional gravity low over East Antarctica are attributed to thrusted high density lower crustal/upper mantle rocks at a depth of 5-6 km along W -verging thrust, which is supported by high seismic velocity and crustal thickening, respectively. It may represent a collision zone at about 1.0 Ga between India and East Antarctica. Paired gravity anomalies in the central part of Sri Lanka related to high density intrusives under western margin of Highland Complex and crustal thickening (40 kID) along eastern margin of Highland Complex with several arc type magmatic rocks of about 1.0 Ga in Vijayan Complex towards the east may represent collision between them with W -verging thrust as in case of EGFB. The gravity high of Sri Lanka in the central part falls in line with that of EGFB, in case it is fitted in Gulf of Mannar and may represent the extension of this ongeny in Sri Lanka.

1591. **Mitra, G.N.** 1973. Method of estimation of fish abundance in the Indian seas and steps to be taken for management of the commercial fisheries. *Proc. Symp. on Living Resources. Seas around India.* pp. 145-154.

Address : Minsitry of food, agriculture, community development and co-operation, Govt of India. New Delhi, India.

Abstract : The present state of our knowledge of resources in the Indian seas, i.e., the Arabian Sea and the Bay of Bengal is very limited. Exploration of demersal fisheries has been done with some intensity upto a depth of 40 fathoms only, but this does not even cover the entire coastal belt. The data available on deeper grounds are sporadic and do not lead to conclusions. On pelagic fisheries our assessment as to the quantities available is yet to be done and since the fishing fleet in the Indian Ocean is being increased considerably it is desirable to take up speedier methods of assessing the fish abundance both for demersal and pelagic stocks. Side by side it is also necessary to encourage sound fisheries management practices as the resources picture becomes clearer. The paper suggests an approach to these problems under Indian conditions.

1592. **Mitra, G.N.** 1988. Catch rates and catch composition of fish in the Wadge Bank in commercial fishing. *CMFRI Spec. Publ.*, 40: 103-104.

Address : Professor Para, Cuttack 753 003, India.

Abstract : The results are given of commercial fishing in the Wadge Bank located south of Cape Comorin between Long. 77° and 78° 10'. The continental shelf off Cape Comorin has a gentle slope up to 100 metres, beyond which the depth sharply increases. The bottom is coarse yellow sand overlying flat rock up to 60 metres contour, beyond this the bottom is firm, clear sand with stretches of flat rock. There are rough patches of pinnacle rocks. Commercial large fishes consist mainly of rock fishes (47.8-65%) and carangids (2.4-11.9%). Catch data trawlers of 450 to 650 HP are included for the period 1965-70.

1593. **Mitra, G.N.** 1989. Catch rates and catch composition of fish in the wadge bank in commercial fishing. *CMFRI Bulletin,* 44(1): 284-287.

Address : Professor Para, Cuttack- 753 003, India.

Abstract : The paper embodies some of the un-published results of commercial fishing in the Wadge Bank located south of Cape Comarin between Long 77° and 78°. 10'. The area is approximately 4000 Sq. miles exposed to full force of both the SW and NE monsoons. The continental shelf off Cape Comorin has a gentle slope up to 100 Metres beyond which the depth sharply increases. Bottom is of coarse yellow sand overlying flat rock up to 60 m contour. Beyond this the bottom is firm clear sand with stretches of flat rock. There are rough patches of pinnacle rocks. Commercial large fishes consist mainly of rockfishes (47.8 to 65%) and carangids (2.4 to 11.9 %). Catch per hour of comparable trawlers of 450 to 650 HP has been estimated after adjusted effort.

1594. **Mittal, P.K.** 1976. Histochemical studies of lipids in the Vitellogenesis of the hermit crab *Clibanaris longitarsus*. *J. Mar. Biol. Assoc. India,* 18(2): 397-399.

Address : Department of Zoology, Punjab University, Chandigarh-160014, Punjab, India.

Abstract : The L_1 bodies containing phospholipids transform into L_2 bodies containing phospholipids and triglycerides, the L_2 bodies transform into L_1 bodies by a gradual attennuation of their medullae into triglyceride spheres. The mitochondria and compound yolk contain phospholipids.

1595. **Mittal, P.K.** 1981. Yolk nucleus during oogenesis in *Neptunus pelagicus* (Brachyura, Crustacea). *J. Mar. Biol. Assoc. India,* 23(1&2): 36-38.

Address : Department of Zoology, Punjab University, Chandigarh-160014, Punjab, India.

Abstract : The yolk nucleus of *Neptunus* consists of three concentric zones. It begins to divide in the circumnuclear region with its contents (proteins, nucleolar extrusions, mitochondria and phospholipids) spread over the ooplasm. Its indirect role in vitellogenesis has been discussed.

1596. **Mittal, P.K.** 1981. Cytochemical studies on nucleus and its extrusions in *Clibanarius longitarsus* (Anomura: Crustacea). *J. Mar. Biol. Assoc. India,* 23(1&2): 44-47.

Address : Department of Zoology, Punjab University, Chandigarh-160014, Punjab, India.

Abstract : Many nucleolar buds have been observed in the nucleus of the early oocytes of *Clibanarius.* Some of them are extruded in the cytoplasm through the nuclear membrane. They fragment into fine granules containing ribonucleoproteins. There is a decrease in pyroninophilia in the ooplasm with the advent of appearance of compound yolk. RNA present in nucleolar extrusions is utilised in protein yolk synthesis. Nucleolus and nucleolar extrusions contain proteins ($-NH_2$ and -SH groups; and tyrosine), RNA and lipoproteins.

1597. **MOEF.** 1983. Biosphere Reserves: Indian approach: India. *Man and Biosphere Committee,* Dept of Environment, Govt. of India, New Delhi, pp15 with XIX: 45 pp.

1598. **MOEF.** 1987. The Gulf of Mannar Biosphere Reserve. *Project Document,* No. 5. *Ministry of Environment and Forests, Govt. of India,* 105 pp.

Address : Ministry of Environment and Forest, New Delhi, India.

Abstract : For the sake of convenience, the entire neritic area of the Gulf of Mannar from Pamban Island to Kanyakumari is grouped into four regions. In each region, the core zone, the buffer zone and manipulation or utilization zone have been demarcated. Their locations and continuous areas are indicaed. The patterns of zonation of the proposed Biosphere Reserve will comprise within it all the islands or the Island arc. The fourth region running from Tuticorin to Kanyakumari will serve as an extensive utilization zone to meet the demands, needs and as a source of livelihood for the local fishermen. A phasing of the programme of action plan is given with time schedule.

1599. **MOEF.** 1994. Coral reef methodology. *Ministry of Environment and Forests (India) Project Report,* March 1994.

1600. **Mohamed, K.S., V. Kripa, T.S. Velayudhan and K.K. Appukkutan** 2006. Growth and biometric relationships of the pearl oyster, *Pinctada fucata* (Gould) on transplanting from the Gulf of Mannar to the Arabian Sea. *Aquacul. Res.,* 37: 725-741.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Comparative studies were made on the growth and biometric relationships of the pearl oyster *Pinctada fucata* (Gould) Tuticorin stock (Tuticorin (TST) parent stock) transplanted from the Tuticorin Bay (8.7°N; 78.2°E) in the Gulf of Mannar along the Indian southeast coast to Kollam Bay (8.8°N; 76.5°E) in the Arabian Sea along the Indian southwest coast (Tuticorin stock at Kollam (TSK) - transplanted stock). At the time of transplantation, Kollam Bay did not have a native stock, however, within a year, the transplanted stock spawned and oyster spats were collected from within the farm (Kollam stock (KS) - progeny stock). The growth in dorso-ventral measurement and total weight in Kollam Bay was 1.4-1.6 times and 3.1 to 6.8 times respectively greater than that observed at Tuticorin. Further more, at Kollam Bay the thickness observed at the end of first year was similar to that obtained at the end of second year in Tuticorin. Both the TSK and KS had significantly higher instantaneous growth rates (IGR) than TST. All the stocks displayed significantly different biometric relationships. The increased growth in Kollam Bay is attributed to the almost double productivity in the Arabian Sea compared with the Bay of Bengal. It is concluded that in the case of *P. fucata* the site and its interaction with environment are important determinants of growth and shell dimensions. The present study clearly indicates that the environmental conditions prevailing along the southeast Arabian Sea are congenial for the growth, gametogenesis, spawning and settlement of *P. fucata* larvae. In spite of strong monsoonal influences in the hydrology of Kollam Bay. The growth and reproduction of *P. fucata* stocks indicates its relative hardiness and ability to adapt to a changed environment.

1601. **Mohamed Kasim, H and M.J. George** 1968. Results of the tagging experiments on the Indian spiny lobster, *Panulirus homarus.* (Linnaus) L, movement and growth. *Indian J. Fish.,* 15(1&2): 15-26.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Mark-recovery experiments conducted with the help of suture tags on Indian spiny lobster *Panulirus hamarus* (Linn.) showed that their movement in the fishing ground is of a very restricted nature. Long migratory movements were not observed. The species grows very fast and attains commercial size by the end of first year after the puerulus stage settles down to the bottom of the fishing ground. The growth rate slows down after the second year. Sizes attained at successive ages have been estimated with the help of von Bertalanffy's growth equation. The commercial fishery is largely supported by 1st and 2nd year animals.

1602. **Mohamed Kasim, H., M.S. Muthu and M.R. Marichamy** 1980. Laboratory bred prawns from Narakkal cultured in saltpan reservoirs at Tuticorin. A success story. *Mar. Fish. Inf. Serv. T & E. Ser.,* 26: 3-5.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A detailed account is given of the production of prawn (*Penaeus indicus*) seed at the Narakkal Prawn Culture Laboratory. The successful rearing of the seed at Tuticorin in saltpan reservoir ponds is described.

1603. **Mohamed Kasim, H.** 1986. Effect of salinity, temperature and oxygen partial pressure on the respiratory metabolism of *Panulirus polyphagus* (Herbst). *Indian J. Fish.,* 33(1): 66-75.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The lethal oxygen levels, time to death, total oxygen consumed and the metabolic rates of *Panulirus polyphagus* (Herbst) are estimated at different salinities, temperatures and oxygen partial pressures after acclimating the lobsters to 17, 32, 39 and 50 ppt at ambient temperatures 22.5, 22.1, 28.1 and 20.1°C, respectively. The incipient lethal salinities are obtained graphically from lethal oxygen levels and time to death at different salinities. The metabolic rate is uniformly high within oxygen independent zone of higher pO_2 and in oxygen dependent zone it is curtailed drastically. Subsequently, the low oxygen partial pressure becomes lethal. As a means of compensation, the metabolic rate in this species decreases at extreme salinities and tends to increase at intermediary salinities. The influence of salinity acclimation and temperature on the metabolic rate is evident. It is suggested that factors other than salinity gradient may also be sought in order to explain the metabolic pattern of this species.

1604. **Mohamed Kasim, H.** 1988. Commercial fish trawling over pearl and chank beds in the Gulf of Mannar. A new dimension to problems in shell fisheries. *CMFRI Bulletin,* 42(1): 94-99.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Examination of the mechanised boat landings at Tuticorin during 1984-85 and 1985.86 of the sacred chank *Xancus pyrum* revealed that nearly 30.000 numbers of these shell have been landed on an average in a

year during these two years. The paper gives an analysis of the catches size range of the chanks landed areas fished and indicates the need for conservation policy to protect the natural beds from being disturbed.

1605. **Mohamed Kasim, H and K.M.S. Ameer Hamsa** 1988. Exploitation of seerfish resources in Gulf of Mannar. *CMFRI Spec. Publ.*, 40: 11-12.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : On an average 34,476 tonnes of seerfish were landed in India during 1982-1985. *Scomberomorus guttatus* constituted 50% of the total catch, *S. commerson* 49.1%, *S. lineolatus* 0.3% and *Acanthocybium solandri* 0.3%. The resource was exploited by both mechanised and non-mechanised fishing units, using gears such as drift gill nets, hooks and lines and trawl nets. On an average 421.4 tonnes of seerfish are being landed annually by all these gears along Tuticorin coast. The growth in length of the dominant species *S. commerson* and the natural, total and fishing mortality rates were estimated for this species with respect to different gears. The yield per recruitment for different combinations of age at first capture and fishing mortality rates for the prevailing M/K ratio are estimated and given in the form of yield isopleth for studying the exploitation rate and yield. The estimated optimum age of exploitation for this species is 3.88 years and the potential yield per recruit is 1749g.

1606. **Mohamed Kasim, H., K.M.S. Ameer Hamsa and P. Sam Bennet** 1988. Present status of perch fishery resources in India and prospects. *CMFRI Spec.Publ.,* 40: 35-36.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The perch resources and fisheries in India are discussed. On an average 27,184 t of perches were landed in India with fluctuation from 12,865 t in 1969 to 49,312 t in 1978. The gearwise and statewise perch production from 1982-83 to 1984-85 indicates that the mechanised units contributed 72.4% and non-mechanised units 27.6%. Among mechanised units, the trawlers have landed the major portion of the catch (68.4%). The statewise species composition of perch landings indicates that the threadfin breams formed more than 50% of the catch. Among threadfin breams, *Nemipterus japonicus*, and among pigface breams, *Lethrinus nebulosus* are the dominant species. The growth, mortality rates, optimum age of exploitation, potential yield per recruit and yield per recruitment at different combinations of age at first capture and fishing mortality coefficients of these species are examined.

1607. **Mohamed Kasim, H and K.M.S. Ameer Hamsa** 1989. On the fishery and population dynamics of seer fish *Scomberomorus commersoni* off Tuticorin (Gulf of Mannar). *CMFRI Bulletin*, 44(1): 46-53.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : On an average 34.476 t of Seer fish were landed in India during 1982-1985. *Scomberomorus guttatus* constituted 50% of the total catch, *S. commersoni* 49.1%, *S. lineolatus* 0.6% and *Acanthocybium solandri* 0.3%. In Gulf of Mannar seer fish are exploited by drift gill nets of different mesh sizes, hooks and lines, trawl nets and to a limited extent by shore-seines. On an average 421.4 t of seer fish are being landed annually by all these gears along Tuticorin coast. The drift gill net *paruvalai* landed on an average 156.7 t at the catch rate of 46.5 kg per unit. Hooks and lines landed annually 141.2 t at the catch rate of 14.6 kg per unit and trawl nets 113.4 t at the catch rate of 3.04 kg per unit. The smaller mesh sized drift gill net *podivalai* landed on an average 10 t annually at the catch rate of 8.65 kg per unit. The fishery of seer fish in Tuticorin is supported by *Scomberomorus commersoni* (91 %), *S. lineolatus* (6.9%) and *S. guttatus* (2.1%). The growth in length of *S. commersoni* estimated from length frequency studies can be expressed by the Von Bertalanffy growth formula (V8GF). Lt = 1938 (1- e .0.2006 (t + 0.0835). The growth in weight may be expressed as Wt = 32002 (1 - e .0 2214 (t + 0.1237)) 3. The natural total and fishing mortality rates have been estimated with respect to different gears. The yield per recruitment for different combinations of age at first capture and fishing mortality rates for the prevailing M/K ratio is estimated and given in the form of yield isopleth. The estimated optimum age of exploitation is 3.88 years and the potential yield per recruit is 1,749 g. The highly selective gears like the drift gill net, *paruvalai* and hooks and lines have been observed to exploit seer fish resource very effectively and more number of larger individuals have been caught. Therefere exploitation by *paruvalai* with still larger mesh size and hooks and lines may be encouraged for enhancing the production of this resource.

1608. **Mohamed Kasim, H and T.S. Balasubramanian** 1989. On the stranding of sei whale, *Balanenoptera borealis* along Gulf of Mannar coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 95: 12-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The details of morphometric measurements of a sei whale *Balanenoptera borealis* stranded off Kayalpattinam on 18th May 1988 is given.

1609. **Mohamed Kasim, H., K.M.S. Ameer Hamsa and P. Sam Bennet** 1989. Present status of Perch fishery resources in India and its prospects. *CMFRI Bulletin*, 44(1): 226-237.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The perch resources and fisheries in India have been dealt with. As seen from the Statewise perch production during 1969-1981, on an average 27,184 tonnes of perches were landed in India with fluctuation from 12,865 in 1969 to 49,312 in 1978. The gearwise and Statewise perch production from 1982-83 to 1984-85 indicates that the mechanised units contributed 72.4 % and non-mechanised 27.6%. Among mechanised units, the trawlers have landed the major portion of the catch (684%). The Statewise species composition of perch landings indicate that the threadfin breams formed more than 50% of the catch. During 1982-83 and 1983-84 the perch production of Tamil Nadu was higher than all other states whereas during 1984-85. Kerala was the first in perch production followed by Andhrapradesh and Tamil Nadu. The different groups of perches landed by trawl and gill net units at different important landing centres on the east and west coast of India show that in all the centres the catch rates of trawlers were higher. The higher catch rate in trawl net operations in Seasons in Dock and New ferry Wharf was due to voyage fishing for more than a day. Among threadfin breams, *Nemipterus japonicus* and among pig-face breams *Lethrinus nebulosus* are the dominant species. The growth, mortality rates, Optimum age of exploitation, potential yield per recruit and yield per recruitment, different combinations of age at first capture and fishing mortality coefficients of these species have been dealt with in detail. The prospects of the perch fishery by commercial trawlers and the possible increase in production by the introduction of pair trawling with high opening trawl net in Gulf of Mannar is discussed.

1610. **Mohamed Kasim, H and T.S. Balasubramanian** 1990. Fishery, growth, yield per recruit and stock assessment of *Sphyraena obtusata* Cuvier off Tuticorin, Gulf of Mannar. *Indian J. Fish.*, 37(4): 281-288.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Annual average catch of 612.2 t of barracudas were landed at the catch rate of 17.1 kg/unit which constituted 3.9% in the total catch landed by trawlers during 1987-89 at Tuticorin. Higher effort input during certain months did not coincide with better abundance of barracudas. *Sphyraena obtusata* Cuvier constituted on an average 69.6% of the total catch of barracudas. The natural mortality coefficient (M) is 1.591, the average annual total mortality coefficient (Z) is 2.8317 and the average exploitation rate (U) is 0.4123. The average standing stock is estimated to be 343.2 t and average annual stock 1,032.7 t. Yield per recruit studies indicate that *S. obtusata* is not exposed to higher fishing pressure.

1611. **Mohamed Kasim, H., T.S. Balasubramanian, S. Rajapackiam and V.S. Rengasamy** 1991. Fish mortality due to pollution by industrial effluents in inshore waters of Kayalpattinam. *Mar. Fish. Infor. Serv. T & E. Ser.*, 113: 26-28.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The percentage composition and size range of different marine organism which suffered mortality on 02-11-89 along the Kayalpattinam coast are given.

1612. **Mohamed Kasim, H., K.M.S. Ameer Hamsa and T.S. Balasubramanian** 1993. On an accidental landing of false killer whale *Pseudorca crassidens* by drift gillnet of Veerapandianpattinam, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 120: 18-19.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements (in cm) of the false killer whale, *Pseudorca crassidens* and the previous stranding, sighting and capture of this species from the Indian seas are discussed.

1613. **Mohamed Kasim, H and K.M.S. Ameer Hamsa** 1994. Carangid fishery and yield per recruit analysis of *Caranx carangus* (Bloch) and *Caranx leptolepis* Cuvier and Valencinnes from Tuticorin waters. *J. Mar. Biol. Assoc. India*, 36(1&2): 63-71.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : An estimated annual average catch of 205.8 t of carangids was landed during 1981-83 by traditional fishing units. The gearwise catch composition of carangid was observed. Depthwise variation in the abundance of carangids was observed from the catch rates of these traditional gears. During 1984-87, an estimated annual average catch of 12,563 t of carangids were landed in which the trawl net units landed 1184.8 t and drift gill net units 71.5 t. Though the abundance of carangids varied from year to year, in general, it appears there is one

pronounced abundance during July to November and another less pronounced during January to April. The annual average species composition of trawl net landings was also studied. Based on the catch in number, effort and length frequency data, the estimated growth parameters of *Caranx leptolepis* are $L_{(inf)}$, 213 mm, K 1.4283 and $10^{-0.9151}$ and of *C. carangus* are La, 498 mm, K 0.7689 and to -0.0455. Estimated growth in weight of these species could be obtained from the length weight relationship given. The natural mortality coefficient MCJ is estimated to be 2.19 for *C. leptolepis* and 1.18 for *C. carangus* from the life span T_{max} of these species. The total mortality coefficient Z varied from 4.33 in 1986-87 to 8.33 in 1984-85 for C. *leptolepis* with an average of 6.10 in trawl net. For *C. carangus*, the Z varied from 4.48 in 1985-86 to 9.69 in 1984-85 with an average of 6.54 in trawl net and in drift gill net it was 2.80 in 1986-87 to 4.77 in 1985-86 with an average of 3.92.

1614. **Mohamed Kasim, H., K.M.S. Ameer Hamsa, P. Sam Bennet, S. Rajapackiam, G. Arumugam** 1994. Exploitation of perch fishery resource off Tuticorin by small mechanised trawlers with an account of the biology of *Scolopsis bimaculatus* Ruppell. *CMFRI Bulletin*, 47: 106-111.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Annual average perch production was 2,541.2 tons at the catch rate of 88.8 kg/unit by average effort of 28612 units of small mechanised trawlers measuring 14 m and below. Peak periods of perch fishery were during June-September and a minor peak during December-February. Inspite of the comparative decline in the catch rate of perch, there is a scope for further increase in perch production provided that effort is increased. The age and growth of *Scolopsis bimaculatus* is described by the Von Bertalanffy growth equation *i.e.* $1_t = 322\ (1\text{-}e^{-14146\ (t+0.0018)})$. This species attains a size of 163.6, 243.9, 283.5 and 303.0 mm in 0.5, 1.0, 1.5 and 2.0 years. Length-weight relationship of this species is defined by the equation Log W = 5.6848 + 3.3699 Log L and the W alpha is 584 g. The natural mortality coefficient (M) is estimated to be 2.2, the total mortality coefficient (Z) is 3.2 and the fishing mortality rate (F) is 1.0. Yield per recruit of this species indicates that for the prevailing M/K ratio 1.56 and age at first capture 0.4353 the F_{max} which can produce the Y_{max} of 52.3 g is 4.5 and suggests that the fishing effort may be increased further from the present level to enhance the yield of this species as in the case of *L. nebulosus* and *N. delagoae*. The fish is a carnivore feeding on fishes, amphipods, Squila spp., brittle stars, prawns, cuttlefish, polychaetes and molluscs.

1615. **Mohamed Kasim, H., R. Marichamy, T.S. Balasubramanian, K.M.S. Ameer Hamsa and S. Rajapackiam** 1994. On an accidental stranding, rescue and return of Hump-back dolphins at Tuticorin Harbour area. *Mar. Fish. Infor. Serv. T & E. Ser.*, 128: 14-15.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : On 11th July 1993, a group of eight dolphins accidentally got stranded in the shallow water area on the outer northern side breakwater near red gate of the Tuticorin major harbour. The rescue and return of these dolphins were discussed in this paper.

1616. **Mohamed Kasim, H., K.M.S. Ameer Hamsa and T.S. Balasubramanian** 1996. Fishery of full beaks and half beaks with special reference on the growth, mortality and stock assessement of *Ablennes hians* (Valenciennes) along the Tuticorin coast, Gulf of Mannar. *Indian J. Fish.*, 43(1): 51-59.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Belonids and hemiramphids commonly known as full and half beaks support a good fishery in Tamil Nadu and on an average 42.6% of this resource in India is landed in Tamil Nadu. They are exclusively exploited by a particular type of drift gill net. The craft, gear and fishing method are dealt with and the catch statistics along with species composition and their abundance are also dealt with in detail. Four species of full beaks namely, *Ablennes hians, Tylosurus crocodilus crocodilus, Strongilurus leiura* and *S. appendiculatus* and two species of half beaks namely *Hemirhamphus far* and *H. georgii* have been observed to support the fishery. The growth parameters of *A. hians* are L = 1,233 mm, K = 0.6052 and t = -0.1178 yr. Based on the length-weight relationship the $W_{(inf)}$ is estimated to be 3,768 g. The age at first capture is 0.9825 yr and the age at recruitment is 0.6183 yr. The total mortality rate is estimated to be 3.87, 3.23 and 3.40 during 1990-91, 91-92 & 92-93 respectively and the natural mortality rate is estimated to be 0.81. The fishing mortality rate for the above period is estimated as 3.065, 2.43 and 2.51 respectively. The exploitation rates estimated for the same period are 0.78, 0.72 and 0.74 which indicate that this species is exposed to a moderately higher fishing pressure by the drift gillnet. Based on the cohort analysis average annual stock of *A. hians* is estimated to be 236.5t and the average standing stock is estimated to be 12.4 t along the Tuticorin coast. For Tamil Nadu the average annual stock of *A. hians* is estimated to be 3,469 t and the average standing stock is 182 t. For a judicious exploitation of this species either a reduction

in the effort or an increase in the mesh size of the gear is suggested. Reduction in the effort may not be feasible. Since the aim of the gear is to exploit the full and half beaks the mesh size may be increased.

1617. **Mohamed Kasim, H., R. Marichamy, S. Rajapackiam and T.S. Balasubramanian** 1998. Rare squid, *Thysanoteuthis rhombus* Troschei, from the Gulf of Mannar, India. *J. Mar. Biol. Assoc. India*, 39: 182-185.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The occurrence of a rare oceanic squid, *Thysanoteuthis rhombus*, off Veerapandianpattinam in Gulf of Mannar on the east coast of India is reported.

1618. **Mohamed Kasim, H., K.M.S. Ameer Hamsa and S. Rajapackiam.** 1999. Age, Growth, Mortality, Yield per recruit and stock assessment of *Carcharhinus sorrah* (Valenciennes, Muller and Henle). *Proc. of the 4th Indian Fish. Forum*, dated 24th to 28th Nov'1996. pp. 381-384.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Drift gillnets landed on an average 117.8 t of sharks forming 6.9% of the total catch by drift gillnets and the peak period of abundance is during June-August. *Laxodon macrorhinus* constituted 36.5% followed by *Carcharhinus sorrah* (26.1%), *Scoliodon laticadudus* (15.8%), *Rhizoprionodon acutus* (10.3%), *Sphyrna zygaena*, (1.8%), *Chiloscyllium griseum*, (1.6%), other *Carcharhinus* spp (2.7%) and other sharks (5.1 %). The $L_{(inf)}$, K and the dominant species *Carcharhinus sorrah* have been estimated to be 1459 mm, 0.3993 (annual basis) and 0.0740 yr for males and 1658 mm, 0.3309 (annual basis) and -0.0901 yr for females respectively. The total mortality rate (Z) is estimated to be 3.35 and 2.82 during 1991- 92 and 1992-93 respectively for males and 5.82 and 4.01 for females respectively. The natural mortality rate (M) is estimated to be 0.63 for males and 0.54 for females. The exploitation rate indicates that females are exposed more severely due to higher fishing pressure than the males.

1619. **Mohan, P.M and G. Victor Rajamanickam** 2001. A need for rethinking in the application of mineral assemblages to provenance. *Hand Book of Placer Mineral Deposits*. Delhi India New Academic Publ., pp. 321-327.

Address : Department of Earth Sciences, Tamil University Thanjavur, Tamil Nadu, India.

Abstract : In the case of the present day beach or river, where active sedimentation is going on and day to day the nature and supply of sediments are changing, the concept applied to paleo sediments is not found useful to derive the provenance. While, taking Tamil Nadu beaches and rivers as a type case, one finds a distribution of 92 different kinds of minerals so far recognised from the different catchment zones. But, from the existing results brought out from the beach and rivers, only 30 minerals could be recognised. It is rather difficult to ascribe the loss of rest of the 60 minerals to the cause of erosion, leaching and other means of destruction. Effort has not been made sufficiently to locate those 60 minerals and the processes leading to loss of those minerals. When one considers those 30 minerals, it is perplexing to locate these minerals in the areas where they do not find a place in the hinterland. For example, glaucophane, the predominant mineral in the Mandapam to Kanyakumari beaches. It does not find a place in the hinterland where only gneisses and granulitic rocks are prevalent. Similarly, in the case of mineral assemblage of either a river or beach, one finds a drastic change in the nature of mineral segregation. In the Vellar River where there is no topaz and epidote, they are found in the respective Parangipettai beach that too, appreciably. Moreover, when the size and shape of the grains examined for zircon, kyanite, garnet, etc., the roundness index and the angularity ratio do not match with the sands in the downstream and beach. The overgrowth and outgrowth available in zircon do not permit to attribute the hinterlands for the provenance. In view of such irregularities noticed in the distribution of minerals in the beaches and rivers, the sedimentalogist who is studying the provenance has to necessarily account the causes of such contradictory distribution. It may be attributable to the role of coastal and fluvial dynamics on the recent sediments. A better look on the role of these aspects with recent sediments and the relation of those sediments with different catchment zones in detail may help to revise the interpretation taken on the ancient deposits of any region.

1620. **Mohan, P.M and G. Victor Rajamanickam** 2001. Indian Beach Placers - A review. *Hand book of Placer Mineral Deposits.* (ed.) G. Victor Rajamanickam. Delhi India New Academic Publ. pp. 23-52.

Address : Department of Earth Sciences, Tamil University Thanjavur, Tamil Nadu, India.

Abstract : An evaluation of the present status of Indian beach placers is categorised and reviewed under (1) status of exploration, (2) placer forming processes, (3) provenance and (4) in the others heading such as techniques, resource management, conservation and preservation, environment, mining, etc. are discussed. Of these, the first and third categories of status of exploration and provenance, respectively have been sub divided into two

divisions namely, west coast and east coast. In the west coast, the published data are grouped from Gujarat to Kerala through Maharashtra, Goa and Karnataka. Further, west coast of Tamil Nadu i.e., up to Kanyakumari also included in this section Likewise, in the east coast the published data comprised from Tamil Nadu to West Bengal through Andhra Pradesh and Orissa. Based on published works, it has been estimated that out of the total length of 6800 km of Indian coastal tract, the exploration has been carried out only to a length of 2,642.288 km. In that stretch, the probable estimated or indicated reserves of placer minerals (ilmenite, rutile, zircon, monazite, sillimanite, and garnet) amount to 339.9235 MT. Within the explored coastal tract, the Ratnagiri coast in Maharashtra, the Quilon coast of Kerala, the Kanyakumari - Tuticorin coast of Tamil Nadu and the Gopalpur coast of Orissa have been fairly well studied and also partially under exploration. Out of 158 articles of published data, 128 articles are published in the form of research articles or book. 12 articles are found in the line of abstracts and 18 numbers are in the shape of unpublished thesis and reports. Further, this review has led to identification of new thrust areas and also the types of research and developmental work that are needed on placer deposits/resources.

1621. **Mohan, V.R., V. Kumar, R. Murugeswari and S. Muthusamy** 1994. Effect of crude and commercial seaweed extracts on seed germination and seedling growth in *Cajanus cajan* L. *Phykos,* 33(1&2): 47-51.

Address : P.G. Deparment of Botany, V.O. Chidambaram College, Tuticorin- 628008, Tamilnadu, India.

Abstract : One of the well documented beneficial effects of seaweed extracts is that it enhances seed germination and plant growth. The effect of crude extracts from three brown seaweeds Padina, Sargassum, Turbinaria and their mixture; two red seaweeds Champia, Helminthocladia and their mixture and two commercial seaweed extracts (SM3 and Algifert) on the germination and seedling growth of *Cajanus cajan* L. was studied. The extracts from Sargassum and Champia showed maximum activity at 0.75%. Rest of the crude seaweed extracts, their mixture and SM3 produced maximum activity at 1.00% concentration. Algifert showed peak activity at 0.10% concentration.

1622. **Mohanachandran, G and V. Subramanian** 1990. Texture, mineralogy and elemental composition of sediments along the southeast coast of India. *Indian J. Mar. Sci., 19*: 128-132.

1623. **Mohan Joseph, M.** 1972. Tidal rhythm in the feeding activity of the intertidal amphipod *Hyale hawaiensis* (Dana) *Proc. Ind. Natl. Sci. Acad.,* 38B: 456-461.

1624. **Mohan Joseph, M and V. Krishnamurthy** 1977. Studies on the shedding of carpospores in *Gracilaria corticata*. *Seaweed Res. Utiln.,* 2(1&2): 1-8.

Address : Central Salt and Marine Chemicals Research Institute, Mandapam Camp-623 520, Tamilnadu, India.

Abstract : The nature of carpospore output in *Gracilaria corticata* was studied in the laboratory. Observations on daily shedding of carpospores showed that there was a pattern of shedding with peaks at intervals of 4-5 days. Cystocarpic plants show a gradual increase in sporulation during August-November which peaks in November and drops in December. By January, the whole population disappears from the intertidal region.

1625. **Mohan Joseph, M and K. Rama Rao** 1977. On the morphology of *Bostrychia tenella* (Vahl) J. Agardh. *Seaweed Res. Utiln.,* 2(1&2)): 30-36.

Address : Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Boergesen (1937) reported *Bostrychia tenella* (Vahl.) J. Ag. from Indian waters. Some details regarding the morphology of the alga are available to some extent by the works of Montagne (1828), Falkenberg (1901), Post (1936), Tseng (1942) and Joly (1954). The detailed structure of the alga and the development of the reproductive structures are not known completely. Advantage was taken of the occurrence of *Bosirychia ienella* in the Gulf of Mannar at Mandapam to study the morphology of the species both from living specimens and from material fixed in 4% formalin and formalin-acetic-alcohol. Suitable preparations were stained in eosine and mounted in glycerine for microscopic examination. Sometimes the material had to be softened by placing in 1% acetic acid or 1% lithium chloride solution. While thin sections were used frequently, most details could be observed on whole mounts and squashes of suitable pieces of the thallus of the alga.

1626. **Mohan Joseph, M.** 1978. Ecological studies on the fauna associated with economic seaweeds of South India-1. Species composition, feeding habits and interrelationships. *Seaweed Res. Utiln.,* 3(1&2): 9-25.

1627. **Mohan Joseph, M.** 1978. Ecological studies on the fauna associated with economic seaweeds of South India-2. Distribution in space and time. *Seaweed Res. Utiln.,* 3(1&2): 26-27.

1628. **Mohan Joseph, M.** 1978. Ecological studies on the fauna associated with economic seaweeds of South India-3. Food preferences of selected algivorous gastropods. *Seaweed Res. Utiln.,* 3(1&2): 38-46.

1629. **Mohan Joseph, M and V. Kripa** 2001. Status of marine pearl culture in India. *Fish. Chimes,* 21(4): 13-19.

1630. **Mohanraj, G., A. Raju, V. Gandhi and V.S. Rengaswamy** 1983. Fish culture in marine farm at Mandapam. *Mar. Fish. Inf. Serv. T & E. Ser.,* 48: 1-8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The feasibility of marine fish culture along the coastal areas of Ramanathapuram District is discussed, considering monoculture of milkfish (*Chanos chanos*) and also polyculture with mullet.

1631. **Moses, J.S and C. Balachandran** 1986. A study on the microbial ecology of certain water sources of Kanyakumari District. *Natl. Sem. on Microbial Ecol. Jan, 23-24, 1986.* p. 51.

Address : Department of Microbiology and Biochemistry, Madras Veterinary College, Madras-600 007, India.

Abstract : A study on the microbial ecology with reference to the presence of Rhinosporidial spores in water sources has been conducted in Kanyakumari District.

1632. **Moses, S.T.** 1924. Crab Folklore. *Man in India,* IV(1&2): 165-173.

1633. **Moses, S.T.** 1924. The anatomy of chank (*Turbinella phyrum*). *Madras Fish. Bull.,* 17: 105-127.

Address : Madras Fisheries Department, India.

Abstract : The Sacred Chank (*Turbinella pyrum* Linn) is a large marine gastropod mollusc extremely abundant in our waters on the east coast being found in large numbers in the Gulf of Mannar, Palk Bay and hence northwards along the shore-line of the Madras Presidency as far as Nellore district. It is found also in smaller numbers off the coast of Travancore, and on the north-west shores of Kathiawar. A well-marked variety also occurs in the Andaman Islands. The distribution and variation of this species is dealt with in full in a paper by Mr. James Hornell published in the memoires of the Indian museum.

1634. **Moses, S.T.** 1929. The Valayans of Pamban. *Man in India,* 9: 149-156.

Address : Madras Fisheries Department, India.

Abstract : Information obtained in the course of an enquiry into the socioeconomic condition of the fishing classes of the Ramnad district viz Karayans, Kadayans (or Sunnambukars), Jonagars, Valayans, and Idayans, indicates that the Valayans described in Thurston's monumental work on 'The Castes and Tribes of South India' include apparently different communities living in the adjoining districts of Trichinopoly, Tanjore, Madura and Ramnad. The members of the community described in this paper deny all connection with the Valayans of the interior.

1635. **Moses, S.T.** 1947. Stranding of whales on the coast of India. *J. Bomb. Nat. Hist. Soc.,* 47(2): 377-378.

Address : Fisheries Department, Baroda, India.

Abstract : This paper provides the collected data on whales in Indian waters, including the stranding data of a whale on the coast of Pamban, Gulf of Mannar.

1636. **MPEDA.** 1977. Fisheries Research. *Indian Fisheries,* MPEDA, 1947-77: 7-34.

1637. **MPEDA.** 1977. Exploited and Potential fishery resources. *Indian Fisheries,* MPEDA, 1947-77: 38-41.

1638. **MPEDA.** 1977. Fisheries Technology, *Indian Fisheries,* MPEDA, 1947-77: 42-47.

1639. **MPEDA.** 1977. Fisheries education and training. *Indian Fisheries,* MPEDA, 1947-77: 48-53.

1640. **MPEDA.** 1977. Fisheries development. *Indian Fisheries,* MPEDA, 1947-77 : 54-68.

1641. **MSSRF.** 1998. Biodiversity of Gulf of Mannar Marine Biosphere Reserve. *Proc. Tech. Workshop*, Chennai, February 10-11. M.S.S.R.F. publn., p. 185.

Address : M.S. Swaminathan Research Foundation, 3rd cross street, Institutional Area, Taramani, Chennai - 600 113, Tamilnadu, India.

Abstract : The Gulf of Mannar Biosphere Reserve was one of the six areas chosen on the basis of the seriousness and diversity of threats, on the one hand and the richness of biological wealth on the other. In order to intensify collaborative work on saving the endangered "protected" areas, MSSRF organised a workshop in Madras on December 18 and 19, 1993. Representatives of voluntary organisations, scientists, forestry experts, lawyers and media representatives attended this workshop. They decided to constitute a National Biodiversity Alliance to launch a concerted and integrated study of the factors responsible for damage to the National Parks and to identify the steps needed to preserve them. Based on the discussions, it was decided to initiate a Conservation Action 1994 programme for undertaking studies in six biodiversity-rich "protected" areas.

1642. **MSSRF.** 2000. Promoting alternative options for livelihood security in the Gulf of Mannar region. pp. 39-40. *X Annual report 1999-2000.* M.S. Swaminathan Research Foundation, Chennai, India, 193 pp.

Address : Centre for Research on Sustainable Agricultural and Rural Development, Chennai, India.

Abstract : The Foundation proposed a plan for strengthening the management of the Gulf of Mannar Marine Biosphere Reserve, which was approved by the Global Environment Facility (GEF) in May 1999. This plan will be implemented by the Gulf of Mannar Biosphere Reserve Trust, which is promoted by the Government of Tamil Nadu as a multi-stakeholder body. A key component of the project involves development and demonstration of new livelihood options for families residing in the vicinity of the Reserve so that the biological resources can be sustainably managed. The Ministry of Rural Development (MORD) of the Government of India, and the United Nations Development Program (UNDP) have approved a proposal specifically in relation to generating viable new options for sustainable livelihood security for implementation during the next three years. The proposal has two components: (a) technology demonstration and access and (b) provision of micro credit and establishment of community banking with strong links to technology utilisation to improve options for sustainable livelihood security. The Foundation is the lead agency for the livelihood security project, and has invited the DHAN Foundation, known for its pioneering and extensive work in micro credit, to be the partner in implementing the project. The plan, approved by the MORD and UNDP in June this year, has been drawn up jointly by the two organizations namely, MSSRF and DHAN Foundation.

1643. **MSSRF.** 2003. Biosphere Reserves- Basics. *Report submitted to UNESCO.* 11 pp.

Address : M.S. Swaminathan Research Foundation, Field Centre, Mandapam - 623 519, Tamilnadu, India.

Abstract : Monitoring Gulf of Mannar Marine Biosphere Reserve plays a key role in the management process regardless of the objective that sets the focus for the process. Unfortunately, this role is not widely recognised. In some documents detailing management plans, monitoring is linked with research under an objective that is separated from management objectives like conservation, sustainable use and education. This separation equates to dismembering the management process. As a result, the success of management strategies cannot be evaluated. In addition, there will be a lack of progress toward a successful management paradigm due to a dearth of comparable performance measures for different approaches.

1644. **MSSRF.** 2003. Cost benefit analysis of artificial reefs. *Report submitted to UNESCO.*

Address : M.S. Swaminathan Research Foundation, Field Centre, Mandapam - 623 519, Tamilnadu, India.

Abstract : The circumstances under which the construction of artificial reefs for lobster production might be deemed to be socially worthwhile as a public sector investment have been examined in detail, the results suggesting that these circumstances are both realistic and attainable. Though both project options (manufactured blocks and quarry rock) are subject to risk, it has been shown that it is possible to quantify these risks so long as information on the probability distribution of parameter values can be obtained. It must be emphasised that in order for the economic benefits of an artificial reef to be maximised, property rights or harvesting rights would need to be clearly defined. At the present time in the UK there is no legal basis on which to establish exclusive rights to lobsters, and changes to the Sea Fisheries (Shellfish) Act 1967 would be required. Under this Act a several fishery for particular species of bivalve molluscs (oysters, mussels, cockles, clams, scallops and queens) can be established, giving holders exclusive rights of depositing, propagating and harvesting; as such they offer holders the necessary means to reap the rewards of their enhancement and management initiatives. Lobsters do not fall within these provisions. Unless the law can be modified to include lobsters, however, any resource rent which

the reef might generate is likely to be dissipated. In these circumstances funding of a reef project would in all probability fail to earn an adequate return.

1645. **MSSRF.** 2003. Manual on Agar production. *Report submitted to UNESCO.* 25 pp.

Address : M.S. Swaminathan Research Foundation, Field Centre, Mandapam - 623 519, Tamilnadu, India.

Abstract : Agar is a colloidal substance extracted from certain species of seaweed belonging to a group called red seaweeds. Agar is insoluble in cold water but soluble in boiling water. It forms a firm gel when it is cooled to 34-43°C and melts again above 85°C. Due to this unique property agar is widely used in food and pharmaceutical industries as well as in biochemical laboratories. In food industries, it is used in the preparation of jelly, ice cream, bread, cake, soft candy and used as a coagulator, thickening agent, emulsifier, anti-staling agent and stabilizer in the preparation of a number of food items. In the pharmaceutical industries, it is used to prepare capsules, laxatives and as antirheumatic agents. Bacteriological grade agar is used in the preparation of bacteriological and tissue culture media. In the biochemical industries, purified agar called agarose is used in immunodiffusion, electrophoresis including reverse electrophoresis, immunoelectrophoresis and electrofocusing as well as in all kinds of chromatography. Because of widespread use in the above industries, demand for agar is increasing every year and thus, agar production can be considered as an important economic activity. Previously agar was produced in the cottage industry because of lack of technique for largescale extraction. Now techniques for extracting agar in industrial scale have been developed and standardized. Though cottage scale agar-production is labour intensive, it is not highly profitable due to low quality and quantity produced. Agar production in medium or smallscale industrial level is highly profitable.

1646. **MSSRF.** 2003. Sea ranching. *Report submitted to UNESCO.*

Address : M.S. Swaminathan Research Foundation, Field Centre, Mandapam - 623 519, Tamilnadu, India.

Abstract : Sea ranching, in order to be responsible and effective, has to involve more than just releasing large numbers of fish into the sea. Ecological, biological, and genetic considerations must be taken into account. In order to increase survival in the wild, artificial habitats have been created, coastal areas have been improved, and predators have been removed in certain enhancement programmes. Released fish have been conditioned to imprint on feeding cues in a given area to improve growth rate, limit dispersal and facilitate recapture. The size or age at which fish are released has been studied to increase the number of fish, which are later recaptured, and to improve return on investment. The site and timing of release have been shown to be extremely important. Management of the genetic resources of the hatchery stock is being applied to conserve genetic diversity, and to choose appropriate genetic stocks for ranching.

1647. **MSSRF.** 2003. Pearl culture. *Report submitted to UNESCO.* 10 pp.

Address : M.S. Swaminathan Research Foundation, Field Centre, Mandapam - 623 519, Tamilnadu, India.

Abstract : Natural pearls were the oldest gems known to mankind. The natural pearls of the Gulf of Mannar and the Persian Gulf enjoyed very good reputation in the world trade from time immemorial. The Gulf of Mannar pearls are famous throughout the world as 'Orient Pearls'. Man has wondered how the oyster produces the pearl and many imaginative minds propounded many interesting theories. Some believed that pearl was formed when a raindrop or a droop of dew fell into the shell when it came to the surface. The truth behind this mystery was unraveled in 1907 when a Japanese scientist Tokichi Nishikawa gave a plausible explanation "the pearl sac theory" for pearl production. According to him, the pearl secreting cells of the mantle migrate into the body of the oyster under the stimulus of a foreign body any by a series of cell division form a pearl- sac around the foreign body. The pearl sac in turn secretes the nacre which becomes deposited over the body, forming a "natural pearl" in course of time. Natural pearls are rare in occurrence small in size and generally irregular shape. The 'cultured pearl' is produced by human interference by inserting a shell bead 'nucleus' and a mantle piece into the gonad of the oyster and growing the oyster in the sea. 'Artificial pearls' are those made of plastics, glass etc. They are painted with pearl essence, which is a mixture of enamel and silvery extract of fish scales.

1648. **Mukherjee, D., P. Chandrasekaran, G. Subramanian, V. Ananth and K. Balakrishnan** 1990. Some studies on the corrosion and biofouling behaviour of a H.S.L.A. steel at Palk-Bay, Mandapam. *Tool Alloy Steels.* pp. 394-401.

Address : Central Eelectro Chemical Research Institute, Karaikudi - 623006, Tamil Nadu, India.

Abstract : Biofouling studies, on a creep resisting HSLA steel, was conducted at Palk-Bay of Mandapam Coast for a period of one year. The corrosion rate weight loss and open circuit potential with respect to SCE were

monitored to assess the corrosion and biofouling characteristics of the alloy. Data on water chemistry and accumulation of biomass on HSLA plates have been collected. Corrosion products were analysed for the presence of iron sulfide and chloride, along with enumeration of SRB by MPN method.

1649. **Mukhopadhey, S.K.** 1988. On some holothurians from the Gulf of Mannar. *Rec. Zool. Surv. India.* 85(1):1-17.

1650. **Mukundan, C.** 1987. General features of the cat fish fisheries. *CMFRI Bulletin*, 40: 1-5.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Catfishes had formed significant seasonal fisheries along the west and east coasts of the country since the early artisanal days, but had been viewed as anything more than of local importance. The traditional gears were mostly aimed at pelagic fisheries and caught demersal species by the way when they fished in shallower coastal areas and the gear took in the bottom layers also. So the ground fish contribution to the country's total marine fish landings was small. Thus, in the earlier years of our concern with the assessment and development of marine fisheries, the sardine and mackerel fisheries easily caught the attention as national fisheries, and the prawn fisheries rapidly turned into an export oriented industry and assumed tremendous importance as a foreign exchange earner.

1651. **Muley, E.V., K. Venkataraman, J.R.B. Alfred and M.V.M. Wafar** 2002. Status of coral reefs of India. *Proc. Ninth International Coral Reef Symposium*, Bali,23-27 October 2000, Volume 2.pp.847-853.

Address : Ministry of Environment and Forests, CGO Complex, Lodi Road, New Delhi, 110003, India; E-mail: muley@vsnl.com

Abstract : The major reef formations in India are restricted to the Gulf of Mannar, Gulf of Kachchh, Andaman and Nicobar and Lakshadweep Islands. Scattered coral growth has also been reported along certain inter-tidal belts and submerged banks both on the east and west coasts of the country. The reefs at present are important to the local community only to the extent of sustenance fishing. Tourism is being developed at some places though local communities do not benefit much from the revenue generated. The health of corals, as deduced from the literature records since 60s has been on steady decline mainly due to stress from anthropogenic pressures and interference. The reef condition is generally poor and declining in near shore waters and areas of high population density. Sedimentation, dredging and coral mining are damaging near shore reefs, while the use of explosives and bottom nets in fishing are damaging off shore reefs in specific sites. The bleaching event of 1998 has been reported to have increased dead coral cover to about 70% in the Gulf of Kachchh, 40-60% in the Gulf of Mannar, 60-80% in Lakshadweep and about 80% (subsequent studies do not confirm this report) in Andaman and Nicobar Islands. Quantitative data and studies on monitoring health of coral reef are inadequate. However, post-bleaching surveys in Lakshadweep and Gulf of Mannar have shown slow recovery of some of the coral species. Impacts of bleaching on other reef organisms and reef fisheries have not been evaluated. Taking in to consideration ecological and economic significance of coral reefs and the threat perceptions, Government of India has initiated measures for their intensive conservation and management. Present paper deals with ecological status of coral reefs in the country and various national and international initiatives as well as current efforts of Government of India along with gaps and future directions for their conservation and management.

1652. **Munuswamy, N.** 1988. Studies on the structural properties of the egg shell of the brine shrimp *Artemia salina* (L., 1758) (Branchiopoda, Anostraca). *Crustaceana*, 54(1): 39-42.

Address : Invertebrate Reproduction Unit, Department of Zoology, University of Madras, Guindy Campus, Madras - 600025, Tamilnadu, India.

Abstract : The brine shrimp *Artemia salina* has unusual physiological features. Their cysts (shelled eggs) are capable of withstanding long periods of desiccation, during which time the embryo may enter a state of cryptobiosis. Artemia cysts collected from Tuticorin, South India, showed poor hatchability. This strain produces both thin- and thick-shelled eggs. In general, the thin-shelled eggs hatch within a few days and are released ovo-viviparously while thick-shelled eggs stop development at the gastrula stage and are released as cysts. The present study describes the fine surface topography as well as functional aspects of the tertiary envelope (egg shell) of the *Artemia* cysts.

1653. **Muralidhar, P., N. Krishna, M.M. Kumar and D.V. Rao** 2005. Chemical constituents of the marine sponge *Echinodictyum gorgonoides*. *Proc. Andhra Pradesh Akad. Sci.*, 9(2): 125-130.

Abstract : Chemical investigation of the sponge *Echinodictyum gorgonoides* furnished a new polyhydroxy

sterol, (20S, 24S)-24-methyl cholesta-7,9(11)-diene-3 beta , 6 beta , 20-triol (echinodictyosterol) along with two known sphingolipids - (2S, 3S, 4R)-2-docosanoylamino-octadecane-1,3,4-triol and (2S, 3S, 4R)-[(2"-2(-hydroxy tetracosanoylamino)]-octadecane-1,3,4-triol. The structure was elucidated by UV, IR, NMR and Mass spectral data and compared with literature data.

1654. **Muralitharan, J.** 1999. Biodiversity of reef ichthyofauna of Gulf of Mannar along the southeast coast of India. *Ph.D. Thesis*, Annamalai University, India, 161 pp.

1655. **Murthy, A.V.S and P.U. Varma** 1964. The hydrographyical features of the waters of Palk Bay during March, 1963. *J. Mar. Biol. Assoc. India*, 6(2): 207-216.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Palk Bay is a shallow and flat basin, the depth of which being on an average 9 metres and nowhere exceeding 15 metres. The hydrography and dissolved oxygen conditions of the Bay waters are studied during the month of March 1963. The distributions of temperature, salinity, density and dissolved oxygen of the surface waters of the Palk Bay indicate that the Bay of Bengal waters entering through the Palk Strait have major influence on the hydrographic conditions of the Palk Bay. The Gulf waters influence the Palk Bay to a minor extent only.

1656. **Murthy, A.V.S.** 1988. Upwelling - a boon to coastal fishery and its study at the turn of this century. *CMFRI Spec. Publ.*, 40: 25-26.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Upwelling in the waters around India and the transformation of physical properties of the neritic waters thereof with a stress on thermal front and the potential utility for fish production in the sea are described. The necessity of obtaining pictures with high grade resolution of the locations and intensities of upwellings and thermal fronts is stressed for effective management of marine fisheries. The only means of fulfilling this objective is by switching over from the time-consuming shipborne observations to satellite produced imagery system.

1657. **Murthy, A.V.S., N. Gopalakrishna Pillai, M. Zaffar Khan, K.V. Sunil Kumar and Shankar V. Alavandi** 1990. Variation in fish catches from the continental shelf between Quilon and Gulf of Mannar and its relation to oceanographic conditions during the southwest monsoon period. *Proceedings of the first workshop on scientific results of FORV Sagar Sampada*, 5th to 7th June, 1989, Cochin. (ed) K.J. Mathew. pp. 291-294.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The fish fauna of the Quilon Bank and Wadge Bank has a dominant nemipterid element and the Gulf of Mannar area has a dominant population of barracudas. Nemipterids constituted 88.2 and 64.4% of the total trawl catch from the Quilon Bank and Wadge Bank respectively. Barracudas formed 58% of the total catch from the Gulf of Mannar. There is tremendous contrast among the three regions with respect to oceanographic conditions of the waters. Both temperature and salinity of the Quilon Bank waters are lower. The Wadge Bank waters are moderate in their temperature but high in salinity. The Gulf of Mannar waters are moderate with respect to salinity but warmer with regard to temperature and it differs much from the rest of the areas with respect to dynamic qualities. These waters showed thermal inversions in the middle region of the water column. The bottom water temperature rather than salinity appears to be the probable reason for the species variations in the trawl catches of the region.

1658. **Murthy, T.S.N and A.G.K. Menon** 1967. The turtle resources of India. *Seafood Export. J.*, 8(1): 49-60.

1659. **Murty, G.R.K., Y. Satyanarayana and T.P. Kumar** 1994. Magnetic profile across Gulf of Mannar. *J. Geol. Soc. India*, 44(4): 443-449.

Address : Naval Physical & Oceanographic Lab., Thrikkarara, Cochin, Kerala, India.

Abstract : A study of the spectral analysis and two-dimensional modelling of magnetic data collected along the track of 200 km traversing the southern part of the Gulf of Mannar indicates the presence of an anomalous body within the basement. The total field magnetic anomaly along the track is well explained by variations in the topography of the anomalous body of normal polarity and uniform magnetisation. The model shows a topographic relief of about 6 km. The presence of volcanic vents in this area suggests that the anomalous body could be more basic in nature having high susceptibility values.

1660. **Murugan, A and J.K. Patterson Edward** 2000. Factors threatening biodiversity of Marine molluscs in Tuticorin, Gulf of Mannar. *Phuket Marine Biological centre special pub.*, 21(1): 159-162.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628 001, Tamil Nadu India.

Abstract : The Gulf of Mannar Biosphere Reserve, which is having 21 coral Islands with an extent of about 628 hectares, is unique for its biodiversity. A variety of coral reef habitats allow the Islands to support complex biological communities. The Tuticorin sector of Gulf of Mannar is rich in molluscan groups including commercially important cephalopods, bivalves and gastropods. Tuticorin was once famous for the sacred chank, *Xancus pyrum* and natural pearl fishery. However, increasing industrialisation of the area has started showing its impact on the ecosystem in this sector of Gulf of Mannar. It is therefore the need of the hour to take appropriate measures to concerve this precious resource not only for sustainable fishing but also to safeguard the needs of the future generations.

1661. **Murugan, A.** 2001. Mangroves and the concept of restoration. *SDMRI Res. Publ.,* 1: 70-74.

Address : Suganthi Devadason Marine Research Institute, 44, Beach Road, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Mangroves are the salt tolerant forest ecosystem of the tropical and subtropical regions. They are the most naturally fertile and biologically productive areas and are important for the healthy coastal ecosystems on which the whole fishery depends. The total area of the world mangrove forests has been estimated at 181,399 km^2 (Spalding, 1977).

1662. **Murugan, A.** 2003. Sea turtles in and around Tuticorin coast, Tamil Nadu: Facts and problems. *Nat. Sem. Reef Ecosystem Remediation*, 24^{th} –26^{th} Sep'03, SDMRI, Tuticorin, India. p. 46.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Olive ridley, Green, Hawksbill, Leatherback and Loggerhead turtles occur along the Indian coast. Orissa coast is unique for the annual mass nesting of Olive ridleys. Tamil Nadu is considered the next dense nesting ground for Olive ridleys. All the five species of sea turtles have been reported along Tamil Nadu coast. The stretch between Nagapattinam and Chennai is the dense nesting ground of olive ridleys. Gulf of Mannar along south Tamil Nadu is characteristic of coral reef, seaweed and sea grass ecosystem. The area between Manapad and Periathalai, 20 kms south of Tiruchendur was once the dense sea turtle nesting ground. Sea turtles were said to be common in Tuticorin area long before. This can be evidenced from the live turtle trade which existed in this coast in 1960s with Sri Lanka with an annual landing of about 3000 to 4000 turtles between Rameswaram and Mimisal. Turtle meat and blood is believed to cure the piles and turtle poisoning has been reported along Tuticorin coast. The habitat degradation apart from increase in fishing pressure, incidental catch and trade are considered the probable reasons for the sparse distribution of sea turtles in Gulf of Mannar area. The industrialization of Tuticorin sector might also be the causative factor which drove away the turtles from this coast. All the five species are legally protected under Schedule I of the Indian Wildlife (Protection) Act 1972 and listed in Appendix I of Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES). Awareness should necessarily be created among the fisherfolk on the use of TEDs and to negate the belief that turtle cures some ailments.

1663. **Murugan, A and M. Santhana Ramasamy** 2003. Incidence of imposex in the muricid gastropod *Chicoreus virgineus* from Tuticorin, Southeast coast of India. *J. Mar. Biol. Assoc. India*, 45(2): 208-213.

Address : Sugandhi Devadason Marine Research Institute, Tuticorin, Tamilnadu, India.

Abstract : The muricid gastropod *Chicoreus virgineus* from Tuticorin area of Gulf of Mannar, southeast coast of lndia has been studied for expression of imposex. The frequency of imposex in females of *C. virgineus* collected from Tuticorin Port was 82.3%. The stage *i.e.*, penis with closed penis duel was predominant with 64.7%. The male: female sex ratio has deviated from normal and was 2.5:1. The RPSI value of 3.2% and RPLI value of 32.0% have been recorded. 11.8% of the females with imposex, which is considered as the last fertile stage of imposex. But no occlusion of genital pore was observed in the present study. Interestingly no imposex was observed in *C. virgineus* from Vellapatti area, which is located approximately 15 km north of Tuticorin Port.

1664. **Murugan, A and M. Santhana Ramasamy** 2003. Biofouling deterrent activity of the natural product from ascidian, *Distaplia nathensis* [Chordata]. *Indian J. Mar. Sci.*, 32(2): 162-164.

Address : Sugandhi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628001, Tamil Nadu India. E-mail: a_murugan@hotmail.com

Abstract : Growth of marine sedentary organisms causes notable damage to ship-hull, harbour structures and industrial cooling and filtration systems. TBT based antifouling paints are widely used worldwide and is to be phased out by the year 2008 because of its adverse effect on non-target organisms. Efforts are therefore being made to develop alternative eco-friendly antifoulant paints. The crude methanol and water extract of the ascidian, *Distaplia nathensis* showed antimicrobial activity against 12 out of 14 bacteria screened in the present study. At a concentration of 0.1 mg/ml, the crude extract completely inhibited the byssal production and attachment in the mussel *Perna indica*. The EC_{50} and LC_{50} were found to be 50 ± 6.45 mg/ml and 150 ± 19.2 µg/ml respectively. The gradient partition showed high polar nature of the active component. The indication of non-toxic nature of the extract in the toxicity assay and the broad spectral antimicrobial activity has revealed that it could be a potential source of the antifouling compound.

1665. **Murugan, A and M. Santhana Ramasamy.** 2003. Chemical defense in ascidians *Eudistoma viride* and *Didemnum psammathodes* in Tuticorin, southeast coast of India: Bacterial epibiosis and fouling deterrent activity. *Indian J. Mar. Sci.*, 32(4): 337-339.

Address : Suganthi Devadason Marine Research Institute, 44- Beach Road, Tuticorin, 628001, Tamilnadu India; E-mail: a_murugan@hotmail.com

Abstract : The culturable epibacterial abundance in the ascidians *Eudistoma viride* and *Didemnum psammathodes* was studied and correlated with their antifouling activity. The epibacterial abundance varied significantly between *E. viride* and *D. psammathodes*. The antibacterial assay of the crude extracts of the ascidians showed inhibitory activity against all the 20 biofilm bacteria. However, *E. viride* showed prominent antibacterial activity than that of *D. psammathodes* with an average inhibition zone of 29.1 mm. The comparison between epibacterial abundance and the antifouling activity showed an interesting significant negative correlation [-0.910 ($P<0.001$)]. Though the ascidians showed activity against all biofilm bacteria, the presence of epibacteria still on its surface could be attributed to their selective inhibition against certain bacteria due to chemical defense mechanism or the ascidians may exhibit a surface property suitable for particular epibacteria which may be symbiotic and contribute to the reduced abundance of other bacterial epibionts.

1666. **Murugan, A.** 2005. Seaweed: A potential source for alternate livelihood option for coastal fisherfolk. *Nat. Symp. Marine Plants, their chemistry and utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, 23-25 June 2005. pp. 48-51.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticoirn-628 00l, Tamil Nadu.

Abstract : Seaweeds belong to the primitive group of non-flowering plants. It is found growing submerged in intertidal, shallow and subsurface waters in the sea and in brackish water estuaries. They are unique with no distinguishable root, stem or leaves. Based on pigmentation, seaweeds are broadly classified into green, brown, red and blue-green algae. They are the, important constituents of the commercially important renewable resources of the ocean. Seaweeds are the only source of agar and algin. Apart from phytochemicals, other products like mannitol, laminarin and fucoidin are also obtained from seaweeds.

1667. **Murugesan, A.G., M.I. Zahir Hussain and N. Sukumaran** 2000. Conservation of marine biodiversity in the Gulf of Mannar - An urgent need for preventing pollution. *Proc. Nat. Sem. Mar. Biodiversity, ICAS, Public No.*3: 84-93.

1668. **Muthiah, P.** 1987. Techniques of collection of oyster spat for farming. *CMFRI Bullein,* 38. 48-51.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The results are presented of experiments conducted on spat collection carried out at Tuticorin during 1978-80, investigating different culture materials. The settling behavior of the oyster larvae, spatfall prediction, fouling organisms and seed hardening processes are discussed briefly. It is concluded that the condition of cultches and the method of exposure are the major factors for spat collection. The cultch materials must be finely roughened, free from slime and without any secretion. Spreading culture materials on the bottom, placing them on racks or suspending from raft are the 3 methods of exposure of spat collectors in the water column.

1669. **Muthiah, P., D. Sundararajan, G. Srinivasan and N. Vaithinathan** 1987. Pests and predators of oysters. *CMFRI Bulletin*, 38: 71-74.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Following a brief review of the common pests and predators of oysters, an examination is made of the predatory role played by Cymatium in oyster culture operations. The mode of attack is described and the relationships between the size of Cymatium and the radula, between Cymatium and oyster size, and between oyster stock and predator population are considered. Means of control of the predator are outlined briefly.

1670. **Muthiah, P and K. Nagappan Nayar** 1988. Incidence of *Perkinsus marinus* in *Crassostrea madrasensis*. *CMFRI Bulletin,* 42(1): 232-235.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Perkinsus marinus* (*Dermocystidium marinum*) commonly known as "Dermo" is one of the causative pathogens for widespread mortalities in oysters. In the natural population of oysters at Tuticorin oyster tissues cultured in fluid thioglycollate medium with dextrose fortified with antibiotics were found to be infected with *D. marinum.* This is the first time that this pathogen has been reported from Indian waters. The incidence of infection in oysters ranged from 10 to 60%. The weighted incidence ranging from 0.05 to 0.35 indicates the very light level of infection.

1671. **Muthiah, P and K.A. Narasimham** 1992. Larval rearing, spat production and juvenile growth of the blood clam *Anadara granosa*. *J. Mar. Biol. Assoc. India,* 34(1&2): 138-143.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The blood clam *Anadara granosa* spawned in the Shellfish Hatchery Laboratory, Tuticorin on two occasions. The fertilised eggs meassured 50-60 µ in diameter, morula larvae developed in 3-4 hrs and the trochophore stage was reached in 5 hrs. The straight hinge stage was attained in 20-26 hrs after fertilization and these larvae measured 83 µ length and 65.5 µ height. Advanced umbo stage was reached on day 12 (size 155.3 x 140.5 µ) and on day 16, majority of the larvae were in pediveliger stage with a average size of 182.7 x 16.29µ Settlement began on day 16 and majority of the larvae were set on day 18. The growth of the spat in the hatchery is described by the exponential equation $L = 0.0002739\ D^{2.2623}$ where L is length in mm and D, days. On day 59, the spat attained an average size of 2.42 x 1.70 mm. A total of 8,090 spat were produced. During the nursery rearing in the field, the seed clam attained 20 mm average length in the following 5 months. In India, A. granosa seed were produced for the first time. The significance of this study for the mass production of the blood clam seed in the hatchery and its relevance to undertake blood clam culture are highlighted.

1672. **Muthiah, P and K. Ramadoss** 2000. Mussel culture (in Tamil). *Souvenir, Golden Jubilee, Staff Recreation club of Tuticorin, R.C. of CMFRI,* pp.51-55.

1673. **Muthiah, P., M.E. Rajapandian, K. Ramadoss, K.K. Appukuttan and T.S. Velayudham** 2000. The edible Oyster culture. ***In*** : *Marine Fisheries Research and Management,* (eds.) V.N. Pillai and N.G. Menon, CMFRI, Kochi. pp. 786-801.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In 1970s the CMFR Institute initiated oyster culture through rack and tray method. Large scale spat collection, preparation of spat collectors, season and seed availability were studied. In 1980, a hatchery was set up with annual production capacity of one million edible oyster seed and the techniques involved in hatchery system were standardized. The seed were supplied to other centers of this Institute and Gujarat Fisheries Department. The Production rates for rack and tray, string and stake method were estimated as 120 t and 22 t respectively. As part of extension, one lab to land programme, 8 training programmes, one workshop and a summer institute were conducted. Results of experimental oyster culture work carried out at Mandapam, Madras, Bheemunipatnam, Kakinada, Mulki, Dharmadam, Ashtamudi and Cochin backwaters are given. Rearing 600 strings in 0.04 ha at Ashtamudi and harvesting 2.5t oysters pointed out 44.8% return with estimated production of 80-105t/ha. Further research priorities on oyster culture aspects are indicated.

1674. **Muthiah, P., J. Xavier Rodrigo and N. Suja** 2002. Larval rearing and spat production of *Marcia opima* (Gmelin). *Aquaculture,* 211(1-4): 393-401.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The baby clam, *Marcia ophna* (Gmelin) was spawned on seven occasions in the shellfish hatchery at the Tuticorin Research Centre, India. The fertilized eggs measured 47.8 µm in diameter and the straight hinged larvae attained at 20 h were 87 µm in length and 71 µm in height. Settlement occurred on day 9 at 273 µm. The

percentage of settlement varied from 13.9% to 56.2%. The growth of post-set clam spat has been described by the equation of $L=0.0086X^{1.4672}$, where L is the length in mm and X is the number of days. The clam seed reached a size of 11.5 mm at 4 months. The significance of this study is to standardize the techniques for hatchery production of the seeds of *M. Opima*. The baby clam, *Marcia opima* (Gmelin) was spawned on seven occasions in the shellfish hatchery at the Tuticorin Research Centre, India. The fertilized eggs measured 47.8 µm in diameter and the straight hinged larvae attained at 20 h were 87 µm in length and 71 µm in height. Settlement occurred on day 9 at 273 µm. The percentage of settlement varied from 13.9% to 56.2%. The growth of post-set clam spat has been described by the equation of $L=0.0086X^{1.4672}$, where L is the length in mm and X is the number of days. The clam seed reached a size of 11.5 mm at 4 months. The significance of this study is to standardize the techniques for hatchery production of the seeds of *M. opima*. The baby clam, *Marcia opima* (Gmelin) has spawned on 7 occasions in the shellfish hatchery at the Tuticorin Research Centre, India. The fertilized eggs measured 47.8 µm in diameter and the straight hinged larvae attained at 20h were 87 µm in length and 71 µm in height. Settlement occurred on day 9 at 273 µm. The percentage of settlement varied from 13.9 to 56.2%. The growth of post-set clam spat has been described by the equation of $L=0.0086X^{1.4672}$, where L is length in mm and X is the number of days. The clam seed reached a size of 11.5 mm at 4 months. The significance of this study is to standardize the techniques for hatchery production of the seeds of *M. opima*.

1675. **Muthu, M.S.** 1978. A general review of penaeid prawn culture. *CMFRI Spec. Publ.,* 3: 25-33.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : In the Indo-Pacific region, prawn culture in coastal brackish water ponds and impoundments has been practised for five centuries or more. The penaeid prawns belonging to the genera Penaeus and Metapenaeus spawn in the sea but the postlarvae enter the estuaries and backwater areas in large numbers and grow rapidly. These areas serve as natural nurseries for the juveniles. The euryhaline nature of these prawns enables them to colonize the estuaries and backwaters. In the traditional culture operations these naturally occuring postlarvae and juveniles are trapped in tidal impoundments and allowed to grow for short periods before they are caught.

1676. **Muthu, M.S.** 1978. Rearing of penaeid prawns under controlled conditions. *CMFRI Spec. Publ.,* 3: 68-75.

Address : Central Marine Fisheries Research Institute, Calicut, Kerala, India.

Abstract : Till recently penaeid prawn culture was dependant on the naturally occurring prawn seed in the estuarine and brackishwater environments. But availability of prawn seed from natural sources is subject to wide fluctuations and there is a worldwide interest in the artificial propagation of the seed of the fast growing species of penaeid prawns. Hudinaga and his associates in Japan have perfected over a period of 30 years the technique of large-scale production of the fry of *Penaeus japonicus* in hatcheries. (Fujinaga 1969, Shigueno 1973). The Japanese method has been adopted in Taiwan to mass produce the fry of *P. japonicus, P. monodon, P. semisulcatus, P. teraoi, Metapenaeus ensis* and *M. joyneri* (Liao and Huong 1973) and in the Philippines ror producing the postlarvae of *P. monodon* and *P. indicus* (Villaluz *et. al.,* Anon 1975 a & b, Anon 1976). This method has also been used for large-scale production of the fry of *P. kerathurus* in Haly (Lumare and Villani 1974) and Spain (FAO 1975); *P. duorarum* in Florida (FAO 1969); and *P. orientalis* in Korea (Kim 1967).

1677. **Muthu, M.S and N. Neelakanta Pillai** 1988. Development of an indigenous hatchery technology for prawn seed production. *CMFRI Spec. Publ.,* 40: 50.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : The Central Marine Fisheries Research Institute has developed a totally indigenous technology for hatchery production of penaeid prawn seed which has been successfully tested on a wide variety of commercially important penaeids. The present technology differs from those employed by other hatcheries in 2 essential respects: 1) Larval stages are fed with mixed diatom cultures which are grown by fertilizing raw seawater exposed to sunlight; and 2) for rearing the postlarvae an inexpensive particulate diet is used instead of Artemia nauplii. These two innovations have greatly reduced the cost of prawn seed production.

1678. **Muthuraman, A.L and Daniel Sudhandra Dev** 1988. On the growth of the pearl oyster *Pinctada fucata* in commercial farm at Krusadai Island. *CMFRI Bulletin,* 42(2): 295-298.

Address : Tamil Nadu Pearls Limited, Mandapam - 623 519, Tamilnadu, India.

Abstract : Growth on two different size groups of the pearl oyster *Pinctada fucata* reared in farm at Krusadai Island was studied for the period from October 1985 to October 1986. Good growth was observed from October ‘1985 to January 1986 and poor growth was recorded from March 1985 to May 1986 in both the size groups.

The growth increment was correlated with rainfall and temperature parameters. Oysters cultured in permanent piling structures at a depth of 4 m, exhibited faster rate of growth compared to the oysters in raft culture at the same depth in velon screen stitched box cages the growth rate of oysters of 20 mm and above was less compared to those reared in cages without velon screen. The stocking density of oysters in a cage and the mortality were found to be directly proportional.

1679. **Muthuraman, B and R. Ranganathan** 2004. Biochemical studies on some green algae of Kanyakumari coast. *Seaweed Res. Utiln.*, 26(1&2): 69-71.

Address : Department of Botany, Annamalai University, Annamalainagar - 608 002, Tamilnadu, India.

Abstract : Six species of marine macroalgae viz., *Caulerpa scalpelliformis, Cladophora vagabunda, Enteromorpha compressa, Halimeda macroloba, Ulva fasciata* and *Chaetomorpha antennina* (Chlorophyceae) were selected to investigate protein, amino acids, total sugars and lipid content. The highest protein content was recorded in *Caulerpa scalpelliformis* and the lowest content was in *H. macroloba*. The highest amino acid content was found in *H. macroloba*. Total sugar content was very high in *H. macroloba* and very low in *Cladophora vagabunda*. The highest lipid content was found in *Ulva fasciata* and lowest content was in *Cladophora vagabunda*.

1680. **Muthuraman, B and R. Ranganathan** 2004. Studies on the photosynthetic pigments of certain marine algae from Kanyakumari coast. *Seaweed Res. Utiln.*, 26(1&2): 73-75.

Address : Department of Botany, Annamalai University, Annamalainagar - 608002, Tamilnadu, India.

Abstract : In the present investigation, an attempt has been made to study the photosynthetic pigments of *Caulerpa scalpelliformis, Cladophora vagabunda, Enteromorpha compressa, Halimeda macroloba, Ulva fasciata* and *Chaetomorpha antennina* (Chlorophyceae), *Padina boergesenii* and *Sargassum wightii* (Phaeophyceae) and *Gracilaria corticata, G. fergusonii, Laurencia rigida* and *Hypnea musciformis* (Rhodophyceae). Among the 12 species, the highest total chlorophyll content was found in *U. fasciata* and the lowest in *Laurencia rigida*. Carotenoid content was high in *U. fasciata* and low in *H. musciformis*. The highest anthocyanin content was found in *Padina boergesenii* and the lowest in *Cladophora vagabunda.*

1681. **Muthuvelan, B., K.V.K. Nair, V. Sampath and M. Ravindran** 2002. Effect of different post harvest treatment and extraction procedures on the gel strength of *Gracilaria edulis*. *Seaweed Res. Utiln.*, 24(1): 165-172.

Address : National Institute of Ocean Technology, Narayanpuram, Pallikaranai, Chennai 601 302, Tamilnadu, India.

Abstract : Fresh seaweed *Gracilaria edulis* harvested from Valai Island of Gulf of Mannar, Tamilnadu, India, was subjected to post harvest treatment of sun, shade and oven drying. The changes in agar yield and physical characteristics of agar *i.e*. gel strength, gelling and melting temperatures were recorded. The gel strength and yield differed significantly in each treatment. The values obtained reflect a strong linear correlation (R^2 0.88) with respect to the agar yield and treatment period, and a weak correlation (R^2 0.47) observed between gel strength and the treatment period. Sun dried material showed comparatively stronger stability in gel strength than oven and shade dried materials. The melting and gelling temperatures were found similar in all treatments. The characteristics of thallus started changing from the fourth day onwards. Experiment on the efficacy of agar extraction methods (1. extraction with water at 25 α C, 2. Extraction with water at 95 α C, 3. Alkali treated at 95 α C and 4. Alkali treated with 0.5% aqueous sodium pyrophosphate at 95 α C) was conducted. The maximum yield (25.10%) and gel strength (124 g/ cm^2) were obtained using alkali with 0.5% sodium pyrophosphate method. Physical characteristics and the contents of sulphate and 3, 6-anhydrogalactose of the alkali-modified agar from *G. edulis* were comparable with those of commercial food grade agar.

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1682. **Nadimuthu, M.** 1998. Studies on the fungi of the coral reef environment of the Gulf of Mannar biosphere reserve. *Ph.D. Thesis*, Annamalai University, India. 117 pp.

1683. **Naganathan, V.** 2003**.** Twenty one percent Marine Harvest from Gulf of Mannar. *The New Indian Express.* 20th *March* 2003.

Address: Gulf of Mannar biosphere Reserve Trust, Ramanathapuram, Tamilnadu, India.

Abstract: There are around 3,600 species living in the region and therefore it is the biggest biosphere reserve in the south and southeast Asia.

1684. **Naganathan, V.** 2003. Participatory management in marine ecosystem - A case study from GOMBR. *Nat. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 66.

Address : Gulf of Mannar Marine National Park, Ramanathapuram, Tamil Nadu, India.

Abstract : The 10,500 km^2 Gulf of Mannar Biosphere Reserve (GOMBR) in South Indian waters is extending between Rameswaram and Kanyakumari. The 560 km^2 Gulf of Mannar National Park (GOMNP) in GOMBR, an IUCN category I protected area is an example for managing the marine biological resources on the Principle of total protection by regulating the resource use to sustainability in the balance 9,940 Km^2 GOMBR area. The attempt is enabled by a GEF-UNDP project through a Govt. based Independent Statutory Trust namely Gulf of Mannar Biosphere Reserve Trust (GOMBRT). The theme is to educate and empower the traditional fisher folk of GOMBR to scientifically manage the GOMBR resources to support their livelihood sustainably. The Trust will integrate the efforts from all Govt. Departments concerned in GOMBR, people of GOMBR, Scientific institutions working in the area and the NGOs working in the area into an amalgam in such a proportion to ensure the conservation of GOMBR. Eco-development is the tool identified for bringing such advancement in the area. This case study reveals the perfectness of the design, which incorporated all relevant aspects of the protected area well addressed and will also provide an insight to evolve standard Marine Protected area Management approach for all potential waters.

1685. **Nagappan Nayar, K.** 1955. Studies on the growth of the wedge clam *Donax cuneatus*. *Indian J. Fish.*, 2(2): 325-348.

Address : Central Marine Fisheries Research Institute, Mandapam camp - 623 520, Tamilnadu, India.

Abstract : A sacoglossan Opisthobranch obtained from the Palk Bay and the Gulf of Mannar in the vicinity of Mandapam Camp has been ascribed to a new species of *Stiliger Ehrenberg* and named *S. nigrovittatus* because of the characteristic dark stripes present on the dorsal region of the rhinophores and the anterolateral regions of the body. Its external morphology and some aspects of internal anatomy have been described along with notes on its early development. Its systematic position and similarity or divergence with other species of Stiliger have been discussed.

1686. **Nagappan Nayar, K and S. Mahadevan** 1965. Underwater ecological observations in the Gulf of Mannar off Tuticorin. II. The occurrence of the synaptid *Chondrocloea* along with the massive sponge, *Petrosia*. *J. Mar. Biol. Assoc. India*, 7(1): 199-201.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In this paper an interesting instance of association between a sponge and a synaptic, which was observed during the course of our underwater dives with SCUBA is recorded. The rocky patches of the sea bottom off Tuticorin exhibited certain characteristic fauna depending on the depth and locality. For instance, the shoreward rocky floor in the 10-13 metre range was characterized by among other things the small and medium sized sponges firmly attached to the substratum and was conspicuous by the absence of the massive sponge of the genus *Petrosia.*

1687. **Nagappan Nayar, K and S. Mahadevan** 1965. Underwater ecological observations in the Gulf of Mannar off Tuticorin. IV. The occurrence of Crinoids (*Lamprometra* and *Comanthus*) on the Gorgonid, *J. Mar. Biol. Assoc. India*, 7(2): 456-457.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Of the rocky bottom the following two categories were noticed on a floor which was rugged due to

moderate outgrowths of live and dead coral blocks (*Favia* spp., *Montipora* spp., *Pocillopora* spp., *Coeloria* sp., *Goniastraea* sp. and *Turbinaria* sp.), sponges (*Acanthella carted* Dendy, *Petrosia testudinaria* (Lamarck), *pachychalina aelicatula* Dendy, *Siphonochalina communis* (Carter) etc., and dense population of seaweeds, broken shells and fishes (Photograph 1). This type of surrounding was more often characteristic of the area lying beyond 17 metres, (2) comparatively barren ground formed of inner extensive core of consolidated dead corals covered with thin film of coarse sand all over, with occasional outgrowths of corals like *Heteropsammia* sp., *Porites* sp., encrusting sponges and coelenterate colonies like *Thuiaria* sp., *Lytocarpus* sp., and *Sertularia* sp. This habitat was more characteristic of the shallower rocky areas. Of course, hard and fast line of demarcation between these two types was not evident.

1688. **Nagappan Nayar, K and S. Mahadevan** 1965. Sponge, *Pterosia* observations in the Gulf of Mannar, off Tuticorin. V. On Sea Anemones and the fishes *Amphiprion* and *Dascyllus* found with them. *J. Mar. Biol. Assoc. India*, 7(2): 458-459.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The giant sea anemone, *Stoichactis giganteum* (Forsk.) was found to grow both on the sandy area as well as on the rocky bottom, the large-lobed disc lying flat reaching up to a maximum of 80 cm diameter in the latter case whereas the sandy forms were smaller in size. On the rocky bed, between 14-22 metres depth, the anemone occupied shallow pits or holes into which they retracted when needed. Often, many *Amphiprion sebae* Bleeker and a few *Dascyllus trimaculatus* (Ruppell) were found swimming over the anemone at a height of nearly 30 mm. In many instances only 2 numbers of equally large *A. sebae* were seen while *Dascyllus* were not seen.

1689. **Nagappan Nayar, K.** 1966. On the Amphipods of the Gulf of Mannar, with special reference to those of pearl and chank beds. *Proc. Symp. on Crustacea, MBAI*, 1: 133-168.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : During the underwater survey of the pearl and chank beds off Tuticorin carried out by 'SCUBA' diving, a number of amphipods were also seen amongst various material collected from the sea bottom. These amphipods were studied in detail. Incorporating the amphipods of the pearl banks of Ceylon described by Walker (1904) a complete list with synonymies of all the reported species of amphipods from the Gulf of Mannar, together with the description and sketches of species wherever found necessary, has been given in this account.

1690. **Nagappan Nayar, K and S. Mahadevan** 1967. Pearl and chank fisheries. A new outlook in survey and fishing. *Souvenir 20th Ann. CMFRI*, pp. 87-88.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The Gulf of Mannar and the Palk Bay Zones of the east coast of the Madras state, particularly the area from Rameshwaram to Manapad, are of very great fishing importance as far as the pearl and chank fisheries are concerned. The submarine plateau of the inshore areas of the sea here affords excellent habitat for the growth of the shellfish, *Xancus pyrum* (Linn.) (the sacred chank) and *Pinctada fucata* (Gould) (the pearl oyster). Chank fishing and pearl fishing in this zone had been conducted from time immemorial under the control of the State. All along the stretch of the sea-bottom, extensive, flat rocky patches occur at a distance of 8-12 miles from the shore within 7-12 fathoms, separated from one another and surrounded by equally extensive patches of fine sandy areas at the same or slightly deeper zones. Whereas the chanks prefer fine and soft sandy areas called locally 'Poochi-manal' or 'pirals' as their abode, the oysters are sedentary and are attached to hard rocky substrata called 'Paar'. Occasionally the one is found in the natural habitat of the other. There are more than 65 well known 'Paars' (rocky sea-bottom) and lesser in number of good chank grounds in the Gulf of Mannar known to fisherman by their depth and location fixed by land bearings. The sea bottom on Palk Bay side is not rocky, at the same time less shallow also. The chanks growing in this zone are classified as 'Patti' variety, which is priced less than the 'Jaadhi' variety fished from Rameshwaram to Tiruchendur.

1691. **Nagappan Nayar, K and S. Mahadevan** 1973. Chank resources of India. *Proc. Symp. on Living Resources of Seas around India.* pp. 672-686.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The sacred chank *Xancus pyrum* (Linn.) is a commercially important gastropod fished in large numbers along the coasts of all but a few of the maritime states of India. Fishing is carried out mainly by skin

diving, although hand-picking and net fishing are also prevalent here and there. The fishery provides a good source of living to nearly 1,000 divers in the Madras State in addition to those engaged in the same profession along the Gujarat and Kerala coasts. The main market for these chanks is West Bengal where chank bangle industry is flourishing. Investigation conducted by means of SCUBA by the authors have brought to light good concentration of chank population suitable for commercial exploitation, over vast stretches in the Palk Bay and Gulf of Mannar. The statistics of annual chank landings, yield from area to area, account of the chank fishery in important centres, details of the diving method and the extent of the chank grounds are recorded. Possibilities for exploiting unfished areas and suggestions for increasing the fishing tempo are discussed in detail. In this context SCUBA diving for chanks has proved very advantageous and is recommended keeping in view the economic aspect of the divers as well as judicious exploitation of the stock.

1692. **Nagappan Nayar, K and S. Mahadevan** 1974. Edible Bivalves: clams and others. *CMFRI Bulletin*, 25: 40-53.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Clams belonging to a number of species and a few other edible bivalves occur in appreciable quantities in different parts of the Indian coasts and support subsistence fisheries. Thousands of square kilometers of our coastal seas, backwaters and estuaries form ideal habitat for the growth of these bivalves and many among the poorer classes of the coastal population use them as food although it should be admitted that a vast majority of other fish-eating population of our country have not developed a liking for these shellfish. The flesh of clams being rich in glycogen, protein and health giving minerals is highly nutritious. In spite of the availability of substantial edible clam resources along the Indian coasts very little attention has been paid to clam fisheries. Hornell (1916d) who made a detailed study of the utilization of shells for manufacturing lime was the first to draw attention to the importance of the clam resources of the Madras Presidency. He (1917) recorded that the clam *Meretrix casta* formed a most important food mollusc. Rai (1932, 1933) showed that *Meretrix meretrix* was the species of prime fishery importance among bivalves of the Bombay coast. Rao (1941) has stated that the clams and mussels are perhaps a more important element in the shellfish populations of our coasts than oysters and that the backwater clams form the basis of a more important fishing industry than sea clams. Recent studies worthy of mention in this context are those of Rao (1951, 1958), Abraham (1953), Nayar (1955), Rao *et. al*., (1962), Ranade (1964), Alagarswami (1966), Alagarswami and Narasimham (1968) and Narasimham (1969).

1693. **Nagappan Nayar, K and S. Mahadevan** 1974. Chank fisheries and chanks. *CMFRI Bulletin*, 25: 122-140.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The distribution and depths of chank beds in the Gulf of Mannar are shown, with descriptions of chank fisheries in other regions, including details of fishing methods. 5 varieties are commercially fished, of which 2, *Xancus pyrum* var. *obtusa* and *X. pyrum* var. *acuta* are discussed in depth. The fishery value of the species is considered, and the rate of exploitation. The industrial uses of chanks are reviewed.

1694. **Nagappan Nayar, K, S. Mahadevan, K. Ramadoss, N. Sundaram and C.T. Rajan** 1978. Experimental study of the settlement and collection of pearl oyster spat from Tuticorin area. *Indian. J. Fish.*, 25(1&2): 246-252.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : For the first time settlement and growth of pearl oysters have been observed on granite stones forming the embankments of the New Tuticorin Port. Large numbers of pearl oyster spat have also been collected by employing different types of spat collectors and the rate of growth of the oysters in the farm has been studied.

1695. **Nagappan Nayar, K, P. Muthiah and M.E. Rajapandian** 1979. Oyster Culture in Tuticorin. *Proceedings of the first workshop on technology transfer in coastal aquaculture*. Cochin 23-24 July, Mandapam. Central Marine Fisheries Research Inst., Cochin India. Cochin-India. *CMFRI Spec. Publn.*, 6: 59-65.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A brief status report of oyster culture in Tuticorin is presented. The socioeconomic conditions of the oyster farmers are described and the progress and constraints of the CMFRI's aquaculture development programmes in the area are evaluated.

1696. **Nagappan Nayar, K, S. Mahadevan, K. Ramadoss, N. Sundaram and C.T. Rajan** 1980. On the fishery of the crab *Scylla serrata* (Forskal) at Tuticorin during 1974-75. *Indian J. Fish.*, 27(1&2): 102-110.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : *Scylla serrata* occurs in fairly good numbers at Tuticorin, throughout the year. In the northern part, it is usually caught from the shallow coastal waters by shore-seines and cast-nets, while in the backwaters and canals of the southern region by a simple trapping device. Apart from these, certain dragnets, stakenets, baited hooks and hand-picking are also resorted to for the capture of this crab. The estimated yield of *S. serrata* during 1974-75 was 9,460.6 kg, of which 53.7% were by nets and 46.3% by traps. The combined annual size-frequency distribution of the crab has indicated the presence of three distinct age groups, with modes at 115, 155 and 185/195 mm. Gross examination of gonadial conditions has shown three stages of maturity for both sexes, representing immature, maturing and mature conditions. Berried females showed two stages in the development of eggs. It appears that for improving the quality and quantity of the catches, the smallest size groups with dominant mode at 115 mm carapace width could be spared from the efforts of the fishery.

1697. **Nagappan Nayar, K, M.E. Rajapandian, A.D. Gandhi and C.P. Gopinathan** 1982. Induced spawning and larval rearing of *Crassostrea madrasensis* (Preston) in the laboratory. *Mar. Fish. Inf. Serv. Tech. Ext. Ser.,* 44 :14-16.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An account is given of investigations on spawning and rearing of oyster (*Crassostrea madrasensis*) in the laboratory at Tuticorin.

1698. **Nagappan Nayar, K and D.C.V. Easterson** 1983. A plan for Molluscan experimental hatchery at Tuticorin, India. *Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: Molluscan culture.* Marine Biological Assoc. of India, Cochin, India. 6: 513-518.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The Central Marine Fisheries Research Institute has developed techniques of oyster culture aimed at production for marketing. A plan has been evolved for hatchery production of oyster seeds. The paper describes the hatchery system being developed at Tuticorin. The layout with greenhouse, seawater filtration, purification and temperature control systems has been so designed as to achieve tangible results.

1699. **Nagappan Nayar, K and S. Mahadevan** 1983. Oyster culture at Tuticorin. *Proc. Symp. Coastal Aquaculture,* 2: 427-435.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Oyster culture as a food producing subsystem, can be undertaken effectively and profitably in India. The success of this centre can have far reaching results in solving the demand for cheap animal protein from the sea and as an income-generating avocation for fishermen. Investigations carried out at Tuticorin to find out the feasibility of oyster farming in coastal areas were successful. Effective methods have been developed for large-scale oyster spat collection by using lime-coated country tiles. For growing the oysters to marketable size in short period 'rack culture' technique was effectively employed. Production of 119 tonnes of oysters per hectare could be achieved in 12 months time. Applicability of the technology developed in popularizing oyster farming along the Indian coasts is discussed in detail.

1700. **Nagappan Nayar, K, M.E. Rajapandian and D.C.V. Easterson** 1983. Purification of farm grown oysters. *Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: Molluscan culture,* MBAI, Cochin, India, 6: 505-508.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The purification of farm grown oysters by scientific methods is essential before they are marketed. Oyster farming is a new venture in India and the technique has recently been perfected by the Central Marine Fisheries Research Institute. The most important task is to perfect the depuration process for which there is no standard method. The present paper gives a satisfactory plan for small-scale purification of harvested oysters before they are marketed for safe human consumption.

1701. **Nagappan Nayar, K and S. Mahadevan** 1983. Socioeconomic perspective of oyster culture in India. *Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: Molluscan culture,* MBAI, Cochin, India, 6: 509-512.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : "Transfer of Technology" scheme initiated in 1979 provided an opportunity to test the feasibility of introducing oyster culture technology developed by Central Marine Fisheries Research Institute amongst a group of small-scale fishermen at Tuticorin.

1702. **Nagappan Nayar, K, M.E. Rajapandian, A.D. Gandhi and C.P. Gopinathan** 1984. Larval rearing and production of spat of the oyster *Crassostrea madrasensis* (Preston) in an experimental hatchery. *Indian J. Fish.*, 31(2): 233-243.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The Indian backwater oyster, *Crassostrea madrasensis* , was spawned in the laboratory at Tuticorin, India. The larvae were reared and the spat settled in 15-20 days. Two species of phytoflagellates, *Isochrysis galbana* and *Pavlova* sp. were isolated from the natural environment, cultured in mass scale and given as food throughout the larval period. Early stages of the development of fertilized egg, successive stages of developing larvae, and metamorphosis to the spat have been described. The methodology of the production of clutchless spat and rearing the post-set oysters are discussed.

1703. **Nagappan Nayar, K., K. Satyanarayana Rao, M.E. Rajapandian, C.P. Gopinathan and A.D. Gandhi** 1987. Production of oyster seed in a hatchery system. *CMFRI Bulletin*, 38: 52-58.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Although oyster culture dates back to First century B.C., the development of hatchery techniques for the production of oyster seed on a year round basis is a recent innovation. Since early 1950s attempts for large scale production of oyster seed have been initiated. Loosanoff and Davis (1952), Dupuy *et al.*, (1977) and AQUACOP (1977) have successfully produced seed of the oysters *Ostrea edulis*, *Crassostrea virginica* and *Crassostrea gigas.* Nayar *et. al.*, (1984) have successfully accomplished the production of seed of *C. madrasensis* on a large scale at the molluscan hatchery laboratory, of Central Marine Fisheries Research Institute at Tuticorin. At this hatchery cultured as well as free of cultureless spat are produced. The production of oyster seed by hatchery techniques is accomplished in six phases of operations viz., (1) Conditioning adult oysters for maturation of gonads (2) Induced spawning (3) Larval rearing (4) Culture of algal food (5) Preparation of spat collectors and (6) Setting of spat. These six functions although interrelated are independent phases of operation and easy to follow and implement.

1704. **Nagappan Nayar, K, S. Mahadevan and P. Muthiah** 1987. Economics of oyster culture. *CMFRI Bulletin*, 38: 67-70.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Economic analysis of any system of aquaculture practice aids not only to improvise management practices but also ensures profitability. Attention on return on investment has been rightly emphasized by Mitchell and Usry (1967), Pillay (1973) and IPFC (1975) to show that well planned and properly managed aquaculture ventures compare very favourably with similar other food production industries. Hornell (1910) realising the edibility of the oyster meat and its nutritional value initiated efforts on oyster farming and gave an approximate account of working expenses of a one hactare park. These estimates are not relevant to the present day cost but nevertheless provide an idea of the material inputs that have to go into the system. Blanco and Montalban (1955) have worked out the economics for one hactare oyster farm. Quayle (1971) and Humphries (1976) have given the production cost of oysters cultured by raft method and economics respectively. Similarly, Blanco (1972) has given the investment returns for oyster farms in Philippines. Koganezawa (1979) has stated that it is difficult to arrive at the production cost of oysters in Japan due to the wide range of culture methods and efficiency. Moreover, these enterprises are owner-operated. It is thus clear that for aquaculture, to become important in national economy the cost effectiveness is vital and it should be technologically practical and also fit into the legal and economic structure (Hanson, 1974). The technology of oyster farming experiments conducted at Tuticorin by rack culture method has been explained by Mahadevan *et. al.*, (1980) and Nayar and Mahadevan (1983). Following this it was felt necessary to explain the economics of this system of oyster farming.

1705. **Nagappan Nayar, K and S. Mahadevan** 1987. Ecology of Pearl oyster beds. *CMFRI Bulletin*, 39: 29-36.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A summary is made of available information on the response of pearl oyster (*Pinctada fucata*) to intensity variations of abiotic and biotic ecological factors in the Gulf of Mannar. Sea-land features of the shallow region in the gulf are described (primary production, wind, water movement, currents, light, turbidity, temperature, salinity, dissolved oxygen, silicate and phosphate). Fauna and flora associated with the pearl oyster banks are examined, indicating also those species causing pearl oyster destruction.

1706. **Nagappan Nayar, K.** 1987. Technology of oyster farming. *CMFRI Bulletin*, 38: 59-62.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An account is given of techniques for oyster culture with respect to work conducted at the Central Marine Fisheries Research Institute at Tuticorin. The rack culture method was found to be suitable at Tuticorin because of the shallow nature of the bay. The location of the farm, racks used, seed collection, rearing of seed oysters, thinning and growing of oysters and harvesting and marketing are discussed.

1707. **Nagappan Nayar, K., K. Satyanarayana Rao, P. Muthiah and M.E. Rajapandian** 1988. Recent trends in Oyster culture in India. *CMFRI Bulletin,* 42(2): 271-275.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Rack and tray method of culture of the oyster *Crassostrea madrasensis* has been developed initially at Tuticorin and oysters have been cultured successfully. Recently Innovations have been made in the methods of collection of oyster spat and techniques of rearing them. The development of hatchery techniques for large-scale production of oyster seed has led to reorientation of culture techniques- Oyster seed are produced in the hatchery by employing different types of spat collectors depending on the kind of culture practice in which they will be used. Prospects for pen, stake and bottom sowing methods of culture have been studied.

1708. **Nagappan Nayar, K., K. Satyanarayana Rao, M.E. Rajapandian and A.D. Gandhi** 1988. Induced maturation and spawning of *Crassostrea madrasensis*. *CMFRI Bulletin,* 42(2): 330-333.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : One of the constraints in the development of hatchery techniques for the production of the seed of oysters on a year round basis is the difficulty in getting spawners from the natural stock throughout the year. In order to overcome this attempts were made for induction of maturation of gonad of *Crassostrea madrasensis* and to make them spawn. After conditioning the oysters in laboratory. Gonads matured within fifteen to twenty days. Spawning was effected by administering thermal stimulation. The conditioning of *C. madrasensis* for maturation of gonads and effective spawning are described.

1709. **Nagarajan, B., I. Suresh, D. Sundar, R. Sharma, A.K. Lal, S. Neetu, S.S.C. Shenoi and D. Shankar** 2006. The Great Tsunami of 26 December 2004: A description based on tide-gauge data from the Indian subcontinent and surrounding areas. *Earth, Planets and Space,* 58(2): 211-215.

Address : Geodetic and Research Branch, Survey of India, 17, E.C. Road, Dehra Dun, Uttaranchal 248001, India; National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

Abstract : The Great Tsunami of 26 December 2004 is described using data from seven tide gauges in India and others from surrounding areas in the Indian Ocean. The tsunami struck the Indian east coast around 0330 UTC. The amplitude was 2 m above the tide at Chennai, Paradip, and Colombo. The east coast of India (and of Sri Lanka) was hit shortly after high tide; Tuticorin and Colombo, however, were hit shortly after low tide. The tsunami wave propagated northward along the Indian west coast. All these gauges are to the west of the earthquake zone and the detided sea levels show first a rise in sea level with the arrival of the tsunami, and then a sharp decrease. Spectral and wavelet analysis of the detided series show that the maximum amplitude was at a period of 35-45 minutes, with another maximum around 20 minutes. Along the Indian east coast, however, there is another broad peak between 1-2 hours within the first few hours after the first tsunami wave.

1710. **Nagarajan, S., S. Salavadi Eswaran, S. Ravikumar and S.L. Sasikala** 2001. Ethanol production in immobilized yeast system. *J. Sci. Ind. Res.*, 60: 499-503.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Present study deals, with the quantitative production of ethanol from pyurvate and acetaldehyde separately before and after supplementing with glucose. Statistical analyses indicate three aspects: (i) determination of mean yield before the addition of intermediates, (ii) determination of significant variation after the addition of intermediates, and (iii) calculation of new mean yield. Ethanol production increase was statistically significant after the addition of intermediates. Maximum production was obtained when glucose was added along with pyruvate (P> 0.05 level). Hence, it is evident that addition of pyruvate along with glucose in the fermentation medium statically increases the ethanol yield.

1711. **Nagarathinam, V., K. Jeyagobi and R. Palanivelu.** 1990. Coral reef mapping through remote sensing techniques. pp. 239-244. ***In***: *Sea level variation and its impact on coastal environment.* (ed) G. Victor Rajamanickam.

Abstract : Corals in the form of fringing reef occur in patches on the shallow continental shelf around the southernmost part of the eastern coast of India. Systematic mapping is needed for the organised exploitation of

the flora and fauna of this region and also for the preservation of the ecosystem. Landsat TM data was used for supervised classification and mapping. The results of such digital mapping were found to be satisfactory for effective inventory and environmental monitoring. Simple techniques such as band ratioing of different combinations and their use for this particular study are also discussed.

1712. **Nagendra, R., R. Kannan, R. Bhavani, P.S. Johari, A.N. Reddy and B.C. Jaiprakash** 2004. Pleistocene-Holocene deep water benthic foraminifera, off Tuticorin coast, Bay of Bengal. *J. Geol. Soc. India*, 63(1): 51-60.

Address : Center for Geoscience/Engineering, Anna University, Chennai - 600025, India; Department of Earth Sciences, University of Windsor, Windsor, Ont., Canada; Regional Geology Laboratory, Oil and Natural Gas Corporation Ltd., Chennai - 600 034, India; ONGC, Tripura Project, Agarthala - 799014, India.

Abstract : Twenty-four Pleistocene-Holocene deepwater benthic foraminiferal species were identified based on taxonomic criteria from a 2.6 m core sample collected during Academik Aleksandr Sidorenko cruise. The quantitative data of benthic foraminiferal taxa is treated statistically using multivariate (both factor and cluster) techniques to understand the relationship between species assemblages and environmental parameters. The temporal distribution of samples in cluster II closely coincides with the distribution of higher loading values of factor 1. Similar associations were identified for cluster III with factor 2 and cluster IV with factor 3. However the faunal relative abundances along with % Total Organic Content (TOC) values broadly divides the core into two environmentally significant zones viz., Zone 1 (between 1,322.6m and 1,321.6 m) which is characterised by high abundance of *Cassidulina carinata* followed by *Pullenia bulloides* and *Hoeglundina elegans* having positive relationship with low TOC values ranging from 0.12 to 1.14 and Zone 2 (between 1,321.6m and 1,320.1 m), which is characterised by high percentages of TOC values ranging from 1.32 to 2.52; whereas *Bulimina aculeata* shows maximum abundance followed by *Bolivina robusta, Cibicidoides kullenbergi* and *Osangularia culter*, suggesting that these species prefer high nutrient environment.

1713. **Nair, A.K.K., G.R. Unnithan and H.K. Iyer** 1992. On the yield rates in the Indian prawn processing industry. *FAO Indo-Pacific Fish. Comm.*, 470 (*Suppl*): 77-87.

Address : Central Institute of Fishery Technology, Cochin - 682 029, Kerala, India.

Abstract : Data were collected from prawn peeling sheds and processing factories in Cochin, Calicut, Mandapam, Vizagapatnam, Bhubaneswar, Paradeep, Puri and Calcutta, India. Peeling and deveining operations were done by the employees of these establishments under commercial conditions. Weighing was carried out by staff of CIFT. It was found that the rates of recovery of meat on peeling was independent of variations in the quantity of raw material taken. For regular collection of data whole prawns of uniform size were weighed and the weight and number of prawns were noted. Then the whole prawns were beheaded and the weight of the headless prawns recorded separately for each sample. The headless prawns were then peeled and the weight of meat recovered was noted for each sample. The yield rates, along with 95% confidence intervals, were calculated from these data for all commercially important varieties of prawns.

1714. **Nair, C.M., K.R. Salin and T.M. Yohannan** 2004. The fishery, trade and conservation of seahorses along the Indian coast. *Proc. Nat. Sem. on New Frontiers in Marine Bioscience Research, January 22-23, 2004.* pp. 513-526.

Address : Central Marine Fisheries Research Institute, Calicut Research Centre, West Hill PO, Calicut, Kerala, India.

Abstract : Seahorses are among the most unusual fishes in existence, and are intended primarily for medicine rather than food. An organised fishery and trade of seahorses existed in India along the Palk Bay and Gulf of Mannar coasts. At the Palk Bay coast, seahorses are targeted by divers along with sea cucumbers and chanks. In the Gulf of Mannar, which provides a less suitable habitat, most of the seahorses are landed as by-catch of shrimp trawling. Seahorses are also fished from Kerala as a by-catch of trawling, though there exists no organised fishery and trade. A total of six species of seahorses were identified from the Palk Bay coast whereas only two species were obtained from Kerala. Most seahorses from India were exported to Singapore, Hong Kong, Malaysia and UAE from Chennai, Tamil Nadu, India. The volume of dried seahorse trade from India was estimated to be 9.75 MT as derived from the catch data in 2001, which was much higher than the official MPEDA statistics of 4.34 MT exported from India during 2001-02, underlying the fact that a lion's share of the exports might be through non-conventional means and had gone undeclared. Seahorses are vulnerable to degradation of their preferred sea grass, mangrove and coral reef habitats, apart from fishing. A holistic approach, based on a detailed study of the population dynamics of seahorses that is integrated with coastal zone protection measures and the

known strategies of fisheries management, is critically important to conserve the seahorses.

1715. **Nair, M.K.R and S. Girija** 1993. Edible oysters- present status of product development and domestic market potential in India. *Mar. Fish. Infor. Serv. T & E Ser.,* 125: 10-17.

Address : Integrated Fisheries Project, Cochin, Kerala, India.

Abstract : The quantity of processed oyster products produced during the five year period from 1985 to 1989 is discussed.

1716. **Nair, M.R., T.S.G. Iyer and K. Gopakumar** 1994. Processing and quality requirements of *Beche-de-mer*. *CMFRI Bulletin*, 46: 76-78.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This paper deals with processing, composition, common quality defects, and export specifications, suggestions for improvement in the processing and finally precautions to be taken during processing.

1717. **Najmudeen, T.M.** 1986. Historical notes on Seeniappa Dharga. *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp,* pp. 13-14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1718. **Najmudeen, T.M., Boby Ignatious, A.C.C. Victor, A. Chellam and D. Kandasami** 1999. Spawning, larval rearing and production of juveniles of the tropical abalone *Haliotis varia* Linn. *Mar. Fish. Infor. Serv. T & E Ser.,* 163: 5-8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The selection of Brood stock and their maintenance, the larval rearing and the diatom culture for feeding habits were studied in this article.

1719. **Najmudeen, T.M and A.C.C. Victor** 2003. Annual reproductive cycle of the tropical abalone *Haliotis varia* Linnaeus in Mandapam, Gulf of Mannar. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 88-90.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India. E-mail: najmudeentm@yahoo.com

Abstract : Pearls produced by abalones have an unique purity and luster. In India, abalones are represented by only one species, *Haliotis varia* and is distributed in the Gulf of Mannar. *H. varia* collected from the intertidal rocks of Manoli Island at Mandapam (09º16' N 79º12' E) were then stocked in a 1.5 ton capacity FRP tank with filtered seawater and kept overnight to allow the clearance of waste materials accumulated in their body. The maturity stages of the gonad were classified as early maturing, late maturing, ripe, partially spawned, spent and indeterminate, based on the colour, size and nature of turgidness of the gonad and microscopic appearances such as ova diameter and presence of sperms. The gonadosomatic index (GSI) and hepatosomatic index (HSI) for each abalone was calculated using standard formula. *H. varia* is dioecious. Almost all the stages of gametogenic activity were found throughout the period of sampling. The pooled GSI showed the highest value in January (7.160) indicating the onset of gonadal maturity. From December to February, high values of GSI were maintained. These peak values followed by a consistent drop in the index value were indicative of large spawning events in the natural habitat. There were other two peaks of GSI obvious at this population in April and July mainly due to the presence of ripe male gonads in the sample. Variations were observed in the synchrony of male and female spawning periods with mature male gonads were evident in the months other than the breeding season. When GSI was analyzed for males and females separately, the values were found to be consistently higher for females. However, both pooled data and sexwise separated data indicated significant variations in gonad indices throughout the year of sampling.

1720. **Nalini, K.P.** 1938. Observations on the structure and function of the nidamental glands of *Chiloseyllium griseum* Mull & Henle with a note on the formation of egg capsule. *Proc. 25th Indian Sci., Congr.,* 165.

1721. **Nalluchinnappan, I., Daniel Sudhandra Dev, M. Irulandi and Y. Jeyabaskaran** 1982. Growth of pearl oyster *Pinctada fucata* (Gould) in cage culture at Kundugal Channel, Gulf of Mannar. *Indian J. Mar. Sci.,* 11(2): 193-194.

Address : Tamil Nadu Fisheries, Pearl Culture Scheme, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Pearl oysters (*Pinctada fucata*) were cultured in pigeon hole box cages. The smaller size group

showed higher growth rate during the initial months and showed average increase in dorso ventral measurement from 9.9 to 24.9 mm in 7 months.

1722. **Nalluchinnappan, I., Y. Jeyabaskaran and S. Krishnamoorthy** 1982. Effect of temperature and salinity on catches of "Choodai" at Tuticorin, Gulf of Mannar. *Matsya.* 8: 62-64.

Address : Marine Biological Station, Tuticorin-628 001, Tamilnadu, India.

Abstract : A study was conducted to determine the effects of temperature and salinity on the abundance of *Sardinella* species in the Gulf of Mannar during the period 1974-76. Annual catch data showed a direct relationship to the annual average salinity value, indicating higher salinity conditions favoring the Sardinella fisheries. The temperature range during the period was 27.8-29.4° C.

1723. **Nalluchinnappan, I and Y. Jeyabaskaran** 1991. Observations on the biology of *Thryssa mystax* off Tuticorin Coast, Gulf of Mannar, eastcoast of India. *J. Mar. Biol. Assoc. India,* 33(1&2): 49-54.

Address : Tamilnadu Fisheries Department, Madras - 600 006, Tamilnadu, India.

Abstract : The second important pelagic fishery at Tuticorin is *Thryssa* spp. The food of *T. mystax* is mainly zooplankton. Juvenile and adult fish differ in their food habits. The length weight relationship is in accordance with cube law ($W = 0.00002383\ L^{3.1063}$. The point of inflexion in the ponderal index is noticed at 122 mm size which denotes the size at first maturity of this species. It has a prolonged spawning season right from December to June with a mean fecundity value of 12,703. Based on the ova diameter frequency polygons, it may be inferred that *T. mystax* spawns during a definite period between December to June.

1724. **Nammalwar, P.** 1978. Blood sugar estimation in the estuarine crab *Scylla serrata* (Forskal). *Sci. Cult*., 44(12): 543-544.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The method used to estimate the blood sugar level of *S. serrata* is described. The sugar content of the blood was 124 mg glucose/ml.

1725. **Nammalwar, P and K. Narayanan** 1979. Mass mortality of fishes due to the bloom of *Trichodesmium thiebautii* on the Gulf of Mannar coast. *Sci. Cult.,* 45(4): 170-171.

1726. **Nammalwar, P.** 1986. Report on the catch of a juvenile whale shark *Rhincodon typus* at Kilakkarai, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 66: 30.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A juvanile whale shark measuring 3.15 m in total length was caught at 05.00 hours on 07-02-1983 at Kilakkarai, Gulf of Mannar.

1727. **Nammalwar, P and G. Mohanraj** 1988. Research and development of induced breeding of marine finfishes in India. *CMFRI Spec. Publn.,* 40: 57.

Address : Central Marine Fisheries Research Institute, Madras, Tamilnadu, India.

Abstract : The paper highlights the role of induced breeding of marine finfishes in aquaculture research and development in India. The methods employed, research results achieved and the constraints encountered in broodstock management and mass propagation of cultivable grey mullet, milkfish, rabbit fish and other marine finfish larvae in hatcheries are reviewed. Problems associated with ovarian development and maturation, larval foods, bacterial contamination, environmental influence and design of hatchery facilities are discussed. A survey on the cultivable marine finfish spawner resources to locate potential areas was conducted along the coastal waters and estuaries. A review of the present status of research and development in induced breeding of marine finfishes and the future strategies are presented.

1728. **Nammalwar, P and G. Mohanraj** 1988. Marine finfish culture research and development in India. *CMFRI Spec. Publn.,* 40: 62.

Address : Central Marine Fisheries Research Institute, Research Centre, Madras, Tamilnadu, India.

Abstract : A review is made of research and development work done on marine finfish culture in India. Information on the resource potential of the various ecosystems utilised, different species of fishes cultured in mono and

polyculture systems, economics and low-cost technology developed for the culture of various species of marine finfishes in different systems are given. The aquaculture practices mainly deal with milkfish, grey mullet, Indian sandwhiting, rabbit fishes and groupers in various ecosystems. Details of suitable areas for culture and production, pond construction, constraints, management and development of coastal fish farms are presented. The ecological and socioeconomic criteria for the selection of suitable aquaculture sites for management and development of marine finfish culture in India are discussed.

1729. **Nammalwar, P and G. Mohanraj** 1990. Present status on induced breeding of marine finfishes in India. *CMFRI Bulletin,* 44(2): 383-393.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper deals with the present status on induced breeding of marine finfishes in India. The role of induced breeding of marine finfishes in aquaculture research and development is emphasised. A review on the seasonal availability of marine finfish spawners such as milkfish and grey mullet from the coastal waters end estuaries in India was made. The methods employed in the collection of live fish breeders from the wild, constraints encountered in broodstock management and Induced breeding for mass propagation of grey mullet. Milkfish, rabbit fish and other marine finfish larvae in hatcheries are given. The problems and prospects on induced breeding of marine finfishes in India are discussed.

1730. **Nammalwar, P and G. Mohanraj** 1990. A review of marine finfish culture research in India. *CMFRI Bulletin,* 44(2): 427-435.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper deals with a review of marine finfish culture research for development in India. Information on the marine finfish seed resources and culture potential of the various estuaries, backwaters and coastal waters, the different species of finfishes cultured in mono and polyculture systems and development of technology for the culture of various species of marine finfishes in different culture systems are given. In India, the aquaculture practices so far have mainly dealt with milkfish, grey mullets, Indian Sandwhitting, rabbit fishes, perches and groupers in various ecosystems. Details of methods of pond construction, suitable areas for culture and production constraints met with in maintenance, management and development of coastal fish farms are presented. The problems in marine finfish culture research for development in India are discussed.

1731. **Nammalwar, P., P. Livingston, C. Kasinathan and N. Ramamurthy** 1992. Instances of whale shark, *Rhincodon typus* Smith along the Tamilnadu coast. *Mar.Fish. Infor. Serv. T & E. Ser.,* 116: 20.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A whale shark *Rhincodon typus* Smith was caught at Dhanuskodi near Rameswaram. The total length was observed as 556 cm. The morphometric and anatomic observations are given.

1732. **Nammalwar, P., A.P. Lipton, S. Krishna Pillai, G. Maheswardu, C. Kasinathan, M. Bose, N. Ramamoorthy and P. Thillairajan** 1994. Instances of finless black porpoise, *Neophacaena phocaenoides* caught in Mandapam region along the Palk Bay coast in Tamil Nadu. *Mar. Fish. Infor. Serv. T & E. Ser.,* 127: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements in cm of finless black porpoise are discussed.

1733. **Nammalwar, P.** 1998. Studies on Mangroves ecosystems of Gulf of Manner Islands and their influence on larval recruitment of economically important fishes and prawns. *Report submitted to Ministry Environment and Forests, New Delhi,* pp. 25.

1734. **Nammalwar, P., R. Marichamy, A. Raju, P. Jayashankar, M.R. Arputharaj, C. Kasinathan and S. Palanichamy** 1999. Collection, Transport and Maintenance of Asian Seabass *Lates Calcarifer* (Bloch). *Proc. Fourth Indian Fish. Forum,* dated 24th to 28th Nov'1996. pp. 45-47.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This paper deals with the collection, transport and maintenance of live seabass, *Lates calcarifer* from the wild in Gulf of Mannar and Palk Bay region during April, 1990 - March, 1994. Preliminary surveys have revealed that most of the specimens collected from the wild were immature and maturing males throughout the year. This species has been found to be protandrous hermaphrodite and the size around with the males undergo

sex change in the natural habitat has been studied. Forage fishes freshly killed sardines and formulated feed was given to the broodstocks during maintenance in concrete tanks and net cages in the sea. Broodstocks were administered with steroid hormones (â- estradiol - â diol) and human chorionic gonadotrophin @ 250µg and 50 I.U./Kg body weight respectively at 60 days intervals for the acceleration of gonadal maturation. Gonadal development of the broodstocks was monitored through live biopsy at 90 days intervals.

1735. **Nammalwar, P.** 2000. Coral fauna in Gulf of Mannar, Tamilnadu. *Regional seminar on productivity of coral reefs in Gulf of Mannar, Kamaraj College, Tuticorin*, pp. 1-8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1736. **Nammalwar, P and K. Muniyandi** 2000. Mangrove ecosystems of Gulf of Mannar, Tamilnadu. *Golden Jubilee Celebrations Souvenir 2000, Mandapam R.C of CMFRI, Mandapam Camp.* pp. 53-57.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Mangroves are termed as 'Tropical tidal wet lands' with typical vegetations distributed along the border of the sea and lagoons reaching upto the edges of the rivers to the point where the water is saline and growing in swampy soils covered by the saline water during high tides. The mangroves dominate almost one quarter of world's tropical coastline. When conditions are favourable, they may form extensive and productive forests protecting the coastline. Mangrove ecosystem serves as the reservoir of species of plants and animals associated together. The mangrove swamps and forests are more diverse and luxuriant in the Indo-Pacific region. The mangroves of India have received inadequate and insufficient attention in the past. Most of the mangroves are on the verge of disappearance due to overexploitation. No sustainable effort has been made to study them in a comprehensive manner.

1737. **Nammalwar, P and M. Rajagopalan** 2000. Marine turtles of Gulf of Mannar, Tamilnadu. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp*, pp. 95-98.

Address : Central Marine Fisheries Research Institute, Madras, Tamilnadu, India.

Abstract : Marine turtles have very long geologic history. They were common in the Cretaceous, 130 million years ago and their fossil record extends back atleast 200 million years. They lived together with dinosaurs and have survived the giant plesiosaurus and Ichthyosaurus. All present day genera and species originated in the period from the early Eocene to the Pleistocene between 60 and 10 million years ago. Together with the marine snakes and iguanas, they are the only surviving seawater adapted reptiles. Their distribution is mostly tropical and subtropical and they depend on the land only during the reproduction period.

1738. **Nammalwar, P.** 2001. Collection of quantitative and qualitative data on fisheries - Gulf of Mannar. Development of GIS based information system for critical marine habitat in the coastal marine area. *Report submitted to Department of ocean Development, New Delhi.* pp. 145.

Address : Central Marine Fisheries Research Institute, Madras, Tamilnadu, India.

1739. **Nammalwar, P and V. Edwin Joseph** 2002. Bibliography of the Gulf of Mannar. *CMFRI Spec. Publ.,* 74:1-204.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Gulf of Mannar which forms an important ecosystem along the Indian Coast has been the focus of anthropogenic interferences and as a result attracted great deal of attention of scientific community. The Gulf of Mannar Marine Biosphere Reserve (GOMMBR) is the India's first National Marine Park. The development of Marine Fisheries in the Gulf of Mannar Ecosystem requires thorough knowledge on the relative abundance of various commercially exploitable fin fish, shell fish and other organisms with their biology for designing appropriate management strategies for sustainable production besides conserving the marine biodiversity. In order to document the information based on these aspects from the Gulf of Mannar in Tamil Nadu, an attempt is made to compile all the published information in the form of a special publication. This ecosystem supports wide spectra of flora and fauna of taxonomic and economic importance. They are comprised of 128 species of corals, 241 species of crustaceans, 731 species of molluscs, 441 species of fin fishes, 171 species of seaweeds, 15 species of seagrasses besides seasonally migratory marine mammals like whales, dolphins, porpoises, dugongs and all the species of turtles. This habitat holds vast patches of mangroves belonging to 9 species of vegetation along with the supporting fauna. A large number of taxonomic, biological, ecological studies on coral reefs, mangroves, seaweeds, seagrasses, sponges, corals, gorgonids, polychaetes, crustaceans, bivalves, gastropods, echinoderms and fishes of the Gulf of Mannar have been made by the Central Marine Fisheries Research Institute and other organizations.

1740. **Nandakumar, G and R.V. Nair** 1974. On a new prawn ground in the Gulf of Mannar. *Indian J.Fish.*,21(1):281-284.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Since the beginning of the last decade, systematic exploratory surveys to assess the fishery potential of the offshore regions of the Gulf of Mannar were undertaken by the Deep Sea Fishing Station, Government of India and the Indo-Norwegian Project from Tuticorin and Mandapam bases respectively. The results of these surveys have revealed certain productive fishing areas for fish and prawns (Rao, 1968; Rao and Dorairaj, 1969; James and Adolf, 1969). Encouraged by these results, entrepreneurs came forward to undertake offshore fishing on a commercial scale and at present there are about 250 mechanised boats regularly engaged in trawl fishing in the Gulf of Mannar and Palk Bay, with Mandapam, Pamban and Rameswaram as their bases of operation.

1741. **Nandakumar, G.** 1978. Change in species composition of prawns in the trawl fishery at Mandapam. *J. Mar. Biol. Assoc. India*, 20(1&2): 181-182.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Prawns form an important constituent of the trawl catches at Mandapam. By and large the green tiger prawn *Penaeus semisulcatus* de Haan, is one of the important species contributing to the prawn fishery. In recent years significant change in the pattern of species composition has been observed and is dealt with.

1742. **Nandakumar, G**. 1980. Observations on the prawn fishery of the Mandapam area. *Indian J. Fish*., 27 (1 & 2) : 257-260.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Trawling for prawns is carried out at night. The prawn fishery showed annual fluctuations and the average annual prawn catch was estimated to be 309.12 tonnes forming 17.78% of the trawl landings. January to May was the peak season for the fishery contributing 60.6% of the prawn catch. The average catch per unit for prawns was 27.12 kg. The fishery was chiefly supported by *Penaeus semisulcatus* (88.72%) and *Metapenaeus affinis* (11.28%).

1743. **Nandakumar, G.** 1982. Experimental prawn culture in coastal ponds at Mandapam Camp. *Part-1: Prawn Culture.* MBAI, Cochin, India, 6: 103-111.

Address: Central Marine Fisheries Research Institute, Cochin - 682 018, India**.**

Abstract : This paper deals with the experimental culture of *Penaeus indicus* and *P. semisulcatus* carried out in two coastal ponds at the fish farm of the Central Marine Fisheries Research Institute at Mandapam Camp for a period of 158 days during 1978 and 1979. Seawater was pumped into the culture pond daily to maintain water level at 0.75 m. Two experiments were carried out to study the growth rate of *P. indicus* at a stocking rate of five numbers per sq. m, one with supplementary food and the other with natural food elements produced by application of inorganic fertilizers. In the third experiment, *P. semisulcatus* stocked at the rate of three per sq. m were fed with pelletised supplementary food. Results of the above experiments are presented and discussed in the background of experimental culture operations carried out earlier.

1744. **Nandhagopal, K and S.K. Subramanian** 2004. Biosorption of Chromium VI by ubiquitous *Sargassum* biomass. *Seaweed Res. Utiln.*, 26(1&2): 77-82.

Address : Department of Botany, Centre for Research and P.G. Studies, Thiagarajar College, Madurai-625 009, Tamilnadu, India.

Abstract : The possibility of utilizing *Sargassum wightii* biomass for biosorption of toxic hexavalent Chromium VI was investigated at various pH ranges. The binding rate of Chromium metal at sequestering sites was very rapid at the initial stage of sorption process and reached equilibrium after 165 min in the agitation time experiment. The removal of Chromium was increased with the increasing dosage of adsorbing agent. The adsorption also increased at acidic pH ranges than at neutral or alkaline adsorbate. As the biomass concentration decreases, the percent biosorption also reduces over a period of contact time in the pH experiments.

1745. **Naomi, T.S., K.J. Mathew and Geetha Antony** 1990. Studies on the distribution of recent planktonic foraminifera in the Arabian sea and Bay of Bengal. *Proc. First workshop Scientific Results, FORV Sagar Sampada, 5-7 June*, 1989. pp. 71-79.

1746. **Narasimham, K.A., P. Muthiah, C.P. Gopinathan and A.D. Gandhi** 1988. Larval rearing and spat production of the great clam, *Meretrix meretrix* (Linnaeus). *Indian J. Fish.,* 35(2): 107-112.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The venerid clam Meretrix meretrix (Limnnaeus) was spawned in the laboratory and for the first time the eggs were reared successfully through various stages to spat. Setting was observed on day 7 and day 10 after fertilization and was mostly completed by day 9 and 12 respectively in the two experiments. The clam seed attained an average length of 2.895 mm and height of 2.475 mm on day 75. During the rearing experiments the haptophycean flagellate, *Isochrysis galbana* was given as food. In the light of the results obtained here the thrust areas for standardising the procedures in the hatchery production of the seed of *M. meretrix* are discussed.

1747. **Narasimham, K.A., P. Muthiah, D. Sundararajan and N. Vaithinathan** 1988. Biology of the great clam, *Meretrix meretrix* in the Korampallam Creek, Tuticorin. *Indian J. Fish.,* 35(4): 288-293.

Address : Central Marine Fisheries Research Institute, Research Centre, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In the great clam *Meretrix meretrix* spawning period is prolonged and the reproductive cycle is biannual in January-April and June-October with peak spawning activity in January-February and September. The proportion of males to females is not significantly different at 5% probability from the theoretical 1:1 ratio. The condition index, expressed as percentage of wet flesh weight in total weight varied from 7.6 to 16.1 with an average of 12.1. The parameters of the Von Bertalanfly growth equation in *M. meretrix* are L < = 99.1 mm, K = 0.3221 per year, and t = -0.0745 year. The life-span is estimated as 7.8 years. The various dimensional and length-weight relationships are given. Also the environmental conditions of the clam bed are described.

1748. **Narasimham, K.A.** 1990. Recent advances in the hatchery production of seed of some commercial bivalves in India. *J. Indian Fish. Assoc.,* 18: 21-25.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Central Marine Fisheries Research Institute has established a shellfish hatchery laboratory at its Tuticorin Research Centre with the objective of developing appropriate technology for the production of seed of commercial bivalves. A viable technology was developed for the mass production of the seed of *Pinctada fucata, P. margaretifera, Crassostrea madrasensis, Perna indica , P. viridis, Anadara granosa,* and *Meretrix meretrix*. The hatchery facility and the technology, comprising brood stock conditioning, induced spawning, larval rearing and seed production are described. In the light of these developments the future outlook is appraised.

1749. **Narasimham, K.A., R. Marichamy, D.B. James, P. Nammalwar and A.C.C. Victor** 1992. The survey of Valinokkam Bay and adjoining area to asses its suitability for integrated sea farming - A Report. *Mar. Fish. Infor. Serv. T & E. Ser.,* 117: 1-8.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A survey of the Valinokkam Bay and adjoining area was conducted to assess its suitability for developing the Integrated Sea Farming Project. During this two day survey, data were collected on several parameters, relevant for initiating sea farming of several candidate species. The results of this survey are given in this report.

1750. **Narayanan, K.R.** 1972. The sacred chank of India. *Seafood Export J.,* 4(5): 25-27.

1751. **Narayana Pillai, V.** 2000. Bivalve mariculture in India (Pearl oyster, edible mussel and oyster): A success story in coastal ecosystem development.

Address : Asia Pacific Association of Agricultural Research Institute, FAO office in India. 55, Max Muller Marg, New Delhi - 110 003.

Abstract : Pearl is one of the oldest of the known gems, produced by the living animal called the pearl oyster. India is well known for the production of natural pearls from time immemorial. There are recorded historical evidences that the country had exported this valuable merchandise to Greece and Rome more than 2000 years ago. India has a wealth of pearl producing oysters the *Pinctada fucata* distributed in the Gulf of Mannar, Palk Bay and Gulf of Kutch and the blacklip pearl oyster, *P. margaritifera* in the Andaman and Nicobar islands.

1752. **Narayana Pillai, V.** 2000. Present status of mariculture in India. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp,* pp. 6-9.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Aquaculture, the farming of aquatic animals and plants has been the world's fastest food production system for the past decade with an average compound growth rate of 9.6% per year since 1984. On the basis of the rapid growth of the aquaculture sector and recent stagnation of landings from capture fisheries, aquaculture is seen by many as a potental source of hope to meet the current and future needs of a growing population in search of food. The marine ecosystem with its rich resource of fauna and flora has sustained both capture fisheries and mariculture activities. India ranks second in aquaculture production next to China. However 90% of the production is from freshwater ecosystem with very little contribution from marine sector. Though there is increased demand for seafood both in the domestic and export market the present marine fisheries scenario is characterized by declining yields from inshore waters and increased conflict between different resource users. However, the vast coastal zone indicates the prospects for augmenting the production through large scale seafarming.

1753. **Narayana Pillai, V., K.K. Appukuttan and A.C.C. Victor** 2001. Pearl culture. ***In***: *Bivalve mariculture in India.* V.N.Pillai *et al.,* (eds.), Asia Pacific Association of Agricultural Research Institutions, Bangkok. pp.3-15.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

1754. **Narayana Rao, K.V., M. Kumaran and J. Sankara Subramanian** 1977. Resources of Horse Mackerel off the southwest coast of India. *Seafood Export J.,* 9(8): 9-27.

Abstract : Distribution of biomass estimates (in tons) of horse mackerel by coverage and area of Gulf of Mannar for the year 1972-75 is given.

1755. **Narayana Rao, K.V., M. Kumaran and J. Sankara Subramanian** 1977. Resources of Ribbon Fish and Cat Fish of the southeast coast of India. *Seafood Export J.,* 9(11): 9-25.

Abstract : Exclusive catch data of catfish and ribbon fishes for Gulf of Mannar for the year 1972-75 are given.

1756. **Narayan Rao, C.R.** 1934. Enteropneusta from Krusadai Island. *Curr. Sci.,* 3(2): 70.

Address : Marine Biological Station, Krusadai Island, Gulf of Mannar, India.

Abstract : Among the specimens contained in our collection, there are two distinct species of the genus *Clamydothorax*. It may be recalled that Spengel mentions in his monograph on Enteropneusta *Plychoderna ceylonica,* two specimens were obtained from the west coast of Ceylon. I have carefully examined the internal anatomy of the Krusadai forms and I have no hesitations in saying that there are two different species of *Clamydothorax* contained in our collection.

1757. **Natarajan, A.V.** 1957. Studies on the egg masses and larval development of some prosobranchs from the Gulf of Mannar and the Palk Bay. *Proc. Indian Acad. Sci.,* 46B: 170-228.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In recent years our knowledge of the eggs and larvae of marine gastropods has increased considerably. The investigations of Lebour (1937) and Thorson (1946) have added much to our knowledge of the eggs and larvae of prosobranchs from Plymouth and Danish waters. Francis (1948) investigations at Algiers and Banyuls supplement at many points the work of Lebour and Thorson. The breeding habits of this group of molluscs at Bermuda as well as in East Greenland and Iceland have also been studied by Lebour (1945) and Thorson (1935, 1941).

1758. **Natarajan, P and R. Thiagarajan** 1979. Methods of shell cleaning and polishing. *Seafood Export J.,* 11(6): 19-25.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The authors describe in detail various methods of shell cleaning and polishing. These methods include (1) burying; (2) hanging; (3) sun-drying; (4) refrigeration; (5) boiling; (6) treatment with formalin and (7) washing with water.

1759. **Natarajan, P.** 1980. Redescription of the flat fish *Paradachirus marmoratus* (Lacepede) from Indian waters. *J. Mar. Biol. Assoc. India,* 22(1&2): 165-168.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The note describes *Pardachirus marmoratus* (Lacepede) (Order: Pleuronectiformes, Family: Soleidae) occurring in the Gulf of Mannar along the Indian Coast. The presence of pores at the base of each dorsal and anal ray, both on the dextral and sinistral side of the specimens is found to be a noteworthy feature.

1760. **Natarajan, P., V. Ramadhas and N. Ramanathan** 1982. A case report of mass mortality of marine catfish. *Sci. Cult.,* 48(5): 182-183.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : *Tachysurus maculatus* is one of the commercially important marine species of catfish known to occur along the coasts of India, Pakistan, Bangladesh, Burma, Hong Kong, Formosa and Japan. Large-scale mortality of *Tachysurus maculatus* was observed in a 300-acre water body, which is adjacent to the coastal region at Therespuram. The mortality of *T. maculatus* was due to high salinity, low dissolved oxygen and the presence of hydrogen sulphide. *T. maculatus* is a bottom feeder and the bottom conditions might have affected the physiology of the fish.

1761. **Natarajan, P and J.D. Jameson** 1984. Effects of food ration on growth and dietary protein conversion in three species of fish fingerlings. *Comp. Physiol. Ecol.,* 9 (suppl) : 348-351.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Experiments were conducted in *Tilapi mossambica*, *Labeo fimbriatus* and *Mystus punctatus* fingerling to determine the effects of three food rations (5, 7.5 & 10%). The data revealed that 1) gross food conversion efficiency was significantly high in Tilapia fed at 5 and 7.5% ration; 2) Labeo and Mystus recorded negative food conversion efficiency (-2.8% & -28%) and protein conversion efficiency (-3% to -9%); 3) in constrast to their negative conversion efficiencies between food and conversion, the relationship index "r" showed -0.66 for Labeo and -0.82 for Mystus, indicating that there is no significant relationship between the two parameters. Mystus lost its body protein reserve at all rations pronouncing its incapability of protein ration at lower protein content diets.

1762. **Natarajan, P., K. Ramadoss, D. Sivalingam and P. Thillairajan** 1988. Ornamental shell industry of Ramanathapuram coast. *CMFRI Bulletin,* 42(1): 106-110.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : As many as twelve shell craft industries established at Keelakarai and Rameswaram cater to the demand of the internal and external market of ornamental shells in India and abroad. Several species of molluscan shells which occur in the Gulf of Mannar and Palk Bay constitute the raw materials for these industries. Apart from very rare species, 15 important species are regularly exploited for this purpose. The Genus *Lambis* commonly known as 'Spider conch' is very important among them by virtue of its abundance. Of the 9 species of *Lambis* known from India, only 3 species are abundant in this coast. Exploitation of these shells are mostly by skin diving and to a limited extent by trawl, gill and drag nets employed mainly to catch finfishes, lobsters and crabs. This paper mainly deals with the ornamental curious and religious values of molluscan shells their industry, types of shells and species used by the industry, varied products, marketing, employment opportunities and certain aspects of costs and earning of the industry.

1763. **Natarajan, P., S. Palanisamy, S. Mohan and R. Thiagarajan** 1997. Development of novel techniques to maintain *Chlorella* spp. stock culture in artificial seawater. *Mar. Fish. Infor. Serv. T & E Ser.,* 148: 12-13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

1764. **Neelakanta Pillai, N.** 1978. Seed production. *CMFRI Spec. Publ.,* 3: 75-80.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : In traditional brackishwater prawn farming in India (paddy and prawn farming in Kerala as well as the culture of prawns in impoundments called 'bheris' in West Bengal) stocking is mainly done by natural process. Post-larvae and juveniles of prawns enter the fields during the rising tide. Since the occurrence of young prawns fluctuates widely from place to place and from season to season, the rate of stocking is beyond control. Moreover a large number of predators are also brought along with the juvenile prawns by the incoming tide, which reduce the actual productive potential of these ponds.

1765. **Neelakanada Pillai, N., K.R. Manmadhan Nair and P.E. Samson Manickam** 1996. Shrimp hatchery. *CMFRI Bulletin,* 48: 88-95.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Successful spawning of *Penaeus japonicus* under controlled conditions and their subsequent rearing upto the juvenile stage by Hudinaga (1942) and his team paved the way for the large scale hatchery production of shrimp seed for aquaculture.

1766. **Neethiselvan, N.** 2001. A new species of cuttlefish *Sepia ramani* sp. nov. (Class : Cephalopoda) from, southeast coast of India. *Indian J. Mar. Sci.*, 30(2): 81-86.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamil Nadu, India.

Abstract : A new cuttlefish *Sepia ramani* sp.nov. collected from Tuticorin Bay (8°48' N, 78°11' E), India, is described based on 50 specimens covering both sexes with a comparison of the closely related species of the same genus. *Sepia ramani sp.* nov resembles *S. pharaonis* in such as fins, funnel, head, buccal membrane and colour and in most of the morphometric characters. However, in *S. ramani* sp.nov, the tentacular club is long with 15-24 enlarged suckers and enlarged suckers are almost sub equal in size, in contrast to 6 enlarged medial suckers of which 3 to 4 suckers are greatly enlarged in *S. pharaonis*. Further, the left ventral arm in males of *S. ramani*.sp.nov is hectocotylised, with 14-16 basal series of quadriserially arranged normal suckers instead of 10-12 in *S. pharaonis*. Both the newly erected species and *S. pharaonis* belonging to strico species complex as the inner cone of both the species are with plate like callosity and without any cavity.

1767. **Neethiselvan, N., V.K. Venkataramani and B. Srikrishnadhas** 2001. Seasonal occurrence of the Siboga squid *Doryteuthis sibogae* (Adam) from Thoothukkudi (Tuticorin) coast, southeast coast of India. *Indian J. Mar. Sci.*, 30(4): 257-260.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamil Nadu, India.

Abstract : Studies on the seasonal occurrence of maturity stages of *Doryteuthis sibogae* revealed that it is a prolonged breeder as matured and spent specimens of both the sexes were recorded almost round the year. Two peak spawning periods, one from August to September and another from December to January were observed. Matured animals were represented by a wider length range inferring non semelparous nature of the species. However, dominance of males during peak spawning season as evidenced from sex ratio studies do confirm existence of a minor degree of post spawning mortality in females. The weight of gonad and nidamental glands increased during maturation and proved as good indices of maturation. Females attained maturity earlier than males. Fecundity showed a significant correlation with dorsal mantle length. *Doryteuthis sibogae* form regular fishery in Thoothukkudi coast on commercial scale. Since this species is a continuous spawner as evidenced in the present study and is intensively exploited at Thoothukkudi bay, an in depth study on stock assessment of this species is an urgent need to sustain the fishery.

1768. **Neethiselvan, N., V.K. Venkataramani and V. Sundararaj** 2001. Status of Squid and Cuttlefish resources of Thoothukkudi coast. *National seminar on marine and coastal ecosystems: coral and mangrove - problems and management strategies, 26-27, Sept 2001, Tuticorin,* p.42.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

1769. **Neethiselvan, N., N. Ramanathan and V.K. Venkataramani** 2002. Breeding biology of the spineless cuttlefish *Sepiella inermis* (Orbigny). 49(1): 97-101.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Studies on the seasonal occurrence of maturity stages of *Sepiella inermis* revealed that this species is a prolonged breeder as mature and spent specimens were recorded almost round the year. Two peak spawning periods, one in November and another in March were observed. Mature animals were represented by a wider length range ruling out the possibility of semelparity. The gonodosomatic and nidamental gland indices increased during maturation. The females attained maturity earlier than males. Fecundity showed a significant correlation with dorsal mantle length. Cuttlefishes contribute substantially to the cephalopod fishery of Thoothukudi (8^{o} 47' N, 78^{o} 9' E), located in southeast coast of India. Out of the three species of cuttlefishes, viz. *Sepia pharaonis*, *Sepia aculeata* and *Sepiella inermis*, which form commercial fishery in this coast, *S. inermis* is notable for its year round occurrence.

1770. **Nelsen, E.** 1959. Primary production in tropical marine areas. *J. Mar. Biol. Assoc. India*, 1(1): 7-12.

Abstract : Most studies of marine primary production have been carried out in temperate or arctic water. The location of most marine institutes, together with the sites of the world's biggest fisheries is of course one of the main reasons for this fact. It would be wrong however, to assert that the tropical parts of the open oceans are particularly little known concerning primary production. These regions are in fact those best understood at present. The German Expeditions during the first third of this century the *Deutschland* and the *Meteor* Expeditions provided the fundamental knowledge concerning the size of the standing stock of phytoplankton in these waters. These were followed by the Danish *Galathea* Expedition in 1950-52 where the organic productivity was measured

by means of the carbon-14 technique. In recent years the work in the open oceans has been greatly intensified. In this article only the primary production by the marine phytoplankton will be discussed. The production caused by sessile microscopic and macroscopic plants living near the coast generally follows the rules valid for the phytoplankton. The carbon-14 technique (Steemann Nielsen, 1952) has rendered it possible to measure the rate of organic production by the phytoplankton, whether it is high or low.

1771. **Nevill, G and H. Nevill** 1869. Descriptions of marine shells from Ceylon. *Proc. Asiat. Soc. Beng.*, 63-64.

1772. **Nevill, G and H. Nevill** 1869. On some new marine gastropods from the southern province of Ceylon. *J. Asiat. Soc. Beng.*, 38(2): 65-69.

1773. **Nichol, J.** 1998. Ecotourism and economic stability: A case for community based ecotourism planning. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve.* pp. 174-178.

Address : The ecotourism society, South Asia Development Planning Inc., F 8/3 Vasant Vihar, New Delhi 110 057.

Abstract : Ecotourism, defined as responsible travel to natural areas that conserves natural environments and sustains the well-being of local people, presents both potential benefits and threats for local communities. Negative impacts of ecotourism affect the local population, as well as the tourism experience for visitors. This, in turn, can lead to a situation whereby tourism is not viable because the destination is no longer desirable for visitors and/or tourism is no longer accepted by the local communities. The potential negative impacts of ecotourism are detailed in this paper.

1774. **NIO.** 1998. Mangroves of India - Conservation Assessment and Management Plan - *Report Summary, National Institute of oceangraphy and Zoo - Outreach organization:* pp. 50.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

1775. **Nithyanandam, A., R. Ramkumar and J. K. Patterson Edward** 2003. Fishery status of two fishing villages in Tuticorin, Southeast coast of India. *SDMRI Res. Publ.*, 3: 177-180.

Address : Sugandhi Devadason Marine Research Institute, 44, Beach Road, Tuticorin 628001, Tamilnadu, India; E-mail: n_anandam@rediffmail.com

Abstract : Fishery developmental programmes are usually carried out with an objective of creating a base for increasing production and to raise the economic status of people involved in this sector. For proper planning and management of fishery resources, the type of fishery, fishing season, marketing and socioeconomic condition of fisherfolk are essential. The assessment of status and fishery of the two fishing villages of Tuticorin Coast, Tharuvaikulam and Siluvaipatti showed comparatively better amenities in Tharuvaikulam when compared to Siluvaipatti. Surprisingly, the illiteracy rate is high in Tharuvaikulam, which has more number of schools. However, the study indicated the need for an urgent awareness creation among the villagers in order to refrain them from destructive fishing. Also, alternate livelihood options along with socioeconomic upliftment schemes are considered vital in these two villages.

1776. **Nithyanandam, A., R. Ramkumar and J. K. Patterson Edward** 2003. Effect of habitat structural complexity on the assemblage of coral reef fish *Pempheris analis* in artificial reefs. *Nat. Sem. Reef Ecosystem Remediation,* 24th-26th Sep'03, SDMRI, Tuticorin, India. p. 38.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin-628 001, India.

Abstract : Ferro cement triangular AR modules were deployed in three areas in Tuticorin coastal waters with different depths. The influence of habitat structural complexity and the assemblage of coral reef fish Bullseye, *Pempheris analis* in the AR stations were observed by underwater visual census. The number of *P. analis* was high in station 3 where the modules were closer to each other than St-l and St-2. whereas in station 1, the assemblage of *P. analis* observed only in areas where the modules were closely placed. This shows that habitat structural complexity had a significant impact on the number of *P. analis* assemblage.

1777. **Nithyanandam, A., R. Ramkumar and J .K. Patterson Edward** 2003. Comparative account on the assemblage of fishes in natural and artificial reefs of Tuticorin, Southeast Coast of India. *Nat. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 57.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Artificial reefs have been used as potential tools for the restoration of marine habitats. In the present study, the fish assemblage established around the artificial reef structures deployed was compared with natural reefs around the islands and mainland area far from AR sites. Survey was carried out using underwater Visual census. A total number of 55 species of fishes were observed in natural and 38 in an artificial reef area. Artificial reefs can be deployed to restore the fish community in the areas where natural reefs have been damaged. AR's do not necessarily mimic the natural environment but it would establish a community of their own, which is influenced by spatial orientation and complexity of the structure.

1778. **Noble, A.** 1982. Distribution of the Indian mackerel, *Rastrelliger kanagurta* along the coasts of India in 1979 and 1980. *Mar. Fish. Infor. Serv. T & E. Ser.*, 36: 7-15.

Address : Fishery Resources Assessment Division, India.

Abstract : The mackerel landings from Ramnad to Kanyakumari coast was rated as 42% of the state's annual landings.

1779. **Nural Shefa, A., E.R. Nisha Lekshmi, S. Ravikumar and K.S. Nanitha** 2002. Studies on photochromic adaptation of solar saltern extremophilic cyanobacteria. *National Seminar on marine and coastal ecosystems: Coral and Mangrove - problems and management* Strategies, Sep.26-27, 2002, SDMRI, Tuticorin.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : The axenic cultures of cyanobacteria *Phormdium tenue, Phormidum fragile, Nostoc piscinale* and B*eggiatoa alba* were allowed to grow under different wavelengths. While in general, higher biomass was observed under the pink color filter, the *P. tenue* preferred white light. Relatively higher chlorophyll-a content was observed under both yellow (540nm) and pink color filters in all the four species. Carotenoid content increased under blue (430nm) and yellow (540nm) color filters in *P. tenue* and *P. fragile* whereas *B. alba* and *N. piscinale* synthesized maximum carotenoid content under red and blue color (680, 430) filters. The phycobiliprotien, phycocyanin content in *B.alba* was maximum in control and in *N.piscinale* preferred blue and pink. Phycoerythrin was found to increase in *B. alba* and *P. fragile* grown under white light while in *N. piscinale* and *P. tenue*, the content was maximum under red and green color. In general, the species showed increased protein content under green, red and pink color filters. Carbohydrate content was maximum in *P. fragile* and *B. alba* under white light while *P. tenue* and *N. piscinale* showed increase in content under green and blue color.

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1780. **Ole Vestergaard and Ben Cattermoul** 2006. Building an integrated Coral Reef Monitoring Network- Lessons from the GCRMN South Asia. pp. 263-277. ***In***: *Coral reef degradation in the Indian Ocean.* CORDIO, Sweden. 285 pp.

Address : Sugandhi Devadason Marine Research Institute, 44 Beach Road, Tuticorin, India.

Abstract : The Global Coral Reef Monitoring Network (GCRMN) has been operating in India, Maldives and Sri Lanka since late 1997 with the goal to establish a regional network of people and institutions to collect coral reef information for integrated and poverty oriented reef management planning and policy making. This paper briefly summarises the activities and experiences of the 'GCRMN South Asia' from its first five years of operation, including a capacity building framework developed to assist, identify, collect and use coral reef information to inform and influence management and policies. Important messages of the paper are that effective coral reef monitoring and management structures need to consider first and foremost the needs of the people who depend on the reefs for their survival. Secondly, it is critical that information of all types (ecological, socioeconomic, cultural, political and institutional) is available in a range of formats to develop holistic policies and management solutions. Through the activities presented below, a set of lessons relating to gathering, organizing, and disseminating that critical information to end users have emerged, which may be useful in future work within and outside the region.

1781. **O'Riordan, B.** 1995. Re-greening the seas. *Samudra Rep.,* 13: 12-15.

Address : Intermediate Technology Development Group, Rugby, UK.

Abstract : An account is given of activities conducted by fish workers from several villages in Trivandrum and Kanyakumari, India to rejuvenate the seabed and provide for the *in*-situ conservation of fish stocks. The construction of artificial fish habitats using locally available materials such as concrete well rings, coconut fronds and tree stumps is discussed, making reference to a project conducted in 1989, which established 3 artificial reefs around the villages of Puthiathura, Thumba and Adimalathura. The reefs were found to act as fish aggregating devices, significantly enhancing catches; dispersed over wide areas, these artificial reefs may serve as marine reserves and important breeding and conservation areas. They also have a potentially important role to play in demarcating exclusive community controlled fishing zones, thereby facilitating sustainable community based management of fish stocks on the basis of harvesting rather than hunting.

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1782. **Padmakumar, K.** 2002. Seasonal variation of antimicrobial activity in marine algae from Kanyakumari coast. *Seaweed Res. Utiln.*, 24(1): 89-94.

Address : Department of Aquatic Biology and Fisheries, Kerala University, Kariavattom, Trivandrum - 695 581, Kerala, India.

Abstract : Antimicrobial activity of six species of marine algae representing Chlorophyceae, Phaeophyceae and Rhodophyceae from Kanyakumari coast, Tamil Nadu, India was evaluated against *Staphylococcus aureus*. The results indicate clear seasonal variation in the production of antimicrobial substances. In Chlorophyceae, a more or less uniform activity was noticed throughout the year, but the highest activity of *Caulerpa racemosa* and *Ulva fasciata* was recorded in the northeast monsoon season. Among the Phaeophyceae, *Dictyota dichotoma* and *Padina gymnospora* exhibited peak activity during southwest monsoon and was inactive during the northeast monsoon. Among the class Rhodophyceae, *Gracilaria corticata* and *Sarconema furcellatum* exhibited maximum activity during the post-northeast monsoon and summer season and minimum activity during the southwest monsoon. The results indicate that no distinct seasonal variation in the antimicrobial activity in Chlorophyceae could be observed and more or less uniform activity prevailed throughout the year. But the Phaeophyceae exhibited an inactive period during the monsoon season and the Rhodophyceae with a seasonal maximum and minimum activity.

1783. **Padmakumar, K and K. Sindhu** 2005. Fauna associated with *Valoniopsis pachynema* (Martens) boergesen of Kanyakumari coast. *Seaweed Res. Utiln.*, 27(1&2): 159-164.

Address : Department of Aquatic Biology and Fisheries, Kerala University, Kariavattom, Trivandrum - 695 581, Kerala, India.

Abstract : Ecology of fauna associated with the green alga *Valoniopsis pachynema* of the Kanyakumari coast was investigated during the most dominant period, September, 1990 to March, 1991. Faunal associates of the algae were quantified as total number of organisms per grain dry weight and also per 100 cm^2 surface area. The maximum number of individuals per gram dry weight and per 100 cm^2 of algae was reported during November 1990. But minimum individuals per g dry weight of algae was registered during February 1991 and for 100 cm^2 of alga was found during September 1990. Totally about 5 major groups of organisms *i.e.*, Coelenterates, Polychaetes, Crustaceans, Molluscs and Echinoderms were recorded. The crustaceans were the most dominant organisms amounting to about 90% and among this, amphipods along contributed to the tune of 87%. Environmental factors did not show any significant correlations with the number of individuals per gm dry weight of algae.

1784. **Padmanabha Rao, C.A.** 1962. A new genus and species of a Cyclopoid Copepod parasitic on a starfish. *J. Mar. Biol. Assoc. India*, 4(1): 100-105.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Humes and Cressey (1958) created the family Stellicomitidae to include two new genera, namely, *Stellicomes* and *Onycopygus* which are parasitic on different genera of starfishes (vide Humes & Cressey *lac. cit.*) collected from the coasts of West Africa and Madagascar (Republique Malgache). Under the genus *Stellicomes*, two new species *S. tumidulus* and *S. guineensis* and under the genus *Onycopygus* a single species *O. impavidus* were described. To my knowledge no other genera and species have so far been added to the family. *Stellicomitids* are peculiarly modified siphonostomatous cyclopoids characterised by the presence of a highly reduced siphon. They appear to be exclusively parasitic on starfishes. The form described in this paper does not correspond to any of the known forms and hence is treated here as a new genus. It is interesting to note that there are morphological gradations between the two known genera and the present form. It may be added here that it is obtained along with the two species of the genus *Stellicomes.* The latter are reported here for the first time after their discovery from the African Coasts.

1785. **Padmanabha Rao, C.A.** 1964. *Stellicomes pambanensis*- A new cyclopoid copepod parasitic on starfish. *J. Mar. Biol. Assoc. India*, 6(1): 89-93.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1786. **Pai, M.V and P.K. Mahadevan Pillai** 1970. Observations on a whale shark, *Rhincodon typus* landed at Tuticorin. *J. Mar. Biol. Assoc. India*, 12(1&2): 224-225.

Address : Central Marine Fisheries Research Station, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Information on whale sharks landed along the coasts of India has not been wanting (Prater, 1941 ; Kulkarni, 1948 ; Chacko and Mathew, 1954; Anon., 1958 ; Kaikini *et. al.*, 1959; Gopalan, 1962; Silas and Rajagopalan, 1963 and Thomas and Kartha, 1964). Chacko (Chacko and Mathew, *op. cit.)* reported the sighting of a whale shark, over 7 metres in length, on the pearl bank, Thollayiram Paar, on 11th December 1953. Silas and Rajagopalan *(op. cit.)* recorded the landing of a female whale shark measuring 5.62 metres in total length on 29th July 1961 at Tuticorin. A male whale shark, *Rhincodon typus* Smith, measuring 5.96 metres in total length, was landed at Tuticorin (north landing place) at 3 p.m. on 27th July 1968. It was reported by the fishermen that it got entangled in the nylon drift net (operated from Tuticorin type of boat), off Tiruchendur, at 18 metres depth at 10 p. m. on the 25th instant. The other fish caught in the net were two specimens of *Scomberomorus* spp. and one of *Rachycentron canadus.*

1787. **Pai, M.V and P.K. Mahadevan Pillai** 1973. Trawl fishery potential of the southeast coast of India. *Proc. Symp. on Living Resources of seas around India,* pp. 261-279.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Scanty information is available regarding trawl fishery resources of the waters of the south-east coast of India in the Gulf of Mannar. Until the establishment of the offshore fishing station of the Government of India at Tuticorin in 1958, no organization has conducted trawling along scientific lines for charting the offshore fishing grounds, in order to delineate the distribution of commercially important fish and prawns in space and time. Since 1959, exploratory trawling by medium sized trawlers has been mainly conducted in the offshore waters around Tuticorin between lat. 8°00' - 9°10'N and long. 77°30'-79°00'E. The results show that fairly rich fishing grounds exist in this area. The paper indicates scope for further exploitation of the grounds so far charted.

1788. **Pajot, G., J. Crockett, S. Pandurangan and P.V. Ramamoorthy** 1982. Further trials of mechanised trawling for food fish in Tamil Nadu. FAO/SIDA. *Programme of Small -Scale Fish. Bay of Bengal, Madras (India).* FAO, SIDA. 28 pp.

Address : FAO/SIDA, Bay of Bengal Programme, Madras, Tamilnadu, India.

Abstract : The aims, scope and results of experiments conducted with high-opening bottom trawls in Palk Bay, Gulf of Mannar and off the Coromandel Coast from July 1980 to May 1981 are described. The trials were designed to: 1) locate suitable fishing grounds in different geographical areas; 2) further development and adapt fishing gear (trawls) and methods to specific identified resources and fishing conditions: 3) construct demonstrations and provide in-service training for counterparts, net-makers and fishermen in the design, construction and use of fishing gear, equipment and methods and 4) further development of simple equipment and arrangements to improve fishing operations and gear handling with respect to efficiency, safety and comfort.

1789. **Pajot, G., J. Crockett, S. Pandurangan and P.V. Ramamoorthy** 1983. Improved deck machinery and layout for small coastal trawlers. FAO/SIDA Program. Dev. Small-Scale Fish. Bay of Bengal, Madras (India). *Madras-India-FAO-SIDA.* 21 pp.

Address : Bay of Bengal Programme, Madras, Tamilnadu, India.

Abstract : Some 15,000 trawlers operate all along the east and west coasts of India. This working paper presents details of innovations to improve the deck machinery and layout of small coastal trawlers in Tuticorin and Nagapattinam. They are also applicable to coastal trawlers elsewhere in the region.

1790. **Pajot, G.** 1993. Small offshore fishing boats in SriLanka. *BOBP/REP/61.*

Address : Bay of Bengal Programme, Madras, Tamilnadu, India.

Abstract : This article has a map showing the Exclusive Economic Zone between India and SriLanka in the Gulf of Mannar.

1791. **Palanichamy, A.** 2000. Scientific, Common and Tamil names of commercially important marine organisms of Gulf of Mannar. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp,* pp. 75-80.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The Gulf of Mannar coastal region contributes rich fauna and flora of sharks, rays, skates, fishes ornamental fishes, crabs, lobsters, prawns, gastropods, bivalves, sea cucumbers, marine mammals, gorgonids,

sea turtles and seaweeds. All the marine organisms are useful in one way or the other. In this paper the scientific, popular and local names of different marine organisms are given.

1792. **Palanichamy, S and A. Rajendran** 2000. Heavy metal concentrations in seawater and sediments of Gulf of Mannar and Palk Bay, southeast coast of India. *Indian J. Mar. Sci.*, 29(2): 116-119.

Address : Offshore Platform, Central Electro Chemical Research Institute, Tuticorin 628 004, Tamilnadu, India.

Abstract : An investigation was carried out to delineate the levels of heavy metals both in the seawater and sediments from the Gulf of Mannar and Palk Bay. The data, obtained during the year 1995 revealed that Cd could not be detected in the waters of Kanyakumari. However, at other stations the levels of Cd were in the order of Arumuganeri>Tuticorin>Thondi> Mandapam. In contrast, Pb levels were found to be maximum at Kanyakumari and minimum at Arumuganeri, while Hg was found to be maximum at Arumuganeri and minimum at Mandapam. Cd levels were found to decrease towards sea from the coast at Tuticorin. However no definite trend was observed at Mandapam and Thondi. Unlike Cd, Pb showed seaward increasing trend at Thondi transect. However, no definite trend was evident for other transects as seen for Cd. Bottom waters showed higher concentration of Cd and Pb as compared to those in surface water. Hg did not show any trend in its distribution. Data on sediments showed that Cd registered maximum levels at Arumuganeri (4.33 ppm) while Kanyakumari exhibited the minimum (0.4 ppm). Similarly the levels of Pb were found to be minimum (1.15 ppm) at Kanyakumari. In conclusion, among the transects studied, Arumuganeri appeared to be polluted.

1793. **Palanichamy, S., S. Maruthamuthu, S.T. Manickam and A. Rajendran** 2002. Microfouling of manganese-oxidizing bacteria in Tuticorin harbour waters. *Curr. Sci.*, 82(7): 865-869.

Address : Offshore Platform, Central Electro Chemical Research Institute, Harbour Area, Tuticorin 628 004, India; Central Electro Chemical Research Institute, Karaikudi - 630 006, Tamilnadu, India.

Abstract : Implication of manganese-oxidizers in corrosion of various alloys stimulated the investigators to concentrate on these aspects. In the present study, an attempt was made to bring out the bacterial genera involved in the oxidation of manganese in biofilms. The materials immersed in seawater for biofilm formation included polyvinyl chloride (PVC), stainless steel (SS), brass and copper. The biofilm samples were analysed quantitatively and qualitatively for both heterotrophic bacterial population (HB) and manganese-oxidizing heterotrophic bacterial population (MHB). Both qualitative and quantitative examination of biofilms showed relatively poor population density on copper. Qualitative examination revealed the representation of both Gram-positive and Gram-negative bacteria on all materials. However, only Gram-positive groups, especially of the endospore-forming genus Bacillus and non-endospore forming genus Propionibacterium were observed on copper coupons. Gram-positive genera dominated over Gram-negative genera in most of the biofilms studied. The genera identified under manganese-oxidizing bacterial isolates were Bacillus, Staphylococcus, Synecoccus, Propionibacterium, Micrococcus, Pseudomonas and Vibrio. Among them, Bacillus species was the most commonly encountered in all the materials studied. Potential measurements for SS^{316} showed positive shift. Analysis revealed enormous amount of manganese in the biofilms.

1794. **Palanichamy, S.** 2003. Marine pollution monitoring with particular reference to the Gulf of Mannar. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 31.

Address : Corrosion Testing Centre, Central Electro Chemical Research Institute Unit, Mandapam Camp - 623 519, Tamil Nadu, India.

Abstract : The exorbitant increase of population and haphazard growth of industries worldwide resulted in environmental pollution problem. However, people could realize the severity of marine pollution particularly by heavy metal pollution only after the outburst of minamata incidence in Japan coast way back in 1950s. Today, the cry of marine pollution is heard from all parts of the globe, as it has become major threat to the very existence of mankind on this earth. UNEP emphasized the need for marine pollution monitoring. Marine pollution monitoring will help identify and quantify pollutants that influence over time against a 'natural' baseline situation. Monitoring and assessment over a period of time are required to conduct the rational management by means of stipulating control measures. The monitoring should cover standard measurements of water quality variables of chemical and biological components. The present study deals with marine pollution monitoring in the Gulf of Mannar.

1795. **Palanichamy, S., S. Ragumaran and A. Rajendran** 2004. Impact of dredging operation on phytoplankton in Tuticorin Harbour. *Seaweed Res. Utiln.*, 26: 103-106.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Dredging activity may exert stress on biotic communities including phytoplankton. In the present study an attempt was made to show dredging effect on phytoplankton population in Tuticorin harbour. Phytoplankton and water samples were collected from two stations one in outer harbour area during three different phases i.e., pre-dredging period, dredging period and post dredging period. Data indicated that the numerical density of phytoplankton population was found to be higher during dredging period (351.8 - 415.8 No/l) as compared to those recorded during pre-dredging period (314 - 364.8 No/1). However, the population density was found to decrease considerably at the end of the dredging period (177- 214.6 No/l). Further, the data collected during post-dredging period revealed that ecosystem needs longer time for further fresh recruitment and growth. During pre-dredging period the major groups identified were *Chaetoceros* and *Ceratium.* While during dredging period, *Ceratium* and *Rhizosolenia* were found to be dominant. Similarly the major species identified during post-dredging period was *Navicula* only. The changes encountered due to dredging operation are discussed in the light of environmental parameters.

1796. **Palanichamy, S., A. Rajendran and S. Ragumaran** 2004. Heavy metal concentrations in some marine algae from the Gulf of Mannar, Southeast coast of India. *Seaweed Res. Utiln.* 26: 107-110.

Address : Corrosion Testing Centre, Central Electro Chemical Research Institute Unit, Mandapam - 623 519, Tamilnadu, India.

Abstract : Gulf of Mannar is rich in seaweed resources all along its coastal areas particularly Kanyakumari, Koodankulam and Mandapam. However, because of the industrial development and consequent increase of effluents together with agricultural run-off and municipal sewage discharge, there could be a serious threat to the biological resources of Gulf of Mannar in general. This paper is an attempt to show the levels of trace metals in seaweeds of Gulf of Mannar. In the present study various seaweeds were analysed for metals like Cu, Cd, Pb, Ni, Cr and Zn. Among the seaweeds studied *Stoechospermum* sp. was found to accumulate relatively maximum levels of metals. Further, among the four localities Arumuganeri showed relatively high metal concentration in ambient seawater but not in seaweed. The variations in metal accumulation in seaweed are discussed in relation to the other environmental parameters like salinity, pH, dissolved oxygen etc.

1797. **Palaniswamy, R.** 1993. Seasonal gonadal changes, spawning and condition index of oyster *Crassostrea madrasensis* (Preston) in the Korampallam creek, Tuticorin. *Indian J. Fish.*, 40(4): 242-246.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Seasonal changes in the gonad of edible oyster *Crassostrea madrasensis* were observed histologically in samples collected from Korampallam creek during February 1987 to January. Two peak spawning seasons were observed in March and September. Gametogenesis started in May 1987 and ripe stages were noticed from September 1987. Spawning occurred during September to October. A second cycle of gametogenesis began during November 1987 and higher percentage of ripe stages was noticed during March 1987 and spawning commenced in March. Oysters showed 5-60% of spent stages with residual eggs throughout the year except August. September, December and February. Oysters passed through indeterminate stage before the advancement of gametogenesis. No hermophrodites were observed during this period.

1798. **Palavesam, A and G. Sankaraperumal** 1990. Effect of heavy metals on chironomid larvae. *Proceedings of 10th Annual Session of AEB & Symposium on Environmental Pollution on Biosystems"*, Loyola College, Chennai. pp. 103-108.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam, Kanyakumari, Tamilnadu, India.

1799. **Palraj, S., V. Ananth, G. Subramanian and P. Chandrasekaran** 1991. Galvanic corrosion behaviour of Al, mildsteel, stainless steel and Zn coupled to Cu in seawater. *Indian J. Mar. Sci.* 20(4): 267-270.

Address : Corrossion Testing Centre, Central Electro Chemical Research Institute Unit, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : The change in area ratio considerably alters the behaviour of passive metals. The passive metals, Al and stainless steel experience ennoblement of galvanic potentials due to the formation of thin microbial film. The coupling of Cu and type ^{304}SS in natural seawater is detrimental to both. Galvanic potentials, current and corrosion rates of metals are affected by the formation of corrosion products, calcareous deposits and biofouling attachments.

1800. **Palraj, S., G. Venkatachari, and G. Subramanian** 2002. Bio-fouling and corrosion characteristics of 60/40

brass in Mandapam waters. *Anti-Corrosion Methods and Materials,* 49(3): 194-198.

Address : Central Electro Chemical Research Institute, Karaikudi, Tamilnadu, India.

Abstract : The bio-fouling and corrosion characteristics of 60/40 brass were investigated in the Palk Bay waters of the Mandapan coast, India, over a period of a year. The experimental methods included corrosion rate by weight loss measurement and analysis of the corrosion product by X-ray diffraction. The biofouling characteristics of 60/40 brass were studied in terms of seasonality of recruitment of organisms and quantification of the fouling community development pattern. The XRD analysis of the products on brass threw more light on the protective nature of the compounds formed and their impact on the overall corrosion rate of the material. The organisms found in fouling deposits on brass included algae, bryozoans and hydroids. The results of the study are discussed in the light of the seawater characteristics and monsoon effects.

1801. **Panchayuthiapani, D., T.J. Abraham and P. Jayachandran** 1995. Inhibition of fish bacterial flora by bacteriocin of lactic acid bacteria. *Fish. Technol.*, 32(2): 118-121.

Address : Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu, India.

Abstract : Seven strains of lactic acid bacteria (LAB) were tested for the production of bacteriocins or bacteriocin-like substances by the agar spot method. By excluding inhibition due to acid and confirming their proteinaceous nature, the inhibitors were confirmed as bacteriocins. The ability of four bacteriocin producing strains, viz., *Lactobacillus plantarum 89, L. plantarum 8014, L. helveticus,* and *Pediococcus pentosaceus* 25445, to inhibit thirty-five strains of bacteria isolated from fish and fishery products were screened. Strains of *Enterococcus* spp. and Flavobacterium/Cytophaga were inhibited by bacteriocins of LAB. *Vibrio parahaemolyticus* was inhibited slightly by bacteriocins of *L. plantarum* 89 and *P. pentosaceus* 25445. *Aeromonas hydrophila, Salmonella* sp. and *V. cholerae* were not inhibited. The bacteriocins of LAB are bactericidal to 42 to 54% of the fish microflora tested.

1802. **Pandey, R.S.** 1978. Mass culture of phytoplankton. *CMFRI Spec. Publ.*, 3: 80-84.

Address : Prawn Culture Laboratory, Narakkal, Kerala, India.

Abstract : Mixed phytoplankton in the marine or freshwater environments will not be readily available for experiments or for feeding of animals reared in the laboratory. Hence, unialgal cultures have to be developed artificially. Pioneering work in this field was done by Miquel in Germany and Allen in Plymouth more than seven or eight decades ago. Since then much progress has been made in the development of artificial media, and mass culturing of selected organisms. This account briefly reviews the work carried out in this direction.

1803. **Panikkar, N.K.** 1938. Recent researches on *Trochus*. *Curr. Sci.*, 6: 552-553.

Address : Department of Zoology, Madras Christian College, Tambaram, Madras, India.

Abstract : Observations on the length of life of the *Trochus niloticus* and a statistical study of the rate of growth of shells have been discussed.

1804. **Panikkar, N.K.** 1944. Occurrence of a Stauromedusa on the Indian coast. *Curr. Sci.*, 13: 238-239.

Address : Department of Zoology, Madras Christian College, Thambaram, Chennai, India.

Abstract : Lucernarians were collected from Krusadai Island. It is one of the Eleupherocarpidae with a well developed but short stalk and eight marginal lobes. The morphometric and anatomic characters are discussed.

1805. **Panikkar, N.K and P.R.S. Tampi** 1949. The egg mass of a Doliid gastropod mollusc from Krusadai Island. *J. Bom. Nat. Hist. Soc.*, 48(3): 608-609.

Address : Department of Zoology, Madras Christian College, Tambaram, Madras, India.

Abstract : During a visit to Krusadai Island in 1947, we found a few gelatinous ribbons washed ashore at Kundugal point on 25-2-47. On examination, these proved to be the egg masses of a gastropod mollusc. In addition to the fresh spawn mass in which the embryos were alive, there were four other ribbons which on account of exposure to the sun had become tough and leathery, superficially resembling the cast skin of snakes.

1806. **Panikkar, N.K.** 1951. Fisheries Research in India, Part I. *J. Bom. Nat. Hist. Soc.*, 50: 741-765.

Address : Department of Zoology, Madras Christian College, Tambaram, Madras, India.

1807. **Panikkar, N.K.** 1951. Marine and estuarine fauna. *Handbook of Indian Fisheries. Ministry of Food and Agri., India*, pp. 24-33.

Address : Department of Zoology, Madras Christian College, Tambaram, Madras, India.

1808. **Panikkar, N.K and R. Prasad** 1953. On an interesting association of ophiuroids, fish and crab with the Jelly fish *Rhopilema hispidum*. *J. Bomb. Nat. Hist. Soc.*, 50: 295-296.

Address : Department of Zoology, Madras Christian College, Tambaram, Madras, India.

1809. **Panikkar, N.K., P.R.S. Tampi and R. Viswanathan** 1953. Some aspects of adaptation in *Chanos chanos*. *Proc. Indian Acad. Sci.,* 37B: 203-213.

Address : Department of Zoology, Madras Christian College, Tambaram, Madras, India.

1810. **Panikkar, P., R. Paulraj and D. Kandasami** 2003. Feeding and ingestion rates in different size groups of Pearl oyster *Pinctada fucata* (Gould) spat. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 50-51.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Optimum feed requirement and ingestion rate of the pearl oyster, *Pinctada fucata* spats of three different size groups were studied. The spats were fed with *Chaetoceros sp.* at different concentrations to study the feeding rate. Growth rates of spats at different feeding levels showed that larger size requires higher concentration of feed. The average wet weight gain was found to be the highest in the smallest group. Spats in the size group 5-9 mm (size A) had the maximum growth (146.9%) when fed at a concentration of 3 lakh cells ml^{-1} $spat^{-1}$ day^{-1}. Lower and higher concentrations showed lesser growth increment. Spats in the size range 10-14mm (size B) registered a wet weight gain of 36.33% at a feed concentration of 6 lakh cells ml^{-1} $spat^{-1}$ day^{-1}, whereas, higher concentration produced comparatively lesser growth rate (Table. 2). Growth increment was the highest (20.01%) in the group 15-19mm (size C) when fed at a rate of 9-lakh cells ml^{-1} $spat^{-1}$ day^{-1}. One way analysis of variance conducted to test the influence of size group on different feeding rates indicated the effect to be highly significant at 1% as F (cal) > table value. It is concluded that the mean gain in weight at different feeding rates for different size groups of spat differ significantly for *P. fucata.*

1811. **Panneer Selvam, B.A., Ditty Chacko and J.K. Patterson Edward** 2003. Preliminary study on molluscan diversity of "The Lost World"- Dhanushkodi, Eastcoast of India. *Nat. Sem. Reef Ecosystem Remediation*, 24th – 26th Sep'03, SDMRI, Tuticorin, India. p. 46.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : After the effect of a massive cyclone during December 1964, colonization is absent in Dhanushkodi except for scanty settlement of fisherfolk. The land on the northern side is plain without vegetation for a stretch of 1 km and seawater replenishes this area during spring tides. The fishermen use "Thallumadi" (push nets), a modified mini version of a trawl net to catch shrimps chiefly. This net lands plenty of economically important molluscan forms as by-catch. A survey was carried out to list the molluscan fauna landed as by-catch from push nets, other indigenous bottom nets and those washed ashore. From the preliminary survey, a total of 103 molluscs belonging to four classes were recorded which includes 45 species of gastropods, 51 species of bivalves, 2 species of scaphopods and 5 species of cephalopods. The molluscan faunal diversity and species composition are discussed.

1812. **Paramasivam, M and G.G.M. Devadoss** 1985. Effect on growth regulators in the field cultivation of *Gracilaria edulis* (Gmelin) Silva. *Indian J. Mar. Sci.,* 14(4): 230-231.

Address : Krusadai Marine Biological Station, Mandapam - 623 518, Tamilnadu, India.

Abstract : Fragments of *Gracilaria edulis* were treated for 12 hr with indole acetic acid, gibberellic acid, kinetin, 2,4-dichlorophenoxy acetic acid (sodium salt) and maleic hydrazide at concentrations 5 and 10 mg/1. The treated fragments were propagated vegetatively in the sea at Krusadai Island. Among these growth regulators, kinetin produced maximum increase of length (32.8%) over control in *G. edulis*.

1813. **Paramasivam, M and G.G.M. Devadoss** 1987. On the cultivation of *Gracilaria edulis* Silva in Chinnapalam estuary, Pamban. *Nat. Symp. Environ. Biol.,* 2nd to 4th April, 1987, St. Xavier's College, Palayamkottai-627 002, India, p. 9.

Address : Krussdai Marine Biological Station, Mandapam, Ramnad, India.

Abstract : Culture practices become inevitable to augment the supply of seaweeds to the industries. Experiments

were carried out with *Gracilaria edulis* Sliva in Chinnapalam estuary, Pamban. Fragments of *G. edulis* measuring 3 cm in length, cut from the healthy plants were inserted in the twists of coir nets 1x1m size. These nets were horizontally placed and kept in the submerged condition at 0.5 m depth even at the lowest tide. About 40gm of material was used for seeding one sq m. of the net. After 56 days harvest was made by cutting the plants with scissors. Rate of growth was 1.1 mm/day. Rate of production was 2.3 gm/day/sq.m. There was 43-fold increase in weight within the experimental period. These preliminary observations indicate the suitability of the estuary for the cultivation of *G. edulis.*

1814. **Paramasivam, M and G.G.M. Devadoss** 1987. Field cultivation of *Gracilaria edulis* (Gmelin) Silva in Chinnapalam estuary, Pamban. *J. Mar. Biol. Assoc. India,* 29(1&2): 360-362.

Address : Krusadai Marine Biological Station, Mandapam - 623 518, Ramnad District, Tamilnadu, India.

Abstract : Requirement of agarophytes for agar producing industries is more than the crop available in the natural habitat. To augment the supply of such seaweeds, culture experiments were undertaken with *Gracilaria edulis* in Chinnapalam estuary area, Pamban, Tamil Nadu, India. About 40 g fragments of *G. edulis* measuring 3 cm in length, cut from the apical parts of healthy growing plants, were inserted in the twists of long coir ropes. The ropes were then tied to the poles already erected in the estuary and were kept submerged at 0.5 m depth even at the lowest low tide. After 47 days the harvest indicated the rate of growth of the plant as 1.5 mm/day. The rate of production was 2.3 g/day/m. There was 2.8 fold increase in weight within the experimental period.

1815. **Paramasivam, M and U.S. Srivastava** 1989. Seaweed culture in Tamil Nadu. *Proc. Nat. Symp. on utilization of living resources of the Indian Seas, December 19-21, 1987 Central Institute of Fisheries Education, Bombay.* pp. 213-218.

Address : Krusadai Marine Biological Station, Mandapam - 623 518, Ramnad District, Tamilnadu, India.

Abstract : Tamil Nadu has extensive resources for seaweeds but the resources are showing signs of depletion. Attention is being paid on increasing the production of commercially important seaweeds and the technical feasibility of seaweed culture through field trials by finding out the growth and production rate of *Gelidiella acerosa*, *Gracilaria edulis*, *Hypnea musciformis* and *Sargassum* species is being studied.

1816. **Parameswaran Pillai, P.** 1976. A review of the calanoid copepod family Pseudodiaptomidae with remarks on the taxonomy and distribution of the species from the Indian Ocean. *J. Mar. Biol. Assoc. India,* 18(2): 242-265.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : .Among the various families of calanoid copepods, Pseudodiaptomidae a predominantly warm water neritic family is important in view of the preference which the members of the family show to coastal waters. No attempt has hitherto been made to investigate the intra-specific relationships of the species belonging to the family Pseudodiaptomidae from the Indian Ocean. In the present communication, a list of those species which have either been described or previously recorded from the Indian Ocean has been given with a brief description *on* their taxonomy. The validity of the two genera, namely *Pseudodiaptomus* Henjck and *Schmackeria* Poppe and Richard, with a view to separate the different species of the family has been discussed. The paper also gives information on the spatial distribution of the species of the family in the Indian Ocean.

1817. **Parameswaran Pillai, P., K.P.S. Koya, N. Gopalakrishna Pillai and A.A. Jayaprakash** 1993. Fishery and biology of yellowfin tuna occurring in the coastal fishery in Indian seas. ***In***: *Tuna Research in India.* (eds) D. Sudarsan and M.E. John. Bombay India Fish Surv. India. pp. 23-38.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This paper discusses the status of the fishery, biology and stock structure of yellowfih tuna (*Thunnus albacares*) taken by different countries bordering the Indian Ocean. Indian catch of yellowfin funa fluctuated between 349.2 tons and 799.5 tons during the period 1987-91. In the present study the data collected from Veraval (1990-91), Cochin (1989-91), Minicoy (1989-91), Vizhingam (1989-91) and Tuticorin (1989-91) are utilised to study the fishery, biology and stock structure of yellowfin tuna taken by coastal fisheries in Indian seas.

1818. **Parida. A.** 1998. Genetic characterisation and species diversity as a prelude to the conservation of mangrove and associated communities. *Proc. of the Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve,* pp. 165-174.

Address : M.S. Swaminathan Research Foundation, III Cross Street, Taramani, Chennai, Tamilnadu, India.

Abstract : Earth's plants, animals and micro-organisms interacting with one another and with physical environment in ecosystems form the foundation of sustainable development. Biotic resources from this wealth of life support human livelihood and aspiration and make it possible to adapt to changing needs and environments. The steady erosion of the diversity of genes, species and ecosystem taking place today will no doubt undermine progress towards a sustainable society. The continuing loss of biodiversity is a telling measure of imbalance between human needs and wants and nature's carrying capacity.

1819. **Parthasarathy, N., K. Ravikumar and K. Ramamurthy** 1988. Floral biology and ecology of *Halophila beccarii* Aschers. (Hydrocharitaceae). *Aquat. Bot.*, 31(1&2): 141-151.

Address : Salim Ali School of Ecology, Pondicherry University, Pondicherry - 605 001, India.

Abstract : The monoecious condition was observed in this seagrass for the first time. Opened male flowers are infrequent. Population density and biomass of this sea grass in the coastal regions of Cuddalore, Pichavaram, Portonovo and Tuticorin in S. India are discussed.

1820. **Parthasarathy, N., K. Ravikumar and K. Ramamurthy** 1988. *Halophila decipiens* Ostenf. in southern India. *Aquat. Bot.*, 32(1&2): 179-185.

Address : Salim Ali School of Ecology, Pondicherry University, Pondicherry - 605 001, India.

Abstract : In India *Halophila decipiens* was earlier recorded only from the coasts near Bombay. Recently it has been reported from the SE tip of peninsular India. A moderate population of this species was observed, occurring associated with *Caulerpa scalpelliformis* and *Ulva reticulata*. The population density and biomass of *H. decipiens* in Tuticorin are recorded.

1821. **Parthasarathy, N., K. Ravikumar, R. Ganesan and K. Ramamurthy** 1991. Distribution of seagrasses along the coast of Tamil Nadu, Southern India. *Aquat. Bot.*, 40(2): 145-153.

Address : Salim Ali School of Ecology, Pondicherry University, P.O. Box 154, Pondicherry 605 001, India.

Abstract : Twelve species of seagrasses are recorded in a survey of Tamil Nadu, southern India. Of the 38 stations studied, species diversity is high in the Gulf of Mannar and Palk Bay, while it is low in the Bay of Bengal. A note on the flowering and fruiting of the species is provided. Further ecological observations on the nature of the substratum, the extent of biotic pressure on seagrass beds and the local use of seagrasses are presented.

1822. **Parukhin, A.M.** 1974. New trematode species of the family Acanthocolpidae Luehe, 1909 from the Red Sea and the Indian Ocean fishes. *Marine animal parasites* Parazity morskikh zhivotnykh [IzvTinro], Kurochkin-YuV Vladivostok-USSR TINRO Vol.88.

Address : Inst. Biol. Yuzhn. Morej, Sevastopol', USSR.

Abstract : In analyzing the collection of trematodes from marine fishes taken during a cruise in the Indian Ocean from May to Oct 1967, 3 new spp were recognized: *Pleorchis mamaevi* Paruchin sp. n. localized in the intestines of *Ichnius* sp (unidentified sp) from the Gulf of Mannar, *Stephanostomum lebedevi* Paruchin sp. n. localized in the stomachs and pyloric caeca of *Abalistes stellaris* (Balistidae) and *Sardinella aurita* (Clupeldae) from the Red Sea, and *Stephanostomum roytmanl* Paruchin sp. n. localized in the intestines of *Caranx sexfasciatus* (Carangidae) from the Gulf of Mannar. Illustrated descriptions and detailed differential diagnoses of the new spp are provided.

1823. **Pathak, S.C and B. Venkatesh** 1988. Role of NABARD in financing marine fisheries projects. *CMFRI Spec. Publ.*, 40: 87.

Address : National Bank of Agriculture and Rural Development, Bombay - 400 018, India.

Abstract : National Bank for Agriculture and Rural Development is the apex organisation dealing with the policy, planning and operational matters related to credit for development of agriculture and allied sectors including marine fisheries. NABARD has been playing a significant role in promoting marine fisheries development as a refinancing agency as well as developmental agency through conducting training programs, supporting innovative type of schemes and funding research projects. NABARD has been extending refinance assistance to schemes for acquiring fishing vessels, mariculture and for building infrastructural facilities. The experience of NABARD in implementing various fisheries schemes is discussed in this paper.

1824. **Patil, R., G. Jeyasekaran, S.A. Shanmugam and R. Jeya Shakila** 2001. Control of bacterial pathogens,

associated with fish diseases, by antagonistic marine actinomycetes isolated from marine sediments. *Indian J. Mar. Sci*., 30(4): 264-267.

Address : Fisheries Collegeand Research Institute, Tuticorin - 628 008, Tamil Nadu, India.

Abstract : Actinomycetes were isolated from different marine samples collected from various stations along the Tuticorin coast. About 133 cultures of actinomycetes were isolated from 129 marine samples. Of the 104 isolates of actinomycetes screened for their inhibitory activity against the bacterial pathogens associated with fish diseases *viz.*, *Aeromonas hydrophila, A. sobria* and *Edwardsiella tarda*, 77 isolates were found to be inhibitory to at least one of the pathogens. The highest incidence of inhibitory isolates was from the sediment samples. All the isolates of antagonistic marine actinomycetes were identified to be Streptomyces. The findings suggest that the antagonistic marine Streptomyces isolates or the antibacterial substances produced by them could be used as antibiotics, which might have a future application in aquaculture systems.

1825. **Patterson Edward, J.K., A. Murugan and K. Ayyakkannu** 1991. Field surveys on Muricidae in India (from 11° 42'N; 79° 46'E to 8° 29'N; 76° 59'E. *Spec. Publ. Phuket Mar. Cent.*, 9: 97-102.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608502, Tamil Nadu, India.

Abstract : Details are given of observations made during surveys conducted in India regarding the Muricidae species, and the craft and gear used for their exploitation. Some 15 species of the family were recorded from the areas studied - Cuddalore, Mandapam, Tuticorin and Cape Comorin; only 2 species were found to be abundant and available in all the sectors - *Chicoreus ramosus* and *C. virgineus*.

1826. **Patterson Edward, J.K and K. Ayyakkannu** 1992. Shell trade and marketing with special reference to *Chicoreus ramosus* along the southeast coast of India: Interviews with shell traders. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent.*, 10: 33-34.

Address : CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India.

Abstract : Interviews were conducted with various shell traders along the southeast coast of India, in the areas of Cuddalore, Rameswaram and Tuticorin, in order to obtain information on shell trading and marketing, particularly on *Chicoreus ramosus*. In general, all the shell traders are fully aware of the real values of Chicoreus operculum, shell and meat. Major problems of facing the trade and marketing sectors are identified as: lack of regular fishery for *C. ramosus*; no proper encouragement from the government to export the Chicoreus products to foreign countries; indiscriminate exploitation by the fishermen occasionally; and, natural attack on the shells by borers, thus reducing the value of the shells.

1827. **Patterson Edward, J.K and K. Ayyakkannu** 1992. Ecology of *Chicoreus ramosus* with data on landings from the southeast coast of India. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent.*,10: 150-154.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of a study conducted to investigate the environmental parameters affecting *Chicoreus ramosus* in Cuddalore, Mandapam and Tuticorin coastal waters of southeastern India. Temperature, salinity, dissolved oxygen and hydrogen ion concentration were studied. Data indicate that the spawning period of *C. ramosus* is during late premonsoon or early monsoon season since most egg capsules were collected during the monsoon season.

1828. **Patterson Edward, J.K., A. Murugan and K. Ayyakkannu** 1994. Landing data and meat trade with *Chicoreus ramosus* and *Pleuroploca trapezium* in the Gulf of Mannar and Palk Bay, southeast coast of India. *IV Workshop of the Tropical Marine Mollusc Programme* (TMMP), Phuket (Thailand), 27th Oct to 2nd Nov 1993. *Spec. Publ. Phuket Mar. Biol. Cent.*, 13: 37-42.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Monthly surveys were carried out at coastal villages of the Gulf of Mannar and the Palk Bay, on the southeastern coast of India. Sixteen potential landing centres were identified, 12 in Gulf of Mannar region and 4 in the Palk Bay region. The average monthly landings at all the 16 landing centres were calculated. The *Chicoreus ramosus* and *Pleuroploca trapezium* fishery is mainly associated with lobster fishery. Monsoon winds (northeast

and southwest) influence these fisheries and hence the fishing season differs from one center to another. The export value of the meat of these 2 gastropods has attracted the attention of the fisher folk and it has emerged as an additional source of income for them. In addition to the fishermen involved in fishing these gastropods, there are about 60 other persons engaged in the gastropod meat trade. The mode of their activity and the problems of the trade are discussed.

1829. **Patterson Edward, J.K and K. Ayyakkannu** 1996. Changes in natural coastal systems in the Gulf of Mannar and the Palk Bay, southeast coast of India with particular emphasis on coral reef ecosystem. *Conference on Coastal Change, BORDOMER 95. Proceedings jointly organized by the Intergovernmental Oceanographic Commission of UNESCO and BORDOMER Organization*, France, Bordeaux, France, 10-16 February,1995 (ed.) E. Duursma. UNESCO, Paris-France. 105: 402-406.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : A coral reef ecosystem is a habitat extremely conducive to different species, with abundance of economically important blological resources like finfishes, shell fishes, seaweeds etc. Coral acts as a natural barrier against sea erosion. There are about 20 coral Islands in the Gulf of Mannar region of the Southeast coast of India, covering about 683 hectares from Mandapam to Tuticorin. This fragile ecosystem is under severe threat due to the indiscriminate anthropogenic effects such as pollution, mining, aquaculture, fishing and tourism. Efforts to conserve this ecosystem for proper utilization have already been initiated by various Goverurnent and rescarch organizations. Coral reefs, the most conspicuous of marine habitats, are iroportant in terms of productivity and diversity. It cannot be denied that coral reef habitats are the marine ecosystem richest in species and are responsible for creating a part of the coastal ecosystem. Though coral reef ecosystems are found in different places in the southeastern coast of India, the ecologically and economically valuable coral reefs are found in the Palk Bay and the Gulf of Mannar region. The region between Rameswaram and Kanyakumari along the mainland coast to a distance of about 170 nautical miles is included in the Gulf of Mannar region. This Gulf is part of the southward extension of the Bay of Bengal as it meets the Indian Ocean. It consists of 20 small Islands situated between lat. 8° 46' and 9° 14' N and long. 78° 9' and 79° 41' E, each about 5 km^2 in area. The present day patch reefs are a secondary formation, resulting in the emergence of contemporary reefs and Islands. The corals of the Gulf of Mannar are more diverse and abundant than those of the Palk Bay (Pillai, 1971). The Palk Bay has lagoons of depth ranging from 1.0 to 2.0 m but they are generally devoid of coral except for a single reef. The seas are turbulent in the Palk Bay. Turbid waters from September to May and the siltation have a greater effect on the corals in the inshore areas of Palk Bay than in the Gulf of Mannar. There are 120 species (33 genera) of the fringing and patch coral reefs in the Gulf of Marmar and Palk Bay region. Of these, 110 species are hermatypic and 10 ahermatypic corals (Pillai 1971). The conspicuous species of the corals belong to the family Acroporidae (Acropora, Astreopora and Montipora). Montipora and Acropora put together constitute 39% of the total species recorded. Species belonging to Poritidae and Faviidae constitute the dominant reef builders here (Pillai 1971). There is scope for sustained income through the exploitation of natural resources in any ecosystem in order to fulfil our requirements, it is essential that attention should be focused on any particular ecosystem with a view of its utilization for a longer time without destroying it. Looking at the Palk Bay and Gulf of Mannar coral reef ecosystem, one can understand the ruthless destruction of that habitat by human activity.

1830. **Patterson Edward, J.K., V. Deepak Samuel and Jamila Patterson** 2001. Status of corals and associated resources in and around Tuticorin Port area. *National Seminar on marine and coastal ecosystems: coral and mangrove - problems and management strategies, 26-27 Sept 2001, Tuticorin*, p.74-75.

1831. **Patterson Edward, J.K and E.V. Muley** 2002. Reef restoration - An overview. *SDMRI Res. Publ.,* 2: 120-124.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin 628 001, Tamil Nadu, India.

Abstract : Coral reef ecosystem is one of the important marine ecosystems, which provides benefits in terms of fisheries, tourism and recreation and coastal protection. The coral reefs are threatened worldwide by natural and anthropogenic causes. The corals are able to overcome all natural threats such as diseases, predators, parasites, sea surface temperature variability and physical forces. However, those natural threats may have a dramatic effect on local reef but are most probably not accountable for large-scale degradation because they recover once the impact is reduced or ceased. The anthropogenic threats are the main causes for the most serious coral devastation and long lasting effect. The technology for reef rehabilitation has been developed mainly to repair

damaged reef areas by natural and manmade causes. It is used to aid the speed recovery of damaged reefs by enhancing or supplementing natural process of resilience. So far several methods were adapted for reef restoration in several countries. In India it is virgin field and small-scale restoration work was started on experimental basis to study the feasibility of using low-tech methods. The status of reef restoration in general and its need in India especially in Gulf of Mannar are discussed.

1832. **Patterson Edward, J.K.** 2002. Resource management and socioeconomic value in Gulf of Mannar coral reef ecosystem, south east coast of India. *Proc. Ninth International Coral Reef Symp.*, Bali, 23-27 October 2000, Volume 2. pp. 779-782.

Address : Suganthi Devadason Marine Research Institute 44, Beach Road Tuticorin- 628001, Tamilnadu, India; E-mail: jkpatty@hotmail.com

Abstract : Gulf of Mannar (GOM) of southeast coast of India is predominantly coral reef ecosystem with rich diversity of flora and fauna. There are 21 Islands in GOM. People living along this ecosystem are mostly dependent on its resources for their livelihood. This precious ecosystem is under severe threat due to various factors, mainly coral mining, industrial pollution, destructive and indiscriminate fishing, tourism, population growth and poverty, illiteracy, lack of awareness, inadequate legislation and lack of coordination. In fact socioeconomic condition of the villagers does not allow them to think about their environment as more than 60% of people live below poverty line. India's diverse culture, conventional food habits and social structures have also much impact and therefore careful planning and alternate income generation are key to the success in any management practices. There is always scope for sustained income through the exploitation of natural resources in any ecosystem to fulfil the dependents. A long term community based coastal resources management program in Gulf of Mannar with the objectives "Development, management and sustainable utilization of coastal resources with community participation" would solve the problem substantially. It also gives an opportunity to the community to manage the environment and to enhance their socioeconomic conditions.

1833. **Patterson Edward, J.K., S. Kulkarni, R. Jayabaskaran, S. Lazarus, A. Mary, K. Venkataraman, S.P. Das, J. Tamelander, A. Rajasuriya, K. Jayakumar, A.K. Kumaraguru, N. Marimuthu, R.D. Sluka and J.J. Wilson** 2006. The effects of the 2004 tsunami on mainland India and the Andaman and Nicobar Islands. pp. 85-97. ***In***: *Status of coral reefs in tsunami affected countries:* 2005. (*eds*) C. Wilkinson, D. Souter and J. Goldberg. Australian Institute of Marine Science. 154 pp.

Address : Jerker Tamelander, IUCN Asia Regional Marine Programme CORDIO and GCRMN, jet@iucnsl.org, JK Patterson Edward, Suganthi Devadason Marine Research Institute, jkpatti@sancharnet.in, K Jayakumar, AK Kumaraguru, N Marimuthu, and J Jerald Wilson, Madurai Kamaraj University, kjkkumar@yahoo.com, akkguru@eth.net, marinemari@hotmail.com and jjeraldwilson@hotmail.com, R Jeyabaskaran, National Coral Reef Research Institute, jeybas@hotmail.com, Sarang Kulkanri, Reef Watch Marine Conservation, sarang@reefwatchindia.org, Sri Lazarus, Institute for Environmental Research and Social Education, lazarus_lasu@yahoo.com, Anita Mary, WWF-India, marineani@rediffmail.com, Arjan Rajasuriya, National Aquatic Resources Research & Development Agency, arjan@nara.ac.lk, Robert D Sluka, Millennium Relief and Development Services, bobsluka@mrds.org, K Venkataraman, National Biodiversity Authority, nba_india@vsnl.net.

Abstract : Mortality from the tsunamis was high, with more than 7,000 deaths in the Nicobar group alone (the final number may never be known as many indigenous people on remote Islands may have perished). On the mainland, there were a similar number of fatalities; The greatest losses were in fishing communities although the waves destroyed roads, jetties, other basic infrastructure and entire villages; There was major damage to the coastal resources of southeast India, particularly to mangrove and coastal forests. On the Andaman and Nicobar Islands there was considerable damage to the coral reefs and beaches, as well as the forests; The earthquakes changed the bathymetry of the coral reefs and coasts of the Andaman and Nicobars: reefs in the South Andamans to the Nicobars subsided by 1-3 metres; many reefs in the northern Andamans were uplifted out of the water and died; and some beaches have almost disappeared, while new beaches have formed; There was major damage to large areas of coral reefs of the Andamans and Nicobars, particularly due to debris being washed off the land and smothering by sediments; Mainland coral reefs in the Gulf of Mannar and elsewhere suffered very minor, localised damage. Many mainland beaches were seriously eroded; and the affected reefs are expected to recover within 5-10 years, if there is effective resource management and enforcement of legislation controlling destructive fishing, coral mining, over-harvesting of reef resources, coastal development, sedimentation and pollution.

1834. **Patterson Edward, J.K., Jamila Patterson, G. Mathews and Dan Wilhelmsson** 2006. Status of Coral reefs

on the Tuticorin coast, Gulf of Mannar, Southeast coast of India. pp. 119-127. ***In***: *Coral reef degradation in the Indian Ocean.* CORDIO, Sweden. 285 pp.

Address : Sugandhi Devadason Marine Research Institute, 44 Beach Road, Tuticorin, Tamilnadu, India.

Abstract : The coral reefs of the Gulf of Mannar along the Indian coast are mainly found scattered around the 21 islands that are distributed in an 8 km wide band between Pamban and Tuticorin. Tuticorin (Lat. 8° 45' N, Long. 78° 10' E) is located at the southern end of the Gulf of Mannar. The floral components comprises of economically viable species of seaweeds such as *Gracilaria* sp., *Gelidiella* sp., *Caulerpa* sp., *Sargassum* sp. and *Turbinaria* sp. The sea grass communities of this region are the most diverse in India with the highest number of sea grass species recorded, providing important feeding grounds for the endangered *Dugong dugon.* The Tuticorin group includes four islands namely, Vaan (Lat 8° 50' N, Long. 78° 13' E), Kasuwari (Lat. 8° 52' N, Long.78° 13' E), Kariachalli (Lat. 8° 57' N, Long. 78° 15' E) and Vilanguchalli (Lat. 8° 56' N, Long. 78° 15' E). As a result of soil erosion caused by excessive coral mining, Vilanguchalli now lies 1 m below mean low tide level. The islands have fringing and patch reefs around them. Narrow fringing reefs are located mostly at a distance of 10-15 m from the islands. Patch reefs rise from depths of 2-9 m and extend to 1-2 km in length with widths as much as 50m.

1835. **Patterson Edward, J.K., Jamila Patterson, G. Mathews and Dan Wilhelmsson** 2006. Awareness raising and feasibility of reef restoration through coral transplantation in Tuticorin, Gulf of Mannar, India. pp. 243-251. ***In***: *Coral reef degradation in the Indian Ocean.* CORDIO, Sweden. 285 pp.

Address : Sugandhi Devadason Marine Research Institute, 44 Beach Road, Tuticorin, Tamilnadu, India.

Abstract : The Gulf of Mannar (GOM) contains 21 islands, which form a chain of small fringing reefs on shallow shores stretching 170 nautical miles between 8°46' and 9°14' N latitude and 78°9' and 79°14' E longitude from north of Mandapam to south of Tuticorin. This area is renowned for its floral and faunal wealth. Patterson *et al.* (2004) reported 104 coral species belonging to 38 genera from the area. A large number of traditional fishermen from the mainland use the reefs as fishing grounds. In 1982, the fishery production in the area was 2,375 tons and in 1983 it was 2,150 tons (Venkataramanujam & Santhanam, 1985). Molluscs, holothurians and algae are harvested in large quantities (Patterson, 2002). Although the conservation authorities of Gulf of Mannar Marine National Park have curtailed destructive reef activities considerably, dynamite fishing and coral mining still occurs in the area.

1836. **Pazhani, K.** 2002. Non-governmental organisation and socioeconomic uplift of fishermen. *Fish. Chimes.*, 22(4): 24-27.

Address : T.D.M.N.S. College, T. Kalikulam-627 113, Tirunelveli District, Tamil Nadu, India.

Abstract : The structure and functions of the Kanyakumari District Fishermen Sangam Federation (KDFSF), Tamil Nadu, India are outlined. The various economic activities undertaken by KDFSF includes, marketing of fish, sale of fishing equipments, adoption of latest technologies like motorisation of catamarans and plywood boats, outboard motor service station, savings schemes, revolving fund, social activities, welfare programs, risk fund, cyclone relief etc. The paper also brings to light the problems encountered by the Federation and made possible recommendations.

1837. **Pearson, J.** 1905. Report on the Macrura collected by Prof. Herdamn, at Ceylon in 1902. *Report to the Government of Ceylon on the pearl oyster fisheires of Gulf of Mannar,* 4: 65-92.

1838. **Pearson, J.** 1923. Statistical dealing with the growth rate of *Placenta placenta*. *Bull. Ceylon, Fish.*, 1: 213-264.

1839. **Pearson, J.** 1926. Report on the operations of the pearl banks during the pearl fishery of 1925. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 15: 3-42.

1840. **Pereira, N and X.N. Verlecar** 2005. Is Gulf of Mannar heading for marine bioinvasion? *Curr. Sci.*, 89(8): 1309-1310.

Address : National Institute of Oceanography, Dona Paula, Goa 403004, India, E-mail: neelam@darya.nio.org

Abstract : Reports are available on 'the free-living populations of *Kappaphycus*' and its deleterious effects on the endemic corals in Hawaii. Though vegetative propagation is supposedly safe, it can be speculated that in case of environmental changes, propagation through spores may not be impossible. Hence, impact assessment survey comprising a detailed investigation is required to assess the growth and abundance of *K. alvarezii* and its rate of encroachment over the native flora.

1841. **Perumal, M.C.** 1971. India- the big fisherman in the Indian Ocean. *Seafood Export J.,* 3(1): 49-53.

Address : Central Institute of Fisheries Operatives, Cochin, Kerala, India.

Abstract : This article indicates the continental shelf on the east coast although trawling grounds are less extensive than on the west coast there are certain patches of trawling grounds all along the coast which offer good prospects of increasing yield. Along the Tamilnadu coast off Tuticorin, the landing of Sciaenids, Silverbellies, Elasmobranchs, Prawns, Perches, Polynemids etc., could be increased.

1842. **Peter Marian, M.** 1988. Culture of live feed organisms for prawn culture. *Proc. Shrimp Farming.* p. 6.

Address : School of Biological Sciences, Madurai Kamaraj University, Madurai-625 021, India.

1843. **Peter Marian, M., M.S.M. Christopher, S. Lazarus and A.M. Selvaraj** 1997. Live Feed culture: Problems and Prospects. p. 148. ***In***: *Problems and prospects of Aquaculture.* (*eds*.). S. Santhanakumar, A.M. Selvaraj and T. Natarajan, SEED.

1844. **Peter Marian, M., J.A.C. John and M.M. Babu** 1998. Recombinant DNA technology in mariculture. pp. 55-68. ***In***: *Trends in Marine Biotechnology.*

1845. **Pillay, K.S and N.S. Varies** 1962. Studies on the structure of alginic acid from the Sargassum seaweeds of Cape Comorin. *J. Proc. Inst. Chem., India,* 24: 205.

1846. **Ponnuraj, M., A.G. Murugesan and N. Sukumaran** 1997. Current environmental issues of coastal aquaculture in Tamilnadu. *Proc. 6th National Symp. Environment,* 186-190.

1847. **Prabhadevi, L and G.S. Ammal** 1997. Occurrence of the spider crab *Rhynchoplax alcocki* Kemp (Brachyura: Hymenosomatidae) in Thengapattanam estuary. *J. Bomb. Nat. Hist. Soc.,* 94(3): 586-588.

Address : Department of Aquatic Biology and Fisheries, Beach P.O., Thiruvananthapuram 695 007, Kerala, India.

Abstract : The description of the spider crab, *Rhynchoplax alcocki* collected from Thengapattanam estuary in Kanyakumari district, Tamil Nadu (India) is given. The species was found on stone pavements encrusted with filamentous algae and calcareous tubes of the polychaete *Serpula* sp., on the southern side of the estuary about 1 km away from the bar mouth.

1848. **Prabhakara Rao, K.** 1952. Significance of variation in *Ptychodera flava* Evolution. *J. Madras Univ.,* (B) 6:

1849. **Prabhakara Rao, K.** 1954. Bionomics of *Ptychodera flava*. *J. Madras Univ.,* 29B: 1-5.

1850. **Prabhakara Rao, K.** 1965. *Moridella brockii* redescribed with notes on anatomy and early development. *J. Mar. Biol. Assoc. India,* 7(1): 61-68.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The facelinid nudibranch *Moridella brockii* Bergh 1888 has been rediscovered and redescribed with notes on anatomy, early development and ecology after seventysix years of its first description.

1851. **Prabhakara Rao, K.** 1968. On a new genus and some new species of Opisthobranchiate gastropods of the family Eubranchidae from the Gulf of Mannar. *Proc. of Symp. on Mollusca MBAI,* 1: 51-60.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A new genus *Annulorhina* based on the type species *A. mandapamensis* and three new species namely *Eubranchus mannarensis, Capellinia fuscannulata,* and *Eubranchopsis indicus* of the family Eubranchidae are described from the Indian Ocean. The present record of the genera *Capellinia* and *Eubranchopsis* extend their distribution to the Indian Ocean. The detailed structure and specific characters of each species have been given and their affinities discussed.

1852. **Prabhu, M.S.** 1954. The perch fishery by special traps in the area around Mandapam in the Gulf of Mannar and Palk Bay. *Indian J. Fish.,* 1(1&2): 94-129.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An account of the perch-fishery by special traps and the different methods of operating them in the Gulf of Mannar and Palk Bay around Mandapam are given. Among the 23 species of fishes caught in perch-traps, only 18 species were true perches. From a study of the percentage composition of the different species caught in perch-traps, *Lethrinus cinereus* was found to be the main species occurring in the catches from both the areas and the second important species *Callyodon ghobban* in the catches from Gulf of Mannar was found to be replaced by *Teuthis marmorata* in Palk Bay. The percentage of non-perches in the traps in the Gulf of Mannar catches was 26.28; *C. ghobban*, a non-perch, alone forming 25.98%, whereas in Palk Bay catches it was only 0.36 corresponding to 0.3% excluding *C. ghobban* from Gulf of Mannar.

1853. **Prabhu, M.S.** 1956. Maturation of intra-ovarian eggs and spawning periodicities in some fishes. *Indian J. Fish.*, 3(1&2): 59-90.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : It is well known that, in the temperate as well as in the tropical waters, fishes exhibit various types of spawning tendencies which are closely connected with the development of the intra-ovarian eggs in batches. Examination of the periodicity in the production of ova in batches from the ovigerous lamellae in the ovaries of oviparous teleosts and a statistical study of the distribution of intra-ovarian eggs in the ovaries of various stages of maturity have been found to give reliable evidence on spawning habits of fishes. Such a study of the intra-ovarian eggs in the ripe and earlier stages of maturity is the basis of the present investigation which was initiated with a view to determining the duration of spawning period in some of the edible food fishes.

1854. **Pradhan, L.B.** 1951. Mackerel Fishery. *Handbook on Indian Fisheries.* Govt. of India, Ministry of Agriculture, pp.57-59.

1855. **Pragasam, B and Daniel Sudhandra Dev** 1988. Studies on the pearl oyster population in pearl oyster grounds off Tuticorin in the Gulf of Mannar. *CMFRI Bulletin*, 42(1): 79-83.

Address : Tamil Nadu Pearls Limited, Tuticorin-628 005, Tamilnadu, India.

Abstract : Details of the inspection of pearl oyster ground and pearl oyster collection (mainly *Pinctada fucata)* for the period from 1977 to 1986 are presented in this paper. The favourable season for diving operations in this area normally sets in from October and ends in May in the subsequent year. During 1977-1986 forty four pearl banks or Paars in the Gulf of Mannar were inspected. A record number of 4,42,321 *P. fucata* were collected during the year 1985-1986, followed by 3,19,718 in 1984-1986 and 2,10,955 in 1981-1982. In 1981-1982 Utti paar supported the collection mainly by contributing 94.28% of the total oysters gathered. During 1984-1985 Devi paar (24.68%). Fernando paar (20,93%), Cruxian paar (24.10%) and Karai paar (29.39%) together contributed 98.10% of the total collection. In 1985-1986 season from Cruxian paar alone, 94.34% of the *P. fucata* were collected. SCUBA diving was effectively employed along with skin diving during 1984-1985 and 1985-1986 seasons.

1856. **Prakash, S., S.A.J. Firthous and B.V. Bhimba** 2005. Biomedical potential of seaweeds against Otitis media infected bacterial pathogens. *Seaweed Res. Utiln.*, 27(1&2): 105-109.

Abstract : Seaweed extracts were studied for their antibacterial activity against Otitis media infected bacterial pathogens. The Otitis Media bacterial pathogens were isolated from 25 infected patients. The isolated bacterial spp. were Gram negative such as *Haemophilus influenzae, Streptococcus pneumoniae, S. pyogenes, Staphylococcus aureus* and *Moraxella catarrhalis*. Bioassay was carried out with 45 extracts of 9 algae namely *Sargassum wightii, Chaetomorpha antennina, Ulva fasciata, Colpomenia sinuosa, Halymenia floresia, Amphiroa fragillisima, Spatoglossum sp. Gracilaria edulis* and *Enteromorpha sp*. Among the 45 extracts, *Halymenia floresia* crude was found to produce maximum growth inhibition against the bacterial pathogens. Five solvents were used for the extraction of antimicrobials of which butanol showed maximum extraction of antimicrobials.

1857. **Prakash Williams, G and S. Ravikumar** 2004. Lipid biomarkers for halobacterial chemotaxonomy. *Seshaiyana*, 12(2): 8.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

1858. **Prakash Williams., G., S. Ravikumar, K. Saivathurai and S. Abideen** 2005. Antifouling compounds from seaweed marine halophytes. *Proc. on Marine Resources*. Department of Botany, S.T.Hindu College, Nagercoil. p9-11. (ed.) M. Sukumaran.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : The intensity of micro fouling in Rajakkamangalam estuary was studied by immersing two different panels (Stainless steel and Acrylic). Stainless steel was found to be less favourable for the attachment of microfoulers than Acrylic panels. Increased micro fouling was observed with increased exposure time. Six bacterial foulers *viz. Pseudomonas* sp., *Escherichia* sp., *Salmonella* sp., *Vibrio* sp., *Streptococcus* sp., and *Clostridium* sp. and two fungal foulers *viz. Alternaria* sp. and *Aspergillus* sp. were recorded in the present study. The *Aspergillus* sp. was found to be the predominant fungal species (19%) and *Pseudomonas* sp and *Vibrio* sp.(15%) were found to be the dominant bacterial species. Among the bacterial species, *Escherichia* sp. was highly inhibited by the methanolic extracts of *Dichtyota dichotoma* whereas *Aspergillus* sp. was highly inhibited by the methanolic extract of *Sargassum wightii.*

1859. **Prasad, N.K.** 1972. Marine fisheries in India. *Seafood Export J.*, 4(1): 165-170.

1860. **Prasanna Varma, R.** 1960. Flora of the pearl beds off Tuticorin. *J. Mar. Biol. Assoc. India*, 2(2): 221-225.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This account deals with the algae collected during a survey of the pearl and chank beds off Tuticorin during December 1958 to May 1959, conducted by Dr. F. Baschieri-Salvadori, F.A.O. Underwater Expert, in collaboration with Mr. K. Nagappan Nayar of the Central Marine Fisheries Research Institute and Mr. Isaac Rajendran of Madras State Fisheries, to whom the author is grateful for the algal collections. In addition, during the, above period pearl fishery was in progress (March to May) and the algae brought by divers along with oysters were also studied by the author.

1861. **Prasanna Varma, R and K. Krishna Rao** 1962. Algal resources of Pamban area. *Indian J. Fish*., 9(1&2):205-211.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The use of algae as food, fodder and manure dates back to many hundreds of years. Seaweeds have also been associated with important industries like agar-agar, alginic acid and iodine, to mention a few. Though Japan takes a lead in the utilization of seaweeds, other countries like China, Malaya, Indonesia, Burma, Siam, Borneo, the Strait Settlements, Indo-China, Australia, Hawaii, New Zealand, Chile, etc., use algae for food as well as in the preparation of agar-agar and other industrial products.

1862. **Prashad, B.** 1920. On a new species of Thalassema from the Gulf of Mannar with notes on Thurston's species *T. formulosum. Rec. Indian Mus.*, 19: 35-37.

1863. **Prater.** 1928. The Dugong or sea cow. *J. Bomb. Nat. Hist. Soc.*, 33(1): 84-100.

Abstract : A dugong *Dugong dugon* from Tuticorin presented to Madras museum by James Hornell.

1864. **Pratt, E.M.** 1905. Report on some Alcyoniidae collected by professor headman, at Ceylon, in 1902. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 3: 247-268.

1865. **Prema, M and V. Krishnamurthy** 2004. Morphological and developmental studies on some Indian species of *Hypnea* Lamouroux (Hypneaceae, Rhodophyta). *Seaweed Res. Utiln.*, 26(1&2): 1-17.

Address : Department of Botany, Ethiraj College for Women, Chennai-600 008, Tamilnadu, India.

Abstract : *Hypnea cervicornis* J. Ag., *H. divaricata* (C.Ag.) Grev., *H. flagelliformis* Grev ex. J. Ag., *H. hamulosa* (Esper) Lamour., *H musciformis* (Wulf.) Lamour., *H. pannosa* I.Ag. and *H. valentiae* (Turn.) Mont. were collected periodically from the southern east coast of India, fixed and studied. Their morphology, structure and reproductive stages are described in the text.

1866. **Prema, P., P. Balaji and R. Vinodh** 2004. Screening of marine algae from Mandapam coast for their antibacterial activity. *Proc. Nat. Sem. on New Frontiers in Marine Bioscience Research,* January 22-23, 2004. pp. 53-62.

Address : Post Graduate Department of Microbiology, V.H.N.S.N. College, Virudhunagar - 626 001, Tamilnadu, India.

Abstract : Due to the increased awareness of environmental pollution and the non-target effects of the chemical fungicides, there is scope for utilizing antibacterial and antifungal substance from marine origin. The utilization

of algae for medicinal purposes is not new, but the discoveries of the last years have opened new, perhaps important possibilities in this field. Besides the products, agar, carrageenan, alginic acid and alginates, algae have numerous constituents, such as, acids, alkaloids and amine, antibacterial, antifungal and antiviral substances, lipids, sterols, fatty acids, phenolic compounds, phytohormones, pigments, proteins, peptides, amino acids, sugar alcohols and vitamins. The present study focuses the biologically and chemically interesting substances from algae that have antimicrobial activity and to compare its effect with the commercially available antibiotics against the common pathogens. When extracts of algae such as *Sargassum wighti, Padina boergesenii, Turbinaria ornate, Gracilaria edulis, Hypnea valentia, Laurencia papillosa, Caulerpa scalpelliformis* and *Caulerpa racemosa* were compared with commercial antibiotics (Amikacin and Chloramphenical), it revealed that more or less similar zone of inhibitions against *E. coli* (16 mm, 15 mm and 11 mm), *S. flexneri* (17 mm), *S. typhi* (8 mm), *P. aeruginosa* (16 mm and 10 mm), *S. aureus* (14 mm), *B. cereus* (12 mm) and *K. pneumoniae* (9 mm). Although the commercial antibiotics are highly effective to kill the pathogens, the use of marine algae is safe, good for health and fails to cause side effects.

1867. **Prema, P., A. Palavesam and P. Balaji** 2005. Aerobic heterotrophic bacterial diversity in sediments of Rajakkamangalam estuary, South west coast of India. *J. Environ. Biol.*, 26(4): 729-734.

Address : Department of Marine Science and Technology, M.S University, Rajakkamangalam, Kanyakumari, Tamilnadu, India.

Abstract : The abundance of aerobic heterotrophic bacterial population in the sediment sample of six experimental stations (S1 to S6) at Rajakkamangalam estuary was studied for a period of one year from March 1998 to February 1999. The important bacterial genera encountered were *Pseudomonas, Bacillus, Vibrio, Escherichia, Micrococcus, Enterobacter, Salmonella, Aeromonas, Shigella, Klebsiella, Proteus, Alkaligenes, Staphylococcus, Citrobacter* and *Flavobacterium*. The bacterial population based on numerical counts showed wide fluctuations in their distribution at different stations. Among the bacterial genera *Pseudomoans* was found to be the dominant genus during the experimental period. The qualitative and quantitative distribution of microflora in the sediment samples are discussed.

1868. **Prem Anand, T.** 2001. Awareness about coral and mangroves among fisherfolk -A survey report from Tuticorin region of Gulf of Mannar. *National Seminar on marine and coastal ecosystem: Coral and Mangrove - problems and management strategies*, 26-27, Sept 2001, Tuticorin.

Address : Suganthi Devadason Marine Research Institute, 44, Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: jkpatty@hotmail.com

Abstract : Tuticorin coast of Gulf of Mannar is having 12 fishing villages. Four core fishing villages, namely Tharuvaikulam, Vellapatti, Thirespuram and Punnakayal, Tamil Nadu, India were selected. The awareness among core fishing population about corals and mangrove ecosystems was assessed using a semi structured interview method. The awareness of the people is directly related to the proximity of the ecosystem to their village. The overall percentage of awareness is more among men than women in all villages. Men less than 20 years of age were also found to be less aware compared to males above that age group. The need to educate the fisher women relating to the importance of corals and mangroves is imperative. Strategies to improve general awareness among the core population are discussed.

1869. **Prem Anand, T., V. Deepak Samuel and J.K. Patterson Edward** 2001. Gastropod shells attached to the surface of *Xenophora pallidula* (Gastropoda, Prosobranchia). *Phuket Mar. Biol. Cent. Spcl. Publ.*, 25(2):363-365.

Address : Sugandhi Devadason Marine Research Institute, 44, Beach Road, Tuticorin, Tamilnadu, India.

Abstract : The gasttopod family Xenophoridae affix foreign objects to the shell surface. The objects include bivalve shells, smaller gastropod, shell fragments, and encrusting corals. We identified gastropods attached on 100 shells of *Xenophora pallidula* (Reeve, 1842). We found that the buccinid *Nassaria nivea* (GmeLin, 1791), *Bursa* sp., the turrid *Turricula javano* (Linne, 1758) and the nassarid *Bullia vittata* (Linne, 1758) were the most common objects. Fragments and bivalve shells could not be identified.

1870. **Prem Anand, T and J.K. Patterson Edward** 2002. Brine shrimp toxicity of opercula of gastropods from Tuticorin coastal waters. *SDMRI Res. Publ.*, 2: 165-169.

Address : Suganthi Devadason Marine Research Institute, 44, Beach Road, Tuticorin 628 001, Tamilnadu India; E-mail: prem_anand_t@rediffmail.com

Abstract : Animals sparing bioassays such as *Artemia* toxicity assay has been used around the world for the screening of bioactive compounds. Research has already shown that brine shrimp toxicity correlates well with

antitumor activity. In the present study 10 gastropod opercula were screened for their *Artemia* toxicity. *Lambis arthritica* and *Chicoreus virgineus* opercula extracts were found to be toxic even in lower concentrations. All extracts exhibited activity in higher concentrations. The opercula exhibiting significant activity at lower concentration were fractionated employing a step gradient. In the column fractions, only EA20:H80 and EA40:H60 of *Chicoreus virgineus* exhibited significant activity in lower concentrations.

1871. **Prem Anand, T., Abdul Wajid Bhat, Yogesh S. Shouche, Upal Roy, Jay Siddharth and Siddhartha P. Sarmal** 2006. Antimicrobial activity of marine bacteria associated with sponges from the waters off the Southeast coast of India. *Microbiol. Res.,* 161(3): 252-262.

Address : Molecular Biophysics Unit, Indian Institute of Science, Bangalore-60012, Karnataka, India.

Abstract : Seventy-five marine bacterial strains associated with four species of sponges (*Echinodictyum* sp., *Spongia* sp., *Sigmadocia fibulatus* and *Mycale mannarensis*) were isolated from the Tuticorin coast, Gulf of Mannar region. The agar overlay method was used to screen for antibiotic production by these strains against four bacteria, viz., *Bacillus subtilis, Escherichia coli, Vibrio parahaemolyticus,* and *Vibrio harveyi* and one fungal pathogen, viz., *Candida albicans*. Twenty-one per cent of the bacterial strains were found to be antibiotic producers and their activities ranged from broad spectral to species specific. A strain coded SC3 was found to be highly potent and was mass cultured. The ethyl acetate extract of the culture broth was further fractionated by reverse phase HPLC and the active fraction identified. In addition, SC3 was subjected to morphological and physiological characterization. The results of the tests showed SC3 to be a Gram-positive rod, sporulating, motile, catalase and oxidase positive. Phylogenetic analysis based on comparative analysis of sequenced 16s rRNA of the active strains indicated a preponderance of bacteria belonging to Vibrio and Bacillus genera with 95-99% sequence similarities. To our knowledge this is the first report on phylogenetic identification of antibiotic producing bacteria associated with sponges from Indian waters.

1872. **Preston, H.B.** 1909. Description of new land and marine shells from Ceylon and S. India. *Rec. Indian Mus.*, 2: 133-140.

1873. **Prince Jeyaseelan, M.J., V. Sundararaj and M. Devaraj** 1991. Significance of mangroves in fisheries. Proceedings on significance of mangroves, Pune. 1990. (eds.) A.D. Agate, S.D. Bonde, K.P.N. Kumaran. Pune, Maharashtra, India. *Maharastra Assoc. Cultiv. Sci. Res. Inst.,* 1991 pp. 14-23.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

1874. **Prince Jeyaseelan, M.J and V. Sundararaj** 1993. Use of reservoirs in water quality management. *Seafood Export J.,* 25(5): 21-23.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Intensive shrimp culture is possible even away from the coastal sites by using water stored in the reservoirs. This possibility has been discussed in this paper.

1875. **Purushothaman, A.** 1998. Microbial diversity. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve.,* MSSRF Publ. pp. 86-91.

Address : Centre of Advanced Study in Marine Biology and Oceanography, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Biodiversity of coral reef ecosystems supports a distinctive plethora of flora and fauna. In particular, microbial diversity plays an important role in reef productivity, thus sustaining the entire ecosystem. The bacteria mediate between the dissolved, particulate and gaseous states of chemical compounds, thereby regulating the distribution of organic and inorganic compounds throughout the ocean. This mediation and regulation contributes to the role of bacteria in degradation of organic matter and nutrient regeneration. Bacteria also serve as an important source of food for a variety of marine organisms, and thereby increase or maintain the productivity of the reef environment.

1876. **Purvaja, G.R and R. Ramesh** 1993. Ecology, conservation and restoration of coral reef ecosystems. *Workshop on the Sustainable Management of Coastal Ecosystems,* M.S. Swaminathan Foundation. (*eds*) M.S. Swaminathan and R. Ramesh. pp. 103-113.

Address : Institute of Ocean Management, Anna University, Madras - 600 025, Tamilnadu, India.

Abstract : The ecological processes and their influence on the coral reef ecosystem are described. The need to declare the reefs in the Gulf of Mannar, near Tamil Nadu, India as a biosphere reserve is emphasized.

Q

1877. **Qasim, S.Z.** 1973. An appraisal of the studies on maturation and spawning in marine teleosts from the Indian waters. *Indian J. Fish.,* 20(1): 166-181.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Maturation and spawning in many telcosts from the Indian waters have been studied by different authors using conventional methods. The most common among these methods are seasonal changes in the condition of gonad; and the ova diameter frequency distribution. The latter is supposed to give an index of the progression of oocytes and their withdrawal from the ovaries. There are several drawbacks in these methods as they were essentially developed for fishes from the temperate region. It is therefore desirable that other methods should also be used for arriving at a realistic picture of the spawning process. Maturity is clearly linked with the growth rate of fishes and hence the two phases pre and post-maturity should be clearly distinguished. Spawning in a population is possibly geared to external events, when conditions for the newly produced broods are most favourable. Fishes in the Indian waters spawn in all the months of the year, but along the east coast spawning largely seems to occur during the pre-monsoon months and along the west coast during the monsoon and postmonsoon months. Many species appear to be continuous breeders, and hence to develop a clear understanding of their maturation and spawning, it is necessary to make observations throughout the year.

1878. **Qasim, S.Z.** 1973. Some implications of the problem of age and growth in marine fishes from the Indian waters. *Indian J. Fish.,* 20(2): 351-371.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Growth studies on teleosts from the Indian waters are largely based on length frequency distribution, for the simple reason that age determination from other conventional methods has been found to be difficult. In some fishes, where scales, otoliths and other hard parts show clear zonations, it is difficult to conclude that these are formed annually. In all those species, which breed successively over prolonged periods, length frequency distribution will not easily indicate yearly broods. Therefore, it has been suggested that before undertaking the study on growth, some generalized growth characteristics in tropical fishes should be taken into account. Experimental studies on fishes, by keeping them in large cages suspended in the sea, has been suggested as one of the possible approaches for determining their rates of growth. The characteristics of some of the well-known growth parameters have been described and the various methods used for estimating the mortality rates of fishes have been indicated. The method employed by the Indian workers, for estimating the mortality rate, is to change the size structure of the catch into age structure and then estimate the total instantaneous mortality coefficient (z) by comparing the abundance of fish at successive ages or from their numbers at successive length groups. From the estimate of z, it is possible to determine both fishing mortality coefficient F and natural mortality coefficient M. The yield from a fishery can be determined by employing the two well-known approaches the Beverton-Holt approach and Shaefer approach.

1879. **Qasim, S.Z., M.V.M. Wafar, S.Vijayaraghavan, J.P. Royan and L. Krishna Kumari** 1978. Biological productivity of coastal waters of India from Dabhol to Tuticorin. *Indian J. Mar. Sci.,* 7(2): 84-93.

Address : National Institute of Oceanography, Dona Paula - 403 004, Goa, India.

Abstract : Biological productivity of coastal waters of India, from Dabhol to Tuticorin was studied during the 17th cruise of *RV Gaveshani* in March 1977. Within 50 m depth from the coast, data on chlorophyll a, ^{14}C uptake and zooplankton biomass were collected at 55 stations. Larger phytoplankton organisms (microplankton) contributed greater spatial variations in primary productivity than nannoplankton. Maximum primary production was recorded in areas adjoining Karwar and Calicut. Production at the primary level of the food chain for the entire coastal area measuring 43 x 10^3 km^2 was at the rate of 0.33 gC/m^2/day or 122 tonnes C/km^2/yr or 5 million tonnes of carbon/yr. Of the 18 major components constituting the zooplankton biomass, copepods formed the dominant group. Caloric value of different components ranged from 0.5 to 6.4 kcal/g dry weight. The average production of zooplankton in the total area was 125 mgC/m^2/day which amounted to 2.5 million tonnes of carbon/yr or 60 tonnes of carbon/km^2/yr. Mean transfer coefficient was found to be 10% and the average tertiary production, calculated from both primary and secondary production rates, was approximately 2 million tonnes of live weight/yr. The average sustainable yield per year has been estimated as 0.8 million tonnes of fish. The annual harvestable yield calculated from the energy budget in terms of calories for the entire coastal area agreed with that estimated from the primary and secondary production rates. The present exploited yield from the coastal waters is of the order of 0.6 million tonnes. The existing yield of pelagic, demersal and crustacean resources from the Kerala

region appears to be greater than the annual sustainable yield and hence the stock in this area requires conservation. In the other coastal regions, further increase in the exploitable yield of the order of 0.2 million tonnes seems possible.

1880. **Qasim, S.Z.** 1998. Exclusive Economic Zone. pp 22-26. ***In***: *Glimpses of the Indian Ocean*. 206 pp.

Address : National Institute of Oceanography, Dona Paula - 403 004, Goa, India.

Abstract : Having established our rights over the EEZ and its resources, we have seldom realized the responsibilities and obligations this has imposed on us. The total area of the Indian EEZ is approximately 2.02 million square kilometers. It is widely dispersed along the coastline and around the islands. To manage the resources of such a large area with vast quantities of water will require knowledge and understanding of the types of resources it commands. It will also require the establishment of a huge infrastructure, trained and skilled manpower and the use of proven technologies. Although no time limit can be set to the exploration and exploitation of its resources, one can appreciate the limits of human ingenuity from the fact that it has taken us hundreds of years to explore and exploit life-sustaining resources of the land, and it is often questioned whether we are doing it wisely and efficiently. Considering this, our sea resources, which we cannot see with our naked eyes and many of which we have yet to locate, will obviously require entirely new thinking and innovation for their management. The handling of our highly risk-prone watery assets thus calls for a considerable degree of understanding. Therefore, as we now know, many of the features of our EEZ are still unknown and what lies ahead cannot be evaluated with any substantial degree of accuracy and precision. Nevertheless, some of the problems which are well known are briefly discussed here.

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1881. **Radhakrishnan, E.V and M. Vijayakumaran** 1988. Potential of spiny lobster culture- An assessment. *CMFRI Spec. Publ.,* 40: 61.

Address : Central Marine Fisheries Research Institute, Madras - 600 105, Tamilnadu, India.

Abstract : Any serious attempt to cultivate spiny lobsters should begin with rearing the juveniles that are caught in large numbers along with the commercial size lobsters. Commercial size (200 g) lobsters can be grown in less than half the time required in nature by proper feeding schedules and environmental management. A further reduction in this growing period has been achieved by inducing accelerated growth by eyestalk ablation. Enhancement of growth in ablated lobsters up to 20 times the normal rate indicates possibilities of rearing lobsters in shorter duration. The present status and the problems which need further attention for developing commercially feasible lobster culture are discussed.

1882. **Radhakrishnan, E.V and Mary K. Manisseri** 2001. Status and management of lobster fishery resources in India. *Mar. Infor. Serv., T&E Ser.,* 169: 1-3.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In India, though lobsters form only 0.12 ± 0.06% of total marine landings they form an important export product comprising 1.07 ± 0.44% in quantity and 2.59 ± 1.15% in value. Total annual landings have been fluctuating between 1,587 to 2,917 tonnes for the past fifteen years (1985-2000) with the highest landing of 4,075 tons in 1985. Heavy demand and attractive price for lobsters in the international market have resulted in increased exploitation of lobsters. Unless new grounds are located scope for improvement in the fishery in the coming years is limited. The multi-species and multigear lobster fishery involving both traditional and mechanized fishermen poses multitude of problems for management of this valuable resource from overexploitation and conservation.

1883. **Radhakrishnan, E.V., M. Vijayakumaran and J. Kittaka** 1995. Early larval development of the spiny lobster *Panulirus homarus* (Linnaeus, 1758) reared in the laboratory. *Proceedings of the fourth international workshop on lobster biology and management, 1993. Crustaceana,* 68(2): 151-159.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Phyllosoma larvae of the spiny lobster, *Panulirus homarus* were hatched and reared in the laboratory on a diet of *Artemia salina* nauplii. The larvae were reared in individual as well as in mass culture systems. The temperature of the rearing water ranged from 26 to 29°C and salinity from 34 to 35 ppt. These larvae reared individually moulted nine times and reached the sixth stage in sixty days. Mean total length of the newly hatched larva was 1.48 mm and stage VI larva measured an average of 4.87 mm. The early stages of phyllosoma larva of *P. homarus* are morphologically similar to those of other tropical species. Larvae infested with sedentary ectoparasites were effectively treated with 10 ppm malachite green. Change in feeding habits resulted in mortality of the larvae in the sixth stage.

1884. **Radhkrishnan, N.** 1957. A contribution to the biology of Indian sand whiting *Sillago sihama* (Forskal). *Indian J. Fish.,* 4(1&2): 254-283.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The Indian Sand Whiting, belonging to the family Sillaginidae (Order Percomorphoidea), is of some importance to the coastal and estuarine fisheries of India. Very little detailed study of this fish seems to have been made, except for a short account of its food and feeding habits by Chacko (1949), notes on the larval and post-larval stages by Gopinath (1942, 1946), general notes by Devanesan and Chidambaram (1948), and observations on the eggs and larvae by Chacko (1950). Cleland (1947) has given an account of three Indian species, *Sillago sihama, Sillago panijus* and *Sillago maculata,* the first constitutes by far the largest element in the commercial catches around Mandapam and Rameswaram Island in the Gulf of Mannar and Palk Bay. A detailed study of the biology of the commonest species was therefore taken up in September 1953 at the suggestion of Dr. N.K. Panikkar, the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, and a note, forming part of the work, has already been published (Radhakrishnan, 1954).

1885. **Radhakrishnan, N.** 1994. The role of fisherwomen in the *Beche-de-mer* industry. *CMFRI Bulletin,* 46: 99-100.

Address : Department of Fisheries, Government of Tamilnadu, Madras-600 006, Tamilnadu, India.
Abstract : *Beche-de-mer* industry is essentially a cottage industry. The men are engaged in going out into sea and diving for the material. At some places women and children are engaged in collecting holothurians during

low tide from mud flats. After men return from sea the work is taken over by women in degutting and boiling holothurians. This relieves additional burden on men who go out into sea. They gainfully engage the women. Formation of fisherwomen Societies and imparting training to them will definitely improve the *Beche-de-mer* industry in Tamil Nadu. The active participation of fisherwomen in this foreign exchange earning industry will certainly improve both the industry and the financial conditions of the fisherwomen.

1886. **Radhakrishnan Nair, P.N.** 1973. On an abnormal specimen of rainbow sardine *Dussumieria hasselti* without ventral fins. *J. Mar. Biol. Assoc. India*, 15(2): 885-886.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An abnormal specimen of *D. hasselti* without ventral fins is recorded and illustrated. The abnormal female specimen was collected from the Gulf of Mannar in May 1969.

1887. **Radhakrishnan Nair, P.N and M. Badrudeen** 1975. On the occurrence of the soft-shelled turtle, *Pelochelys bibroni* (Owen) in the marine environment. *Indian J. Fish*., 22(1&2): 270-274.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A soft-shelled turtle, *P. bibroni*, caught alive from Palk Bay a new record from the southern part of Indian peninsula - proves beyond doubt that the species can tolerate the marine environment, as against the belief that it is purely a freshwater form. The behaviour of the animal was studied keeping it under captivity for 14 days. The taxonomic details and the distributional record of the species are given.

1888. **Radhakrishnan Nair, P.N., K.K. Appukuttan and C.S. Gopinadha Pillai** 1976. New horizon in marine products export exquisite handicrafts from shells & corals. *Seafood Export J.,* 8(9): 11-19.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The demand for polished shells and handicrafts there of, at home and abroad, was an incentive to many entrepreneurs in South India especially in Ramnathapuram District in Tamilnadu, to start cottage industries producing beautiful curios and several utilitarian objects with molluscan shells. *Dentalium* is collected from the intertidal zones of Palk Bay and Gulf of Mannar for making toys and models. Details about the ornaments from molluscan shells are given.

1889. **Radhakrishnan Nair, P.N.** 1982. On the systematics of Rainbow sardines *Dussumieria* spp. (Family: Dussumieriidae - Pisces) from Indian waters. *J. Mar. Biol. Assoc. India*, 24(1&2): 80-91.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The systematics of the Rainbow sardines of the genus *Dussumieria* valenciennes has been studies in detail. The existence of two species namely *Dussumieria acuta* valenciennes and *D. hasseltii* Bleeker in Indian waters has been re-established as against the view of the whitehead 1963 who synonymised these two species to one namely, *D. acuta* Val. In this study specimens collected from east and west coasts of India were analyzed morphometrically and meristically and the characters compared statistically. Clear differences many of the characters, sufficient enough to substantiate the existence of two different species, were noticed. The two species are redescribed and photographs presented in the text.

1890. **Radhakrishnan Nair, P.N.** 1982. Diurnal variation in the feeding habits of *Dussumieria acuta* Val. from the Gulf of Mannar and the Palk Bay. *J. Mar. Biol. Assoc. India*, 24(1&2): 112-117.

Address : Central Marine Fisheries Research Institute, Vizhinjam, Kerala, India.

Abstract : A distinct variation in the feeding intensity was noticed in *Dussumieria acuta* between the day and night. This was due to the diurnal variation in the feeding habits of this fish, feeding actively during day time and starving during the night. The study over a period of two years in 1969-70 and 1970-71 showed that in day samples only 6.05% fish during the first year and 2.57% fish during the second year were with empty stomachs, whereas in the night samples 98.33% during the first year and 98.16% during the second year were either with empty or with “little” stomachs.

1891. **Radhakrishnan Nair, P.N.** 1991. The age and growth rate of rainbow sardine *Dussumieria acuta* from Mandapam area and its age group composition in the fishery. *J. Mar. Biol. Assoc. India*, 33(1&2): 229-240.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The age and growth rate of *Dussumieria acuta* of the Gulf of Mannar and the Palk Bay, during April 1969 to March 1971 was studied. According to the Peterson's method of length frequency analysis the fish grows to a total length of 73 mm, 95.5 mm and 113 mm at the end of 1st, 2nd and 3rd quarters of and year and to 128 mm at the end of 1st year, resulting in an average growth rate of 10.75 mm per month. Results of the Probability Plot technique of Cassie (1954) applied to the data, showed perfect agreement with those of Peterson's method. Von Bertalanffy's growth equation was fitted and the estimated values of the growth parameters were: L_8 = 191 mm, K = 0.20701 and t_0 = -1.34 quarters. Theoretically the fish grows to a length of 128.05 mm, 163.28 mm and 178.91 mm at the end of 1st, 2nd and 3rd years. No growth rings were traceable on the otoliths, but a straight-line relationship could be noticed between the lengths of otolith and the fish. The growth by weight showed that the optimum age for exploitation of *D. acuta* is when the fish is 1 to 1 is equivalent years old. A study of the age composition of *D. acuta* in the commercial catches during 1969-71 showed that in the shore seine and the gill net catches 1-year group dominated, whereas in the trawl net catch the 0-year class dominated during 1969-70 and 1-year class during 1970-71.

1892. **Raghukumar, C.** 1987. Fungal parasites of marine algae from Mandapam (South India). *Dis. Aquat. Org.*, 3(2): 137-145.

Address : Biological Oceanography Division, National Institute of Oceanography, Dona Paula, Goa 403 004, India.

Abstract : Several fungal parasites of marine algae from Mandapam, on the east coast of south India, are reported. The green alga *Chaetomorpha media* collected from intertidal rocks showed the presence of the fungal parasites *Pontisma lagenidioides* and *Labyrinthula* sp. on incubation in sterile seawater under laboratory conditions. Similarly, the blue-green alga *Lyndbya* sp. and the green filamentous algae *Rhizoclonium* sp. and *Cladophora* sp., incubated in seawater, showed severe infection by *Labyrinthula* sp. The host range of *Labyrinthula* sp. and culturing methods are also discussed. These pathogens are new records from India and some of the host/ parasite combinations reported here are also new.

1893. **Raghunathan, C and K. Ayyakkannu** 1992. Oxygen consumption and lethal level of oxygen deficiency in *Chicoreus ramosus*. *Proceedings of the second workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May,1992. (eds) J. Hylleberg, K. Ayyakkannu,and S. Khokiattiwong. *Phuket Marine Biological Cent.,* 10: 213-215.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of an investigation conducted to determine the rate of oxygen consumption and the lethal level of oxygen for *Chicoreus ramosus* from the Tuticorin coastal waters of the Gulf of Mannar. The study showed that *C. ramosus* can survive in a closed system for 2-3 days at very low levels of oxygen. The rate of oxygen consumption fluctuated during the experiment and no consumption was recorded at certain hours of the experiment. This could be ascribed to the fact that whenever the dissolved oxygen content in the seawater decreased, the rate of oxygen consumption also decreased and at that time the animals closed their aperture tightly with the operculum.

1894. **Raghunathan, C and K. Ayyakkannu** 1994. Reproductive biology of *Pleuroploca trapezium* Linnaeus (Neogastropoda: Fasciolaridae). IV Workshop of the Tropical Marine Mollusc Programme (TMMP), Phuket (Thailand), 27th Oct to 2nd Nov 1993. *Spec. Publ. Phuket Mar. Biol. Cent., 13: 89-93.*

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The marine prosobranch gastropod *Pleuroploca trapezium* was collected randomly in Gulf of Mannar, southeast coast of India over a period of 12 months. The sex ratio was 1:1 (M:F) during April, June and November while females were slightly higher in number in all other months. The maximum gonad length in males (15.7 cm) and females (16.2 cm) were observed in March whereas the minimum was 6.0 cm in males and 7.2 cm in females and they were found in June. The calculated gonad indices were maximum in males (2.80%) and females (3.20%) during March and minimum (males, 0.68%; females, 0.78%) in July. Though spawning was noticed from January to February, peak spawning was in March. The egg capsules were collected between January and April. The morphology of capsules is described.

1895. **Raghu Prasad, R and P.R.S. Tampi** 1952. An account of the fishery and fishing method for *Neptunus pelagicus* near Mandapam. *J. Zool. Soc. India*, 3(2) : 335-339.

1896. **Raghu Prasad, R.** 1954. Hydromedusae of the Gulf of Mannar and Palk Bay near Mandapam. *Proc. Indian Sci. Congr., (41st Sess):* 170.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1897. **Raghu Prasad, R.** 1954. Observations on the distribution and fluctuation of planktonic larvae off Mandapam. *Proc. Indo - Pacif. Fish. Counc.*, 21-34.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1898. **Raghu Prasad, R.** 1954. The Characteristics of Marine plankton at an inshore station in the Gulf of Mannar near Mandapam. *Indian J. Fish.*, 1(1&2): 1-36.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The paper deals with the gross qualitative and quantitative changes in the plankton of an inshore station in the Gulf of Mannar. These changes are compared with those observed at other places along the coasts of India. Hydrological and meterological features of the area are briefly described. Fluctuations in the surface temperature and salinity show similarity in general trends in the two years. The maximum and minimum surface temperatures recorded were 31.50° C and 24.00° C in 1950 and 30.60° C and 24.60° C in 1951 respectively. In 1950 the surface salinity was the highest in May (36.41 ppt) and the lowest in December (29.44 ppt). During the following year the lowest (29.01 ppt) was recorded in January. The highest salinity for the year was 36.02 ppt in September but no data are available for May 1951.

1899. **Raghu Prasad, R and P.R.S. Tampi** 1954. Notes on some decapod larvae. *J. Zool. Soc. India*, 9: 22-39.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A wide variety of decapod larvae is characteristic of the inshore plankton of Mandapam (q. v., Prasad, 1954) but the specific identity of many of these larvae is still unknown. Our present knowledge of the decapod larvae of Indian waters is mostly based on the pioneering work of Menon (1933, 1937 and 1940) who, however, could not determine the species in many cases because of the inadequacy of material in some cases and the difficulty he experienced in getting the earliest larval stages hatched in the laboratory.

1900. **Raghu Prasad, R and P.R.S. Tampi** 1954. Some aspects of relative growth in the blue swimming crab *Neptunus pelagicus* (Linnaeus). *Proc. Nat. Inst. Sci. India,* 20B: 218-234.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1901. **Raghu Prasad, R and R. Jayaraman** 1954. Preliminary studies on certain changes in the plankton and hydrological conditions associated with the swarming of Noctiluca. *Proc. Indian Acad. Sci.*, 40B: 49-57.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1902. **Raghu Prasad, R.** 1956. Further studies on the plankton of the inshore waters of Mandapam. *Indian J. Fish.*, 3(1&2): 1-42.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A comparative study of the intensity, distribution and fluctuations of plankton at two inshore stations G and P in the Gulf of Mannar and the Palk Bay respectively, was made. 261 Samples, 90 from Station G and 171 from Station P, collected during July 1951 to June 1953, formed the material for this study. The fluctuations in the net plankton volume from month to month were greater at Station G than at Station P and during several months a relatively higher standing crop of plankton was recorded at the latter station. The phytoplankton cycles at Stations G and P showed distinct differences and further, the magnitude of phytoplankton population in several months as well as the total annual production, as judged from the standing crop, was distinctly higher at Station P. The abundance and succession of many species of diatoms showed some degree of annual variation, but a few species exhibited extreme fluctuations. One such interesting example is that of *Rhizosolenia alata* and *R. imbricata* which were noticed to cause local blooms in March 1950 and February 1951 respectively. In 1952 and 1953, although there were blooms of diatoms in the Gulf of Mannar, they were not caused by a single species as in 1950 and 1951 and further numbers during January – February 1952.

1903. **Raghu Prasad, R.** 1957. Seasonal variations in the surface temperature of seawater at Mandapam from January 1950 to December 1954. *Indian J. Fish.*, 4(1&2): 20-31.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The maximum and minimum temperatures recorded during the period January 1950 to December 1954 and the Deviations of the monthly mean atmosphere temperature from the mean monthly surface temperature are discussed in this article.

1904. **Raghu Prasad, R and P.R.S. Tampi** 1957. On the Phyllosoma of Mandapam. *Proc. Nat. Inst. Sci. India,* 23B: 48-67.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The first phyllosoma of *Panulirus ornatus* and *Thenaeus orientalis* has been described based on larvae hatched in the aquarium. Attempts to rear the larvae in the aquarium to study the complete larval history proved unsuccessful. Descriptions of three more stages of phyllosoma of *T. orientalis* and seven stages phyllosoma of a species of *Scyllarus,* presumably *S. orientalis,* obtained from the local plankton, have been given. From the available data the occurrence of phyllosoma in the Indian coastal waters appears to be during December to April which gives some indication of the breeding season. The larval life seems to be protected and may extend up to about six months.

1905. **Raghu Prasad, R.** 1958. A note on the occurrence and feeding habits of Noctiluca and their effects on the plankton community and fisheries. *Proc. Indian Acad. Sci.,* 47B: 331-337.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The effect of Noctiluca swarms on fisheries are more adverse than beneficial. Swarming takes place only when the sea is calm and there is an abundant supply of diatoms, the outbursts being usually preceded by diatom blooms. Noctiluca voraciously feed on several species of diatoms and to a very small extent on some of the smaller zooplankters. The presence of a large number of Noctiluca in an area seems to exclude other zooplankters, particularly the copepods. The rapid grazing down of diatoms and the exclusion of other zooplankters result in an almost monospecific population of these abnoxious cystoflagellates. Such plankton adversely affects the important fisheries for sardines, anchovies, mackerel etc., as these fishes do not occurin the presence of Noctiluca swarms. The negative indication continues as long as the swarms persist but transient swarms do not seriously affect either the plankton community or fisheries.

1906. **Raghu Prasad, R.** 1958. Plankton calendars of the inshore water at Mandapam with a note on the productivity of the area. *Indian J. Fish.,* 5(1&2): 170-188.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Planktonological investigations in various parts of the world have established that there are divergences in the pattern of annual distribution of plankton at the same station as well as between closely adjacent stations in the same general region at the same time. Despite these differences certain trends or nebulous patterns become apparent from prolonged observations. To differentiate the fortuitous from the truly repetitive changes data should necessarily cover a number of years and the observations should be spaced as closely as possible. These ideal conditions are, however, often difficult to achieve.

1907. **Raghu Prasad, R., V. Krishna Pillai and P.V. Ramachandran Nair** 1958. A note on the organic production in the inshore waters of the Gulf of Mannar. *Curr. Sci.,* 27: 302-303.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Although considerable data are available on the standing crop of plankton, practically no information is available on the daily production of organic matter in our waters and therefore investigations were started in 1957 with a view to measuring the magnitudes of production of organic matter by the plankton algae and the fluctuations.

1908. **Raghu Prasad, R and K.N.K. Kartha** 1959. A note on the breeding of copepods and its relation to diatom cycle. *J. Mar. Biol. Assoc. India,* 1(1): 77-84.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The breeding of copepods in the Gulf of Mannar and Palk Bay has been discussed. The maximum breeding in the Gulf takes place during September-March, whereas in Palk Bay it is from May-September. The difference in the intensity of breeding at the two regions is more apparent than real and the possible reasons for the observed differences are discussed. The species of copepods breeding during these periods at the two regions are different. The close relation between breeding of copepods and the diatom cycles of the two regions is discussed and it is observed that in both the areas breeding, to a very large extent, is dependent on the diatom cycle.

1909. **Raghu Prasad, R.** 1960. Observations on the distribution and occurrence of diatoms in the inshore waters of the Gulf of Mannar and Palk Bay. *Indian J. Fish.*, 7(1&2): 49-68.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Forty-nine out of the fifty-one species of diatoms occurring commonly in the plankton of Mandapam area have been classified into bio-geographical groups and the general character of the diatom flora of the Gulf of Mannar and Palk Bay is described. The seasonal variations and periodicities exhibited by fifteen species, which are well-represented in the plankton have been compared for both the places. It is found that the biological spring falls in May and the 'autumnal maximum' occurs in October or November. Most of these species are forms with spring maxima but which remain more or less important throughout the season while a few are with distinct spring and autumn maxima. The data suggest that Palk Bay is having a larger breeding stock of autochthonous diatoms, which are mostly neritic, whereas in the Gulf of Mannar there are more oceanic diatoms. The validity of the existing bio-geographical grouping of some of the species of diatoms and the necessity of widening the concept of species habits and habitats are mentioned in the light of the available data.

1910. **Raghu Prasad, R.** 1960. On the newly hatched phyllosoma of *Scyllarus sordidus*. *J. Mar. Biol. Assoc. India*, 2(2): 250-252.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India.

Abstract : Panulirid lobsters are easily obtainable along the Indian coast but among the scyllarids only *Thenaeus orientalis* has so far been found to be common, although besides this about twelve species belonging to *Scyllarus, Scyllarides* and *Parribacus* have been recorded from our waters. Nevertheless, the occurrence of different types of scyllarid phyllosomas in the seas surrounding our coast has been observed by the authors (1957 and 1960) and constant efforts are being made to collect the various adult forms and also to ascertain the species to which the different types of larvae belong. Recently the authors were able to obtain in the shore seine catches from the Gulf of Mannar near Mandapam, during the months of January and February, several adults of *Scyllarus sordidus* both males and berried females. De Man (1916) mentions this species as occurring in the Gulf of Mannar and remarks that the adults are usually found in shallow waters inhabiting coral reefs or places where the bottom is composed of sand and shells. This species, however, has not been reported from the Gulf of Mannar since De Man's account. The berried females were kept in the aquarium and the larvae were successfully hatched out, a description of which forms the subject matter of this paper.

1911. **Raghu Prasad, R., P.R.S. Tampi and V.S. Durve** 1961. A note on the occurrence of the Anthomedusa *Cladonema* in the Indian region. *J. Mar. Biol. Assoc. India,* 3(1&2): 251-252.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : On 30-3-1961 while cleaning one of the experimental aquaria, which was partly filled with seawater and not used for nearly three weeks, the occurrence of a large number of small medusae was observed. These were readily identified as the anthomedusa, *Cladonema* Dujardin. The identification of the species, however, has been more difficult because of slight variations in some of the characters from the available descriptions of the different species.

1912. **Raghu Prasad, R., S.V. Bapat and P.R.S. Tampi** 1962. Observations on the distribution of plankton at six inshore stations in the Gulf of Mannar. *J. Zool. Soc. India,* 4: 141-151.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : It has long been recognised that the distribution of plankton may be very patchy, especially in the coastal regions because near the land the sea may be frequently disturbed over small areas by the mixing of coastal and oceanic waters, tidal streams and the upwelling of the lower layers of water against coastal banks. This is further complicated by the sporadic outbursts of larval forms from the littoral fauna and the shallow water benthos. This patchiness in distribution of plankton, if it exists in an area surveyed, raises the important question regarding the extent of the area over which each haul may be taken as representative.

1913. **Raghu Prasad, R and P.V. Ramachandran Nair** 1963. Studies on organic production in Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 5(1): 1-26.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Study of organic production was initiated in the inshore waters of the Gulf of Mannar to determine the magnitude of production, its seasonal variations and the present yield in terms of carbon with a view to assess the

fisheries potential. Organic production values determined with oxygen technique as well as ^{14}C technique have been compared with values obtained elsewhere. Standing crop of phytoplankton determined as Harvey Pigment Units or total number of cells also have been compared with other observations made in Indian waters. Initial values of plant pigments and phytoplankton cells and increase of cells in the light bottle were found to follow more or less the same pattern as organic production. Analysis of the data indicated that values of plant pigment units can sometimes give erratic pictures of standing crop especially during turbulent conditions. It is found that the standing crop as well as organic production is high in the inshore waters of the Gulf of Mannar. The trend and magnitude of production are reflected in the fishery. It is also found that the present yield could be easily stepped up with a little more effort.

1914. **Raghu Prasad, R.** 1964. Study of primary production and its importance in an integrated fisheries research programme. *Fish. Technol.*, 1(1): 37-40.

1915. **Raghu Prasad, R.** 1967. Organic production in Indian waters. *Souvenir 20th Ann. CMFRI.*, pp. 22-24.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Studies on the quantitative and qualitative distribution of the standing crop of plankton in the Indian coastal waters have been fairly extensive. But investigations on the production of organic matter which enable us to assess the relative fertility of the various regions of the sea are of recent development. Systematic measurements on the production of matter in the southeast coast of India and recent measurements from the west coast together with the information already available on the nutrient salts enable us to draw a general picture of the productivity of the Indian waters.

1916. **Raghu Prasad, R and P.R.S.Tampi** 1968. On the distribution of Panulirid and scyllarid lobsters in the Indian ocean. *J. Mar. Biol. Assoc. India*, 10(1): 78-87.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : During the course of a study of the phyllosoma larvae collected from the Indian Ocean the need for compiling information on the distribution of the various species of adult lobsters recorded from the region was felt. Further, the increasing demand for lobster tails and consequent stepping up in the commercial exploitation of lobsters necessitate a study of the geographical distribution of the various species which constitute the fishery. Identifying phyllosoma larvae is an extremely difficult task. Two ways this could be achieved are by rearing them in the laboratory or by a process of elimination based on the knowledge of the geographical distribution of the adults. While identification by the latter procedure will still be provisional the former will give more precise data. Based on rearing work the authors (see Prasad and Tampi, 1957, 1959a and 1960) have already described the phyllosoma of four species viz., *Thenaeus orientalis, Scyllarus sordidus, Panulirus ornatus* and *P. homarus* (as *P. burgeri).* On account of great difficulties in rearing all the known species in the laboratory it was thought that the unknown types of larvae could be tentatively assigned to different species on the basis of the distribution of the adults. Therefore, data on the distribution of the species of adult palinurids and scyllarids recorded from the Indian Ocean region, at present lying scattered, have been brought together here. The preparation of this report has been made somewhat difficult owing to the confusion in the taxonomic status of some of the species plus the fact that in several instances, particularly in the earlier records, the locality has not been accurately given.

1917. **Raghu Prasad, R and P.V. Ramachandran Nair** 1969. A preliminary account of primary production and its relation to fisheries of the inshore waters of the Gulf of Mannar. *Indian J. Fish.*, 7(1&2): 165-168.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The total annual production of carbon of the surface-waters of the first station from July 1957 to June 1958 was 88.792 gm/m^3, while from July 1958 to June 1959 it was 90.750 gm/m^3. The average annual production from all the analyses of the surface and depth samples from the six stations for the year 1959 was 88.730/m^3.

1918. **Raghu Prasad, R.** 1970. To the wonder seas. *Seafood export J.*, 2(1): 17-19.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The general trend of marine fish production in India has been showing an increase but considerable fluctuations have been noticed in the annual landings in certain years. Oil sardine, Bombay duck and mackerel together constitute about forty two percent of total catch. The landings of each of these species exhibit wide variations from year to year, the individual intensity of fluctuation being 46%, 18% and 33% respectively. But intensity of fluctuation in respect of crustaceans and other groups of fishes is quite low implying a comparatively

consistent contribution from these fisheries year after year. The highest landings of marine fish take place during the months of October to December, which coincides with the peak fisheries for oil sardines, Bombay Duck and Mackerel. Thus, the success or failure of these fisheries is the main determining factor of the total marine fish production in India.

1919. **Raghu Prasad, R and P.V. Ramachandran Nair** 1973. India and the Indian Ocean Fisheries. *J. Mar. Biol. Assoc. India*, 15(1): 1-19.

Address : Indian Council of Agricultural Research, New Delhi, India.

Abstract : This account deals with the present yield and its composition, potential resources both qualitative and quantitative from the inshore and offshore grounds as well as oceanic areas, in relation to the productivity of the Indian Ocean as evidenced by organic production, plankton biomass and chlorophyll distribution. The paper also includes notes on the different aspects of problem-oriented research and stresses the need for extending our fishing horizon in order to place the Indian fisheries on a firm footing *vis-a-vis* that of countries exploiting the Indian Ocean resources.

1920. **Raghu Prasad, R and P.R.S. Tampi** 1977. Accent on brackish water fish farming. *Seafood Export J.*, 9(1):1-4.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : This paper emphasises the know-how adopted in salt water fish farm at Vepalodai, Tuticorin doesn't appear to be adequate. Some economic system will have to be evolved.

1921. **Raghuram, K.P and K. Venkataraman** 2003. Staghorn corals of Gulf of Mannar. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India, p. 33.

Address : Marine Biological Station, Zoological Survey of India, 130, Santhome High Road, Chennai-600 028, Tamilnadu, India.

Abstract : Gulf of Mannar is one of the four major coral reef areas in India and is famous for its rich marine biodiversity. Till today 208 species under 60 genera and 15 families of scleractinian (hermatypic) corals have been reported from India of which 82 species under 13 genera are from Gulf of Mannar Biosphere Reserve (GoMBR). Among the hermatypic corals the genus *Acropora* (possessing axial corallite and distinct radial corallites) is the largest genus among all scleractinian corals with 170 species worldwide (Wallace, 1999), of which 47 are from the reefs of India. In GoMBR, 13 species are recorded, in other reef areas such as Gulf of Kachchh(1) and Lakshadweep (14). Andaman and Nicobar Islands however, have rich diversity of the *Acropora* species (42) than the other reef areas of India. Pillai (1983) reported 12 species of *Acropora* from the south east coast of India (GoMBR and Palk Bay). The present report deals with five new records of the species of *Acropora* of which one species is new record to India collected during 1998-2003 from different islands of GoMBR.

1922. **Ragothaman, G.** 1981. A Check List of Phytoplankton off Tuticorin. *Acta Bot. Indica*, 9(2): 329-330.

Address : Department of Bioscience, South Gujarat University, Surat, India.

Abstract : Twenty-two species of phytoplankton collected from the cruises off Tuticorin are listed.

1923. **Ragunathan, M.B.** 1974. Edible molluscs of India. *Seafood Export J.*, 6(9): 29-32.

Address : Zoological Survey of India, Madras, Tamilnadu, India.

Abstract : Molluscs have been used as an edible item in the menu of our country since time immemorial, though of late it has become a delicacy with more sophisticated class of people. It has always remained the cheapest and most easily available food for the poor people of our country. A good number of species occur in Indian waters both in sea, freshwater and in estuaries. A comprehensive and consolidated list of species which are edible or which can be profitably exploited as a fishery resource is not readily available in literature. The present list makes an attempt to present details of 65 commonly occurring species with their geographical distribution and scientific and common names. It is hoped that this paper will be of some value to the marine food exporters.

1924. **Ragupathy, S., G. Nagarajan and A. Mahadevan** 1998. Mycorrhizae in coastal sand dunes of Tuticorin Tamil Nadu. *J. Environ. Biol.*, 19(3): 281-284.

Address : Centre for Advanced Study in Botany, University of Madras, Guindy Campus, Chennai - 600 025, Tamilnadu, India.

Abstract : Twenty one plant species of coastal sand binder were examined for vesicular absuscular mycorrhizal (VAM) association. Only 14 species showed mycorrhizal colonization. VAM colonization ranged from 20 to 85%. The VAM species were *Acaulospora longula, Gigaspora albida, G. gigantea, Glomus clarum, G. claroideum, G. intraradices, G. occultum, G. pustulatum, Sclerocystis pachycaulis* and *S. microcarpus.*

1925. **Rahman, M.K and B. Srikrishnadhas** 1994. The potential for spiny lobster culture in India. *Infofish Int.,*1:51-53.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The results of rearing experiments in India suggest that the spiny lobsters *Panulirus homarus* and *P. ornatus* may be cultured economically in large cement tanks of 5-10 mt capacity using clams, mussels, oysters, crabs, trash fish etc as feed.

1926. **Rahman, M.K and B. Srikirishnadhas** 1994. Packing of live lobsters - the Indian experience. *Infofish. Int.*, 6: 47-49.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Tuticorin, a small town on the south coast of Tamil Nadu in India, is the main centre of activity for the live spiny lobster (*Panulirus* sp.) trade. These lobsters have a unique physiological adaptation to survive out of water for a couple of hours in humid conditions and for several hours at low temperatures. Details are given of a method which, exploiting this physiological feature, has been developed by exporters for the transport of live lobsters. The method involves the packing of the lobsters in thermocol boxes on top of chilled sawdust/straw/ sack cloth layers, with bottles of frozen water packed at the sides of the boxes not in contact with the lobsters. Up to 5-7 kg of lobsters may be packed on the bed of straw and then finally covered with the sack cloth before sealing the boxes. When properly packed, the lobsters can survive up to 96 hours of rigid transport conditions.

1927. **Rahman, M.K., B. Srikrishnadhas and A.S.M. Anandasekaran** 1994. Spiny lobster culture in controlled conditions. *J. Aquacult. Trop.*, 9(3): 235-239.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Growth performance of spiny lobsters in controlled condition has paved the way for growing lobsters to marketable size on a commercial scale. The study explains the growth potential of *Panulirus homarus* in controlled condition and its commercial feasibility. Increment in growth of 172.67 g body weight and carapace increment of 2 cm in 150 days was obtained in this experiment. To reach a marketable size of 250 g from 85 g, the cost of production was Rs. 245/kg with a net profit of about Rs. 93,000/year/10 tanks of 50 m^2 area (1 US$ = Rs. 30.00).

1928. **Raj, M.C.V and T.C. Chandrasekhar** 1986. High temperature processing of fish sausage. 1. An improved technique. *Fish. Technol.*, 23(2): 146-148.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : An improved technique for the preparation of fish sausage (*Nemipterus japonicus*) over the conventional method (90° C for 1 h) has been evolved by processing at a temperature of 115.6° C (4.5 kg) for 20 min. The overall quality characteristics of fish sausage, particularly its colour, texture and appearance remained unchanged and the product was in good condition up to 9 days at ambient temperature in contrast to the shelf life of 3 days by conventional method. The design of the equipment used for the processing of fish sausage and the method of operation are described. The keeping quality of the product from an organoleptic stand point was also studied.

1929. **Raj, M.C.V and T.C. Chandrasekhar** 1986. High temperature processing of fish sausage. 2. Effect of certain preservatives on the shelf life. *Fish. Technol.*, 23(2): 211-216.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The effects of preservatives like fat coated sorbic acid (FCSA) and glucono-delta-lactone (D-lactone), both separately and in combination, on the shelf life of high temperature (115.6° C for 20 min) processed fish sausage (*Nemipterus japonicus*) stored at three different temperatures namely, ambient (28 k 2° C), cooler storage (2 ± 2° C) and refrigerator (10 ± 2° C) were studied. Whereas the control (without preservative), FCSA, D-lactone and FCSA + D-lactone treated samples could be stored for 9, 9, 11 and 13 days respectively at ambient temperature, those stored at lower temperatures were found to be in acceptable condition for 70, and 80 days respectively. Organoleptic evaluation of taste and flavour of the products carried out by panelists revealed that FCSA and FCSA + D-lactone treated samples were unacceptable with regard to the taste, flavour and texture.

However, the taste flavour and texture of the control and D-lactone treated samples were in acceptable condition.

1930. **Raj, M.C.V and T.C. Chandrasekhar.** 1987. High temperature processing of fish sausage. 3. Studies on some of the storage characteristics. *Fish. Technol.*, 24(1): 48-53.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The proximate composition of the high temperature processed fish sausage was found to be 14.56% protein, 4.65% fat, 69.14% moisture, 2.12% ash and 8.12% carbohydrate. The quality of the product during storage was assessed on the basis of the changes observed in the physical, chemical and microbiological parameters. The results of the different tests such as pH, volatile base nitrogen (VBN), trimethyl amine nitrogen (TMA-N) and jelly strength are summarised and discussed. The total bacterial load increased gradually during storage but was not proportional to the initial load.

1931. **Raj, M.C.V., T.C. Chandrasekhar and K.V Saralaya** 1987. High temperature processing of fish sausage. 4. Heat penetration study. *Fish. Technol.*, 24(2): 136-137.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : An examination was made of the rate of penetration of heat into fish sausage during processing at 115.6 °C. Findings showed processing for 24 minutes to bring about complete destruction of *Clostridium botulinum*. A processing time of 30 minutes destroys almost all spoilage-causing organisms, thus prolonging the shelflife of the products.

1932. **Raj, M.C.V., G. Sugumar, G. Jegatheesan and V. Sundararaj** 1988. Developments in fish processing and preservation technology in Tamil Nadu. *CMFRI Spec. Publ.*, 40: 73.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A review is made of developments in processing and preservation techniques over a few decades with a note on the various sea foods meant for export. The infrastructural facilities available in Tamil Nadu for freezing, canning and other methods of preserving fish and fish meal production are assessed.

1933. **Rajagopalan, M., M. Vijayakumaran and A. Bastin Fernando** 1984. Some health problems observed in the hatchlings and juveniles of sea turtles in captivity. *CMFRI Bulletin*, 35: 55-58.

Address : Central Marine Fisheries Research Station, Madras- 600 015, Tamilnadu, India.

Abstract : Some health problems of turtles encountered while rearing them *(Lepidochelys olivacea* and *Eretmochelys imbricata)* in captivity are recorded here. Most of the problems occurred in the group rearing of the hatchlings and were connected with water quality, availability of food, feed quality and stocking density. Successful treatment for some of the infections are also discussed.

1934. **Rajagopalan, M.** 1996. The marine turtles and their conservation. pp.126-132. ***In***: *Marine biodiversity conservation and management,* (eds.) *N.G. Menon and C.S. Gopinatha Pillai*. *Pub. CMFRI*, 1996, 205 pp.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

1935. **Rajagopalan, M., E. Vivekanandan, S. Krishna Pillai, M. Srinath and A. Bastin Fernando** 1996. Incidental catch of sea turtles in India. *Mar. Fish. Infor. Serv. T & E Ser.*, 143: 8-13.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The details on occurrence and nesting of five species of sea turtles in India is discussed in this article.

1936. **Rajagopalan, M.** 2000. Seaturtles. ***In***: Marine Fisheries Research and Management, (eds.), V.N. Pillai and N.G. Menon, CMFRI, Kochi, pp.152-161.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : All five species of the turtles occurring in the Indian seas are placed in Schedule I of the Indian Wildlife (Protection) Act 1972 thereby according them complete protection from exploitation. The programme at the Central Marine Fisheries Research Institute on the conservation and management of endangered sea turtles generated a good amount of awareness on sea turtles at various levels and these efforts would go a long way in strengthening the national effort in the conservation and management of sea turtles.

1937. **Rajagopalasamy, C.B.T and P. Natarajan** 1987. Infestation of certain parasites of mullet *Liza tade* (Forsskal). *J. Mar. Biol. Assoc. India,* 29(1&2): 208-219.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : To understand the nature of infestation 547 fish (54.7% males and 45.3% females) collected from 2 different environments were examined. Infestation, the indicator of severity of attack is described in relation to periods, size and sex of the host. A high percentage prevalence (75.87%) was noticed owing to multiple infestation. Among the prevalence reported for different parasites, the infestation due to metacercariae was found to be greater (33.52%) while it was less (13.92%) due to adult digeneans. Although no significant infestation was evident among sexes and biotopes, significant difference was noticed among parasitism ($p > 0.01$). The environmental influence on infestation and the possible causes for the increased or decreased infestation in the host population were clarified. The results obtained were statistically tested to find out the nature of dominance of infestation.

1938. **Rajagopalasamy, C.B.T and P. Natarajan** 1987. Observation on the spatial distribution of certain parasites of mullet *Liza tade* (Forskal). *Proc. Estuarine Management, Trivandrum (India),* 4-5 Jun 1987. pp. 523-528.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The spatial distribution of the protozoan parasites, *Myxobolus* sp., the monogenean, *Ancyclodiscoides* sp., the metacercariae and the copepod, *Ergasilus* sp., on the gills and in the integument of the mullet *Liza tade*, is described and discussed. The regional distribution showed more concentration of metacercariae towards the central region (57.96%) followed by the lower (24.34%) and upper (13.24%) regions. While *Myxobolus* sp. and *Ancyclodiscoides* sp. preferred the central sector of the gill filament, the *Ergasilus* sp. was inclined more towards the terminal sector. The difference between the occurrences of parasites was found to be statistically significant ($P < 0.01$).

1939. **Rajaguru, A., G. Shantha and R. Natarajan** 1988. Mangrove waters as nursery grounds for juveniles of marine flatfishes. *CMFRI Spec. Publ.,* 40: 62.

Address : Centre of Advanced Study in Marine Biology, Porto Novo - 608 502, Tamilnadu, India.

Abstract : Pitchavaram mangrove waters serve as nursery grounds for juveniles of marine flatfishes. Food and feeding habits of juveniles of 4 species of marine flatfishes, (*Pseudorhombus arsius, P. elevatus, Brachirus orientalis* and *Cynoglossus puncticeps*) have been studied from Pitchavaram mangrove waters and compared with those of their adults, which are marine. Amphipods and copepods dominated the diet of the juveniles, while polychaetes and prawns were the primary food items of adults. Food composition, seasonal variation in the food, and variation in feeding intensity have been presented.

1940. **Rajakumar, M., R. Suresh and P. Selvaraj** 1999. Employment and income of fishing households in Chidambaranar District, Tamilnadu. *Proc. 4th Indian Fish. Forum,* dated 24th to 28th Nov'1996. pp.469-470.

Address : Department of Fisheries Economics and Statistics, Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The study was taken up to identify and estimate the levels and pattern of employment and income of fishing households in Chidambaranar district. Punnakayal, the largest *Vallam* operating fishing village in the district was purposively selected for the survey. Seventy respondents, equally distributed between i) Crewhead and ii) Owner cum-crewhead categories were selected and information collected by direct personal investigation using a structured and pretested interview schedule. The collected data were analysed and results presented.

1941. **Rajakumar, T., A. Murugan and K. Ayyakkannu** 1992. Seasonal variations in slime forming organisms on the shells of *Chicoreus ramosus* from Cuddalore, Mandapam and Tuticorin waters, southeast coast of India. *Phuket. Mar. Biol. Cent. Spec. Public.,* 10: 188-193.

Address : Centre of Advanced Study in Marine Biology, Porto Novo - 608 502, Tamilnadu, India.

Abstract : An account is given of the fouling and boring organisms of *Chicoreus ramosus* found in the waters of Cuddalore, Mandapam and Tuticorin off the southeastern coast of India. The seasonal and geographic variations in the occurrence of slime forming organisms associated with shells of this muricid are also described.

1942. **Rajamani, M.** 1990. Observations on experimental artificial reef constructed at Tuticorin. *Proc. 2nd Indian Fish. Forum,* dated 27th to 31st May'90. pp. 261-263.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An experimental artificial reef was constructed in the break-water of Tuticorin Harbour during July-August, 1989 at a depth of 6 m using discarded lorry tyres. A total number of 23 modules, consisting of 69 tyres and fabricated in three different designs, were used for the reef construction. The reef occupied a bottom area of approximately 50 sq.m. with a height of 0.8 to 1 m. Within a period of one month from the time of construction, autotrophic community dominated by red algae and heterotrophic community dominated by cirripedes, in addition to colonization by various groups of invertebrate organisms, were observed on the reef structure. The inhabitation by fish was observed during the third month. The behaviour of fish and shellfish in the artificial reef was observed by SCUBA diving.

1943. **Rajamani, M and M. Manickaraja** 1990. Observation on the seasonal prawn fishery of the Periathalai coast in the Gulf of Mannar. *Indian J. Fish.*, 37(3): 183-188.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The seasonal prawn fishery of Periathalai, a fishing village on the southeast coast of Tamil Nadu, India, lasts for a period of three to four months in a year. The fishery was constituted exclusively by *Penaeus indicus*. During the three year period from 1985 to 1987 the estimated catch of *P. indicus* ranged between 95.9 and 106.7 tons and the maximum catch was recorded in the month of July. There was a gradual decrease in the female population. Mature and spent-recovering females formed major portion whereas immature females were seldom recorded in the catches.

1944. **Rajamani, M and M. Manickaraja** 1991. On the collection of spiny lobsters by skin divers in the Gulf of Mannar off Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.*, 113: 17-18.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Size frequency distribution of *Panulirus ornatus* collected by the skin divers form the sea off Tuticorin discussed.

1945. **Rajamani, M and M. Manickaraja** 1991. A note on the commercial fishery of the king prawn off Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.*, 113: 24-25.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : This paper deals with the estimated catch and percentage composition of *Penaeus latisulcatus* landed by mechanized trawlers at Tuticorin fisheries harbor during the years 1987-90.

1946. **Rajamani, M and M. Manickaraja** 1994. Some hydrographical features of a brine shrimp ecosystem at Tuticorin. *J. Mar. Biol. Assoc. India*, 36(1&2): 299-301.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The fluctuations in salinity, dissolved oxygen and pH in a natural ecosystem of the brine shrimp *Artemia salina* at Tuticorin salt pan area were studied for a period of seventeen months from November1984 to March 1986 and the cyst production was observed to take place when the level of salinity and dissolved oxygen ranged between 104 and 138 ppt and 0.5 and 2.1 ml/l respectively.

1947. **Rajamani, M and M. Manickaraja** 1995. On an abnormality in the protozoa larva of the prawn *Penaeus semisulcatus* de Kaan. *J. Mar. Biol. Assoc. India*, 37(1&2): 264-265.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The note reports on the observation of an abnormal rostrum in a protozoea larva of the prawn *Penaeus semisulcatus* de Haan which was reared from egg under laboratory conditions at Tuticorin.

1948. **Rajamani, M and M. Manickaraja** 1995. The fishery of green tiger prawn *Penaeus semisulcatus* off Tuticorin. *Mar. Fish. Infor. Serv. T & E Serv.*, 140: 1-5.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The estimated effort, catch and catch rate of *Penaeus semisulcatus* landed by mechanized trawlers at Tuticorin Fishing Harbour from 1986-87 to 1990-91 were discussed in detail.

1949. **Rajamani, M. and M. Manickaraja** 1995. Fishery of the painted crayfish *Panulirus versicolor* in the Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 140: 6-7.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The size ranges in *Panulirus versicolor* landed by bottom-set gill nets at Kayalpattinam and Tharuvaikulam centres during the year 1985-92 are discussed.

1950. **Rajamani, M.** 1996. Artificial reef and its role in marine fisheries development. *CMFRI Bulletin*, 48: 13-17.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Floating bamboo bundles and piles of stones kept on the sea bottom have long been used by traditional fishermen as fish gathering devices in various parts of the world. These objects provide living space, shelter for protection from the predators thus functioning as (i) a habitat for organisms. The attached algae and other sessile organisms serve as food especially for young ones. Thus the area where such objects are placed function as (ii) a feeding ground. These objects also act as a suitable substratum for attachment of eggs in some cases thus functioning as (iii) a spawning ground. Based on these principles artificial reefs are constructed in different parts of the world either to create a new fishing ground or to improve the production potential of the existing grounds. Although the construction of artificial reefs has been taken up as a Government sponsored programme in many countries, particularly in the Southeast Asian countries on a commercial scale, in India the work is still in a preliminary stage with only a few voluntary organisations and fishermen society taking some interest. In Japan for instance, annually $ 100 million is spent on artificial reef technology under Government's subsidiary project called the Coastal Fisheries Structure Improvement Project. Annually, about 60 million cubic feet of artificial reefs have been installed in recent years. According to the surveys taken since the beginning of the National Artificial Reef Programme, the productivity index in Japan has been estimated to be as high as 50 kg of fish per cubic metre of reef volume. India with a long coast line of over 6100 km can also significantly increase its marine fish production by constructing artificial reefs in certain selected places along the coast.

1951. **Rajamani, M and M. Manickaraja** 1996. On the gill net fishery of *Penaeus indicus* Milne Edwards along Tuticorin Coast. *J. Mar. Biol. Assoc. India*, 38: 158-161.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The gill-net fishery of *Penaeus indicus* H. Milne Edwards along Tuticorin coast was seasonal extending for a period of five to eight months. During the period 1990 - '92 the estimated annual landing of this species ranged from 7.7 to 25.0 tonnes. Prawns in the size range of 118 to 143 mm in total length dominated the fishery. Sexes were more or less equally distributed and the proportion of mature females formed a significant proportion from June to August.

1952. **Rajamani, M and M. Manickaraja** 1997. On the fishery of the spiny lobster off Tharavaikulam, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 146: 7-8.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The estimated average monthly catch (kg) of *Panulirus ornatus* and *P. homarus* landed by bottom set gill nets at Tharuvaikulam during the years 1990-92 are discussed.

1953. **Rajamani, M and M. Manickaraja** 1997. The spiny lobster resources in the trawling grounds off Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.*, 148: 7-9.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The estimated catch, effort and catch rate (kg/ unit) of lobsters landed by mechanized trawlers at Tuticorin Fisheries Harbour during 1991-93 are discussed.

1954. **Rajamani, M., S. Lakshmi Pillai and J. Xavier Rodrigo** 1998. On the mass production of Rotifer with different combinations of fertilizers. *Mar. Fish. Infor. Serv. T & E. Ser.*, 159: 11-13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The hydrographical conditions in Rotifer culture tanks during the period of experiments is discussed.

1955. **Rajamani, M., S. Lakshmi Pillai, D.B. James and P.J. Ganesh** 1998. On the occurrence of a bisexual strain of the Brine shrimp *Artemia* in the salt pans at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.*, 152: 12-13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The parthinogenetic and bisexual strains of Brine shrimp in the salt pans at Tuticorin coast is discussed.

1956. **Rajamani, M., S. Lakshmi Pillai, N. Retnaswamy and J. Xavier Rodrigo** 1999. On the fecundity and inter spawning periodicity in an exotic species of Brine shrimp collected from the salt pans at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.,* 161: 13-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In India, the brine shrimp *Artemia* species has been reported to occur in the salt pans of Tamilnadu, Maharastra, Gujarat and also in the inland salt lakes in Rajasthan. To study the fecundity, experiments were carried out with the brine shrimps collected from the saltpans at Veppalodai. The fecundity of the brine shrimp and its inter-spawning period are given.

1957. **Rajamani, M and M. Manickaraja** 2000. On the fishery of the white prawn *Penaeus indicus* from the trawling grounds off Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 166: 12-15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The estimated catch effort, catch rate and composition of *Penaeus indicus* landed by mechanized trawlers at Tuticorin fishing harbour from 1986-87 to 1990-91 are discussed.

1958. **Rajamani, M., S. Lazarus, P.P. Pillai, and T.M. Yohannna** 2000. Artificial reefs. ***In***: *Marine Fisheries Research and Management.* (eds.) V.N. Pillai and N.G. Menon, CMFRI, Kochi. pp. 669-676.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : At Tuticorin and Minicoy, observations were made on the experimental artificial reefs constructed by the Scientists of CMFRI during 1988-'92, whereas at Vizhinjam the artificial reefs constructed by the local artisanal fishermen were monitored by the Scientists of the Institute. Good congregation of fishes was observed in the vicinity of the artificial reefs at all the three Centres. In the experimental artificial reef constructed at Tuticorin, four distinct groups of fishes were recognized based on their mode of attraction towards the reef structures. At Vizhinjam, an increase in the landing of fish was noticed in the commercial catches. At Minicoy, settlement of pearl oyster spat and growth of several species of Seaweeds were recorded.

1959. **Rajamani, M.** 2001. Creation of artificial habitat for spiny lobsters in the sea off Vellapatti, Gulf of Mannar. ***In****: Perspectives in Mariculture.* (*eds*.) N.G. Menon and P.P.Pillai, MBAI, Cochin, pp. 131-138.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : An experimental artificial habitat for spiny lobsters was created in the sea off Vellapatti, a fishing village near Tuticorin in the Gulf of Mannar during June 1997. A total of 49 modules fabricated out of 147 stoneware pipes were used to create the artificial habitat, which covered a floor area of approximately 1000 sq.m. Inhabitation of lobsters in the artificial habitat was recorded for the first time three months after the installation of the modules. Both *Panulirus ornatus* and *P. hamarus* were encountered in bottom set gill net catches operated in the vicinity of the artificial habitat. *P. ornatus* was the dominant species constituting on an average 76.8% of the total lobster catches. The size (total length) of the lobsters captured from the artificial habitat ranged from 115 to 255 mm and from 135 to 165 mm in *P. ornatus* and *P. homarus* respectively. The importance of artificial habitat in the production, conservation and optimum exploitation of the spiny lobster resources from the sea is discussed in the paper.

1960. **Rajamani, M., S. Lakshmi Pillai and N. Retnaswamy** 2001. On the distribution of sexual and parthenogenetic *Artemia* in the salt pans around Tuticorin. *Mar. Fish. Infor. Serv., T&E Ser.,* 168: 19-20.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In India, the occurrence of the sexual strain of the brine shrimp, *Artemia franciscana* in the natural ecosystem was reported for the first time from the salt pans of Karapad at Tuticorin recently by Rajamani et *al (Mar. Fish. Infor. Servo T* & *E. Ser.* 152 1998.). Following this discovery an intensive survey of the salt pans at selected places in and around Tuticorin was conducted during the period from October 97 to March 99 to study the distribution of this exotic species in the natural ecosystem. Also, the hydrographical conditions in the natural ecosystem were studied and the results are presented in this article.

1961. **Rajamani, M and M. Manickaraja** 2003. On the deep sea prawn resources off Tuticorin. *Mar. Fish. Infor.*

Serv., T&E Ser., 178: 16-19.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The prawn resources along Tuticorin coast are exploited mainly by three types of gears *viz.*, prawn gill net and thallumadi in the artisanal sector and trawl net in the mechanised sector. The prawn gill nets, popularly known as disco valai, are operated by the traditional fishermen from many coastal villages south of Tuticorin and the fishery is seasonal extending for a period of four to five months. The gear thallumadi is operated round the year at a few places in and around Tuticorin in shallow coastal waters and exploit mostly juvenile prawns. In the mechanised sector, trawlers keeping their base at Tuticorin Fishing Harbour operate in the ground off Manapad-Uvari in the south and off Erwadi in the north of Tuticorin. Although the prawn fishing in the mechanised sector is carried out round the year, the peak fishing activities normally extend for a few months only from May/June to September/October every year with the catch being dominated by landing of the green tiger prawn, *Penaeus semisulcatus* with moderate landing of *P. indicus.* During the rest of the months although prawn fishing continues, the number of units operated becomes less and the landings are also poor. It is during these lean seasons a few fishing vessels first attempted to explore new fishing grounds and ventured into the deeper waters off Tuticorin in late 1989 in order to exploit the resources available in the deep sea. As the trawlers returned with heavy catch consisting of a variety of deep sea fishes and prawns, a regular fishing to exploit these resources commenced thereafter during the lean season thus marking the beginning of the exploitation of prawn resources from the deep sea. The present article gives an account of the deep sea prawn resources landed at Tuticorin Fishing Harbour over a period of ten years from 1993 to 2002.

1962. **Rajamani, M., S.A. Kumar and S.V. Maharajan** 2003. Quality of the cysts of *Artemia franciscana* collected at Tuticorin with observations on growth, maturity and sex ratio of the offspring. *Indian J. Fish.,* 50(4): 479-487.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The cysts of the exotic species of brine shrimp *Artemia franciscana* collected from the natural ecosystem at Tuticorin, Tamil Nadu, India during January 2001 were processed, stored and their quality evaluated. A total of 22 experiments were conducted on hatching and it was observed that the time taken for first hatching ranged from 13 hours and 10 minutes to 17 hours. The maximum hatching percentage recorded at 24 hours and 48 hours were 52.0 and 79.9 respectively. The Iinstar obtained from the hatching experiments were reared in outdoor culture tanks at 30, 50, and 70 ppt with two different types of feed and the maximum size of 10.04c0.3 mm was recorded on 18th day in the animals fed with rice bran at 70 ppt. The earliest first pairing and first spawning were recorded on 6th and 12th days respectively in the animals fed with mixed phytoplankton at 50 ppt.

1963. **Rajamani, M., S.A. Kumar and S.V. Maharajan** 2005. Production of cysts and biomass of the exotic species of brine shrimp *Artemia franciscana* (Kellog) in outdoor culture system. *Indian J. Fish.,* 52(1): 61-71.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The production of cysts and biomass of the exotic species of brine shrimp *Artemia franciscana* was studied for a period of 90 days in out- door culture system at a salinity range of38 to 83 ppt. From the initial stocking density of 231 to 294 nauplii / 700 1 of brine the population density steadily increased and reached the maximum of 389.7 to 565.3 numbers/l on 38th day of culture. The total quantity of cysts and biomass harvested from the culture system ranged from 26.450 g to 33.860 g and from 813.6 g to 1226.7 g respectively. The first maturity and first spawning were recorded at the age of 7-8 and 12-13 days respectively and the maximum density of 59.3 riding pairs /1 was recorded on 59th day of culture. The prospect of the culture of the exotic species is discussed in this paper.

1964. **Rajan, C.T.** 1963. On the Larval stages of *Solmundella bitentaculata* Browne. *J. Mar. Biol. Assoc. India*, 5(2): 314-316.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Solmundella bitentaculata* Browne (Order: Narcomedusa, Family: Aeginidae) is very widely distributed and has been recorded from the Indian waters by Menon (1932). *S. bitentaculata* of the tropical Atlantic and Pacific was originally described by Quoy and Gaimard as *Charybda bitentaculata* and subsequently by Haeckel as *Aeginella bitentaculata* and by Mass as *Solmundella (Aeginopsis) hensinii.* The development of *S. mediterranea* has been studied by Muller, Metschnikoff, Mass and Woltereck (Ref. Mayer, 1910). There is at present only very little information about the larval stages of *Solmundella bitentaculata.* While engaged in the quantitative

determinations of planktonic animals, a series of larval stages of *S. bitentaculata* were collected. These samples were from two- four- and six-fathom lines of the inshore waters of Palk Bay during May 1960 to September 1962 and collected every week from the surface and bottom, the latter with the aid of a casella bottle. One litre of a well-stirred sub-sample was sedimented with formalin for 24 hours, the clear portion decanted and the remaining part centrifuged for about 15 minutes at 2000 rpm. Out of a total of 250 samples only 10 contained the larval stages, mostly during the months of August-September. Due to the paucity of occurrence of the various stages it was difficult to rear them in the laboratory. In this connection it would be worth mentioning that the larvae have not so far been observed in similar plankton collections made from 5 stations in the Gulf of Mannar.

1965. **Rajan, C.T and M.E. Rajapandian** 1988. Resources study of the Clam, *Mesodesma glabratum* in the Islands of the Gulf of Mannar. *CMFRI Bulletin,* 42(1): 68-70.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A survey of twenty Islands lying between Tuticorin and Pamban in the Gulf of Manner during 1977 indicated extensive beds ranging from 0.25 to 1.50 km^2 of *Mesodesma glabratum* along the intertidal zones of these islands. The population density was very high in six islands nearer to Tuticorin and low in the Islands nearer to Pamban. It was estimated that the rich beds in Van Island and Upputhanni Island contained as much as 4,50,000 numbers each, which is a seasonally renewable resource. At present this valuable resource remains unexploited.

1966. **Rajan, K.V.M.** 1982. A success story of deployment of mechanised boats for shark long lining. *Seafood Export J.*, 14 (8): 9-15.

Address : Central Institue of Fishery Technology, Cochin 682 029, India.

Abstract : Financial returns from fishing operations by mechanised boats are unsteady and showing trends of diminishing returns and therefore fishermen are in need of diversified methods of fishing and do not want to keep their boats idle. Few boats of Thootur village Kanyakumari coast have successfully resorted to shark long lining and have found it to be remunerative. An account of this diversification of the fishing effort including species of fishes landed, fishing season and ground, the crafts and gear employed, bait used, fishing operations, operational expenditure and receipts along with the author's observations and suggestions for making the above operations more profitable are presented.

1967. **Rajan, M.R and S.P. Raj** 1994. Sewage recycling through Fish Culture. *Environ. Ecol.,* 12(2): 247-251.

Address : PG Department of Zoology, Kamaraj College, Tuticorin - 628 003, Tamilnadu, India.

Abstract : The effect of different BOD loadings of sewage on fish culture, BOD and microbial reductions were carried out. The BOD reduction ranged from 85.6 to 96.5%. The average percentages reduction in total viable bacteria, coliforms, Salmonella and fecal Streptococci in different ponds were between 61.9 and 87.7, 89.1 and 98.1, 92.4 and 97.1 and 95.1 and 100, respectively. The Silver carp *Hypophthalmichthys molitrix* production was higher in all ponds irrespective of the quantum of primary production. The fish production was higher in pond loaded with 19 kg BOD/hectare per day which was 9.04 t/hectare.

1968. **Rajapackiam, S., T.S. Balasubramanian and G. Arumugam** 1990. On a large devil Ray *Manta birostris* landed at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 106: 11.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The morphometric measurements of *Manta birostris* (Walbaum) is discussed in this article.

1969. **Rajapackiyam, S., T.S. Balasubramanian, K.M.S. Ameer Hamsa and H. Mohamed Kasim** 1993. On the Landing of Giant-sized White-spotted Shovel Nose Ray from Tuticorin waters, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.,* 121: 14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of *Rhyncobatus djiddensis* landed at Tuticorin is discussed.

1970. **Rajapackiam, S., T.S. Balasubramanian, K.M.S. Ameer Hamsa, H. Mohamed Kasim** 1994. On the Landing of large sized hammer head shark *Spyrna lewini* at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.,* 127: 13-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A large sized female hammer head shark was caught by hooks and line off Tuticorin and the morphometric characters are given in detail.

1971. **Rajapackiam, S., K.M.S. Ameer Hamsa, T.S. Balasubramanian and H. Mohamed Kasim** 1994. On a Juvenile Whale Shark *Rhincodon typus* caught off Kayalpattinam (Gulf of Mannar). *Mar. Fish. Infor. Serv., T & E Ser.*, 127: 14-15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The stranded juvenile whale sharks morphometric characters are analysed.

1972. **Rajapackiam, S., T.S. Balasubramanian, K.M.S. Ameer Hamsa and H. Mohamed Kasim** 1994. On the unusual landings of lesser devil ray from Gulf of Mannar. *Mar. Fish. Infor. Serv., T & E, Ser.*, 129: 20-21.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The month-wise estimated fishing effort (drift gill net) and catch of *Mobula diabolus* and the morphometric measurements (in cm) of four large sized specimens of *Mobula diabolus* are discussed.

1973. **Rajapackiam, S., D. Sundararajan and T.S. Balasubramanian** 1997. On the two large devil rays landed at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.* 149: 16.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In the Tuticorin waters around 30 trawlers are engaged in Deep Sea Fishing in depths between 100 and 400 m. On 24-04-97 two female specimens of devil ray *Manta birostris* locally known as 'Kombu thirukai' measuring 5.53 and 5.42 m each in the disc width were caught off Tuticorin at a depth range of 100 to 125 m by a deep trawler.

1974. **Rajapackiam, S.** 2000. Culture of Mud Crab (in Tamil). *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI*. pp. 65-71.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

1975. **Rajapackiam, S.** 2000. Hatchery production of mud crab larvae (in Tamil). *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI,* pp. 73-81.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

1976. **Rajapandian, M.E and V. Sriramachandramurthy** 1966. On the Occurrence of the spotted Threadfin, *Polynemus microstoma* in the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 8(2): 365-367.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : During the course of examination of the trawl catches off Mandapam in the Gulf of Mannar (79°-79°30' E. 8º50'-9°10' N. landed by the Indo-Norwegian Project fishing boats at Mandapam during October 1965 to March 1966, we came across several specimens of *Polynemus microstoma* Bleeker hitherto not reported from the seas around India.

1977. **Rajapandian, M.E and K.S. Sundaram** 1967. A case of complete albinism in the marine Catfish *Tachysurus dussumieri* (Cuvier and valenciennes). *J. Mar. Biol. Assoc. India,* 9(1): 194-195.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : One specimen of the marine catfish, *Tachysurus dussumieri* (Cuvier and Valenciennes) exhibiting complete albinism was collected on board a purse seiner of the Indo-Norwegian Project, on 5th July 1966, off Mandapam in Palk Bay (Long. 79° 2' Lat. 9° 21') at a depth of 5 fathoms. On removal from the net it was immediately transferred to a drum containing seawater, but it did not survive. Since this is the first instance of albinism recorded in *T. dussumieri,* particulars regarding the same are given.

1978. **Rajapandian, M.E. and C.T. Rajan** 1983. Studies on maturity stages and spawning periodicity of *Crassostrea madrasensis* (Preston) at Tuticorin Bay. Proc. Symp. Coastal Aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: *Molluscan culture. Marine Biological Assoc. India, Cochin, India,* 6:475-478.

Address : Central Marine Fisheries Research Institute, Tuticorin 628 001, Tamil Nadu, India.

Abstract : Studies undertaken during 1976 on the gonadal maturity of the backwater Oyster *Crassostrea madrasensis* at Tuticorin revealed a biannual spawning periodicity. March-April and August-September were found to be the peak periods of spawning. A broad correlation has been observed between diurnal temperature differences and spawning of oyster.

1979. **Rajapandian, M.E and C.T. Rajan.** 1987. Biological aspects of Oysters. *CMFRI Bulletin*, 38: 30-39.

Address : Central Marine Fisheries Research Institute, Tuticorin 628 001, Tamil Nadu, India.

Abstract : The biology of oysters is discussed in detail with the aim of providing information of use to the developing oyster culture industry of India. The following aspects are examined: habitat and distribution, food and feeding, growth, conditions of oysters, reproduction, maturation of gonads, hermaphroditism, fertilization, and development.

1980. **Rajapandian, M.E and P. Muthiah** 1987. Post-Harvest Technology (Oyster culture). *CMFRI Bulletin*, 38 : 63-66.

Address : Central Marine Fisheries Research Institute, Tuticorin 628 001, Tamil Nadu, India.

Abstract : Techniques in India for the handling and processing of oysters after harvesting are described. Purification methods, the transportation and storage of live oysters, shucking methods, processing, freezing and canning are covered. The utilization of oyster shells is also considered briefly.

1981. **Rajapandian, M.E., K.S. Rao, P. Muthiah and D. Sundararajan** 1988. Post harvest techniques and sanitation for oysters. *CMFRI Bulletin*, 42(2): 394-397.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Oysters are often transported alive and consumed raw. They are likely to harbour pathogenic microorganisms due to their filter feeding habit. Therefore depuration of the shellfish using appropriate method is essential. The need for monitoring the bacterial quality and levels of the oyster growing areas and the bacterial load of Oyster meat is emphasized. Results of bacteriological studies on the water quality in the oyster farm at tuticorin and most of cultured oysters are discussed.

1982. **Rajapandian, M.E., C.P. Gopinathan, J. Xavier Rodrigo and A.D. Gandhi** 1990. Environmental characteristics of edible oyster beds in and around Tuticorin. *J. Mar. Biol. Assoc. India*, 32(1&2): 90-96.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The investigations on various hydro-biological parameters which influence the condition factor, spawning and the resource characteristics of the edible Oyster *Crassostrea madrasensis* around Tuticorin have been conducted in three habitats of oyster beds, namely coastal (Tuticorin Bay), mangrove (Korampallam Creek) and estuarine (Punnakaal) areas. Observations on the stages of maturity, spawning and condition of oysters in the three habitats have been made and a correlation of the above biological aspects of the oysters with the environmental factors have been attempted. A direct correlation has been observed between the biological aspects of oysters and the productivity parameters of the habitat. The water temperature also showed a direct relationship with the condition factor of the oysters. The mean value of the condition factor of the oyster were found to be at the optimum level during April when productivity parameters were observed to be at higher level. The chemical factors especially the nutrients such as nitrates and phosphates showed indirect relationship with maturity and condition of the oysters. Among the different habitats, the mangrove area registered higher productivity rates, which has a well defined relation with the condition of oysters.

1983. **Rajapandian, M.E., K. Ramadoss, D. Sundararajan, S.M. Sathakathullah and R. Athiapandian** 1993. Experience paper on the operation of pilot project on oyster culture at Tuticorin. *Mar. Fish. Infor. Serv. T & E Ser.*, 125: 3-7.

Address : Central Marine Fisheries Research Institute, Tuticorin 628 001, Tamil Nadu, India.

Abstract : In this paper, the different growth methods such as shell string method are discussed and the production rates are compared.

1984. **Rajasekaran, A., A. Murugan, P.R. Anand Vijayakumar, P. Thirupathy Kumaresan and M. Santhana Ramasamy** 2003. CNS depressant activity of the methanolic extract of the ascidian *Distaplia nathensis*. *SDMRI Res. Publ.*, 3: 101-104.

Address : Arulmighu Kalasalingam College of Pharmacy, Krishnankoil 626 190, Tamil Nadu, India.

Abstract : The methanolic extract of the ascidian *Distaplia nathensis* Meenakshi was investigated for CNS depressant activity using actophotometer in swiss albino mice. Reduction in locomotor activity, reduction in onset and prolongation of phenobarbitone sodium induced sleeping time were observed in mice, treated with methanolic extract of ascidian *D. nathensis*.

1985. **Rajeev, A, S. Prakash, B.V. Bhimba and M.M. Babu** 2003. Antifungal action of marine micro algae against human localised and systemic fungal pathogens. *Seaweed Res. Utiln.,* 25(1&2): 221-226.

Address : Microbiology Laboratory, Institute for Coastal Area Studies, Manonmaniam Sundaranar University, Rajakkamangalam-629 502, Kanyakumari, Tamilnadu, India.

Abstract : Six marine microalgae like *Chlorella marina, C. salina, Isochrysis galbana, Nannochloropsis occulata, Dicarteria inorta* and *Chromulina jreibergensis* were cultured and their extracts were screened for antifungal activity against the human pathogens. The selected human localised and systemic fungal pathogens were *Candida albicans, Trichophyton rubrum, Epidermophyton floccosum, Microsporum gypseum* and *Cryptococcus neoformans.* It was found from the present study that the fungal pathogens *Cryptococcus neoformans* was highly inhibited when compared to other fungi by the algal extracts. The maximum contribution of marine micro algal species on the extraction of antimicrobials indicates that *Isochrysis galbana* has rich bioactivity than the other algal species. Among the 5 solvents (acetone, benzene, butanol, isopropanol and water) used on the extraction of antimicrobials from microalgae, it was found that n-butanol gave maximum extraction.

1986. **Rajendran. I.** 2000. Bioactive compounds from Gulf of Mannar resources. *Golden Jubilee Celebrations Souvenir 2000, Mandapam R.C of CMFRI, Mandapam Camp,* pp. 63-67.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Man has been venturing the oceans for his livelihood since ancient time. *i.e*., One century B.C. as recorded by Pliny the Elder. Of the wealth of oceans viz. fish, algae, mangroves, corals, minerals, natural gas and petroleum, fish by-catches, shells, etc., fishes substitute the major animal protein demand of the increasing world population. About 60% of the population of the developing countries derive 40% or more of the total animal protein from fishes; As the population is increasing alarmingly mainly in developing countries, controlled and sustainable sea resources exploitation are to be kept in mind. As the terrestrial exploitation to some extent has lead to non-sustainable state now, alarm has started from different parts of the world to control the global destabilization like green house effect, global warming, etc. To overcome these, oceans have been the point of attraction for sustenance and as a result oceans uncover many new things of nature hitherto unknown.

1987. **Rajeswari Anand, M.** 1998. Structural and functional aspects of seagrass communities. *Proc. Ttechnical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve,* pp. 102-109.

Address : M.S. Swaminathan Research Foundation, Taramani, Chennai, Tamilnadu, India.

Abstract : The taxonomic status of seagrass species make the system very unique. Seagrasses are the submerged marine flowering plants and it is noteworthy that none of them is related to any terrestrial species. No marine dicots have been reported. Although seagrasses belong to only two families, the ecosystem exhibit significant species diversity.

1988. **Raju, A.** 2000. Fish and fisheries of Gulf of Mannar. *Golden Jubilee Celebrations, Souvenir 2000, Mandapam R.C. of CMFRI, Mandapam Camp,* pp. 44-46.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : India has an extensive coastline length of 7,150 km. The Gulf of Mannar region occupies the southeast coast of India (Latitude-8° 55'-9°15'N Longitude- 78°-79°16'E). The entire coastline of Gulf of Mannar from Thoothukudi to Dhanuskodi is sheltered from the fury of wind and waves by the existance of a chain of Islands or sand clays. The Island system and coral reefs spread over this region offer shelter for a variety of marine fauna and flora. Both mechanized trawlers and non-mechanised vessels carry out fishing throughout the year. But the shore seine fishing is seasonal in certain areas particularly in the southern region, When the Gulf of Mannar covering its southern portion becomes rough during April to September, the shore seine operations shift to Palk Bay and when the Palk Bay becomes rough during October to March, the units migrate to Gulf of Mannar. There are eight trawl fish landing centres such as Pamban (Therkuvadi), Mandapam (boat building yard), Keelakarai, Ervadi, Valinokkam, Mundhal, Vembar and Thoothukudi.

1989. **Raju, A., D. Kandasami, I. Rajendran, I. Jagadis and N. Ramamurthy** 2001. Observations on fattening, growth and sex reversal of the greasy grouper *Epinephelus tauvina* (Forskal). ***In***: *Perspectives in Mariculture,* (*eds*.) N.G. Menon and P.P. Pillai, MBAI, Cochin, pp. 357-368.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

1990. **Raju, A., C. Kasinathan, N. Ramamoorthy and P. Villan** 2004. On the stranding of sea cow, *Dugong dugon* at Mandapam along the Gulf of Mannar coast. *Mar. Fish. Infor. Serv., T&E Ser.,* 181: 11-12.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : In the seas around India, sea cows are distributed in the Gulf of Mannar, Palk Bay, Gulf of Kutch and Andaman islands. On 18.9.2003, a dead male sea cow *Dugong dugon* (Muller) measuring 194 cm in total length and about 125kg in weight was stranded along the Gulf of Mannar coast at Mandapam, Tamil Nadu. The animal had extreme wounds in the posterior side of body and a part of alimentary canal was found protruded outside the body near the genital region. It appeared that the injury might have been caused by a propeller of inboard engine vallam operating in the near shore waters. The morphometric measurements of specimen are given.

1991. **Raju, G.** 1962. New records of the giant Trematodes of the genus Hirudinella from Indian waters. *J. Mar. Biol. Assoc. India*, 4(2): 232-234.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In the course of the examination of the stomach contents of certain Scombroid fishes *Katsuwonus pelamis* (Linnaeus), *Neothunnus macropterus* (Temminck & Schlegel), *Euthynnus affinis* (Cantor) and *Acanthocybium solandri* (Cuvier & Valenciennes) from Minicoy and Tuticorin, I was able to collect several specimens of the so called giant trematodes belonging to the genus *Hirudinella* (Digenea-Family Hemiuridae). These have not hitherto been definitely recorded from Indian waters, though Rao (1960) mentions about the parasites resembling *Distomum* sp., from the stomachs of *Acanthocybium solandri* from Vizhingam. These are large, muscular and cylindrical or globular worms with the body strongly marked with transverse folds. The mouth and oral sucker are subterminal. The acetabulam situated close behind the oral sucker is larger than the latter. The oral sucker opens into the pharynx which is continued as oesophagus from which two lateral diverticula are directed forward. From the oesophagus two intestinal caecae pass backwards, filling the hind end of the body. The genital pore is a median and ventral opening near the oral sucker. The excretory pore is at the posterior tip of the worm. The testes lie behind the acetabulam.

1992. **Ram, K.** 1990. The ideology of feminity and women's work in a fishing community of south India. *Women, poverty and ideology in Asia*, pp. 128-147.

Abstract : The Mukkuvar caste of Kanyakumari, Tamil Nadu, have a complex set of rules governing fishing, and women are excluded entirely from the activity. Marketing of fish is also restricted to women aged forty and over. The rules are interpreted here in a cultural and religious context, and the author argues that we should not view ideology and culture as purely repressive.

1993. **Ramachandran, S and R. Krishnamoorthy** 1998. Remote sensing and the application of GIS for coral reef management. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*. MSSRF Publ., pp. 49-55.

Address : Institute for Ocean Management, Anna University, Chennai 600 025, Tamilnadu, India.

Abstract : Coastal zone in India assumes greater importance because of its high productivity and human dependence on the resources. There is an urgent need to protect the coastal environment while ensuring its continuing production and method or technique to properly store the coastal zone data for various analysis and applications. The advent of Geographic Information System (GIS) during recent years has eliminated the problem of storing and integrating coastal zone data. A GIS based Coastal Zone Information System (CZIS) has been created for Rameswaram by integrating conventional, remote sensing and socioeconomic data.

1994. **Ramachandran, S.** 2000. Southeast India. *Seas at the millennium - An environmental evaluation*, 2: 161-173.

Address : Institute for Ocean Management, Anna University, Chennai - 600 025, Tamilnadu, India.

Abstract : The seas along the southeastern states of India, totalling approximately 1,860 km, are described in this chapter. Covering the States of Tamilnadu and Andhrapradesh, the ecologically important and distinctive sites are the Gulf of Mannar, Palk Bay, Vedaranyam, Pichavaram, Pulicat Lake, the Godavari-Krishna delta and the Coringa mangroves. Economically important areas and centres of industry include Tuticorin, Nagapattinam, Cuddalore, Chennai, Nizampattinam, Kakinada and Vishaghapatnam. The coastal population density is 20 to 600/km^2, and more than 9 million people live along these coastal areas. The major activities that cause degradation of coastal ecosystems in these areas are disposal of untreated domestic and industrial wastes, port and harbour activities, ocean traffic, exploration and exploitation of minerals, oil and gas, as well as natural hazards such as

storm surges. Both coastal erosion and siltation of river mouths are major problems in some of these areas as well. Reduction of freshwater flow in the rivers due to the construction of dams for irrigation purposes has affected coastal ecosystems and the stability of coasts. The rapid development of activities and the increasing coastal population are threatening the health of seas and their resources. Fisheries have stagnated during the past five years and environmental degradation is evident through the reduction of biodiversity, loss of habitats, reduction in mangroves and by impacts on coral reefs. Community participation in integrated coastal zone management plans and strict implementation of those plans are required for the sustainable utilisation of marine resources and conservation of biodiversity.

1995. **Ramachandran, S., K. Selvavinayagam and A. Surendran** 2003. Quantitative study on chlorophyll using IRS-P4 OCM data of Tuticorin coastal waters. *Photonirvachak*. 31(3): 227-235.

Address : Institute for Ocean Management, Anna University, Chennai, 600025, India.

Abstract : Quantification of Chlorophyll using IRS data was attempted. OCM-DAS software developed by Space Applications Centre, Ahmedabad was used in data analysis. The results showed considerable variations in nearshore (case 2) waters due to interference from yellow substance and sediments. However, in offshore areas (case 1) the measurements showed good correlations. The r^2 values are 0.663 for nearshore waters and 0.892 for offshore waters.

1996. **Ramachandran Nair, P.V., C.P. Gopinathan and V.K. Balachandran** 1978. Studies on phytoplankton productivity and the estimation of potential resources. *CMFRI Spec. Publ.,* 3: 109-115.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The phytoplankton are the microscopic plant life of the sea, which constitute the primary producers synthesizing the basic food. It belongs to the class algae, which besides chlorophylls possess other characteristic pigments. The important components of phytoplankton are: Diatoms, Dinoflagellates, blue-green algae and very minute forms called the nannoplankters. In addition to these, two other classes namely, Silicoflagellates and Coccolithophores also belong to the category of phytoplankton.

1997. **Ramachandran Nair, P.V., G. Luthur and C. Adolph** 1967. An ecological study of some pools near Mandapam (South India) formed as a result of the cyclone and tidal wave of 1964. *J. Mar. Biol. Assoc. India*, 7(2): 420-439.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Ecological study of populations in five pools at Mandapam formed as a result of the cyclone and tidal wave was conducted for over a three-month period. Three pools with higher salinity and lower silicate content were colonised by *Peridinium* while two pools with lower salinity and higher silicate content were colonised by *Pyrocystis,* both causing bioluminescence in the pools. All the pools showed clear succession of organisms with the progressive onset of summer and increase in salinity. Diatoms were succeeded by dinoflagellates in abundance. The climax of succession was marked by the appearance of flagellates belonging to either autotrophic chlamydomonadineae or saprophytic cryptomonadaceae. Nine species of penaeid prawns, one species of crab, a few specimens of amphipods, and Acetes were the crustaceans collected. Size range, dominant size groups and total weight of the prawns are given. A few specimens of *Sepioteuthis* and a number of tintinnids were also recorded. Forty-six species of fish which are mainly coastal in their habitat occurred in the pools. Size range, total number and the dates on which dead ones were noticed are given. Twenty-four species of fish were found to tolerate hypersaline conditions of which four were found alive even in brine water (92 ppt). The conditions in the pools were of a special nature. Salinity together with the diurnal variation of oxygen, with a pre-dawn minimum and the high temperature in the afternoon are considered as having affected the survival of the fauna consisting of fish, prawns and crabs.

1998. **Ramachandran Nair, P.V.** 1972. Phosphorus fractions in Gulf of Mannar and their relation to organic production. *J. Mar. Biol. Assoc. India,* 14(2): 752-757.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The variations of the three phosphorus fractions-inorganic, organic and particulate Phosphate have been discussed in relation to the primary production in Gulf of Mannar off Mandapam. Though the rate of primary production is uniformly high, instantaneous concentration of inorganic Phosphate is low and without significant seasonal variation. But the total Phosphorus, dissolved organic Phosphate and particulate Phosphate show definite seasonal variation. From primary production the rate of phosphate assimilation and regeneration have been deduced.

1999. **Ramachandran Nair, P.V and C.S. Gopinadha Pillai** 1972. Primary productivity of some coral reefs in the Indian seas. *Proc. Symp. corals and coral reefs, MBAI*: 33-42.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Primary productivity of coral reefs, in Manauli Island (Gulf of Mannar), Minicoy (Laccadive Sea) and Andaman Islands (Bay of Bengal) was estimated by the diurnal changes of oxygen in the seawater flowing over the reefs. There was a strong unidirectional flow due to trade winds in the first region whereas in the other two regions there was only tidal flow. However, there was measurable variation in all the places between the upstream and downstream measurements of oxygen values and these variations have been graphically integrated in order to obtain the primary productivity. Manauli and Minicoy reefs are autotrophic with annual net production of 2,500 gC/m^2 and 3,000 gC/m^2 respectively. The production of the reef near Port Blair, in Andaman Sea is 1,200gC/m^2/year which does not meet the respiratory requirements of the organisms and hence it is not self supporting. The reasons for this difference are briefly discussed.

2000. **Ramachandran Nair, P.V., Sydney Samuel, K.J. Joseph and V.K. Balachandran** 1973. Primary production and potential fishery resources in the seas around India. *Proc. Symp. Living resources of seas around India*, 184-198.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper deals with an account of the results of investigations on primary production using oxygen and ^{14}C techniques in the Gulf of Mannar, Palk Bay and the west coast of India. These together with the data of *GALATHEA* and International Indian Ocean Expeditions have been used to estimate the productivity of the different regions. It is found that the maximum production is towards the coast within 50 meters depth and gradually decreases seaward. The mean value over the shelf on the west coast is 1.19 g C/m^2/day for <50 meters, yield as the ratio of carbon production is 1.7 million tonnes. On the east coast, the average for the shelf is 0.43 g C/m^2/day for <50-200 meters and 0.18 g C/m^2/day for <200 meters. Based on this potential yield as the ratio of carbon production is 1.7 million tonnes. On the east coast, the average for the shelf is 0.63 g C/m^2/day and 0.14 g C/m^2/day outside the shelf, though very high rates of 2.0 g C/m^2/day are usually found in the shallow near shore regions of Gulf of Mannar and Palk Bay, the estimated yield from the east coast is over 0.6 million tonnes. Hence the potential resources over the entire shelf region of the west and east coasts of India together would be of the order of 2.5 to 3 times the present yield.

2001. **Ramachandran Nair, P.V., V.K. Pillai and V.K. Balachandran** 1988. Potential applications of satellite remote sensing technique in oceanography and fisheries. *CMFRI Spec. Publ.*, 40: 26-27.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A wide range of data collection can be achieved by remote sensing in oceanography and fisheries, which by conventional shipboard observation would take considerable time and effort. IRS 1 (Indian Remote Sensing Satellite 1), expected to be launched this year by ISRO, will form the first of a series of operational remotesensing satellites in resources survey. The Joint Experiments Programme (JEP) for the development of suitable sensors in marine fisheries, organised by ISRO in collaboration with CMFRI and FSI, enabled the development of suitable sensors in the estimation of chlorophyll and bioproductivity. In addition to the IRS utilization Programme, SPOT, LANDSAT MSS and TM data also will be available for this.

2002. **Ramadhas, V., V. Sundararaj and M.D.K. Kuthalingam** 1982. Primary productivity of Indian mangroves. Int. Symp. Utiln. Coastal Ecosystems: Planning, Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982. *Atlantica*, 5(2): 102.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Indian mangrove ecosystems are known for their nutrient fertility and high productivity. In these mangrove waters, primary production ranged between 50 and 800 mg c/m^3/hr with chlorophyll reaching the peak value of 45 mg/m^3 during periods of phytoplankton bloom. The very high assimilation efficiency recorded in these waters is quite indicative of the better quality of the water with non-limiting level of nutrients, added and regenerated continuously. Major fraction of total organic carbon synthesis was due to nanophytoplankton, which contributed to more than 90% of primary production. Seasonal variation in primary production is discussed in the light of the data available on nutrient concentration, grazing pressure and monsoonal inflow of freshwater.

2003. **Ramadhas, V., R. Santhanam, V.K. Venkataramani and V. Sundararaj** 1999. Gulf of Mannar- A profile. *Coastal Pollution Awareness Meet; Fish. Coll. Tuticorin*, 41 pp.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The Gulf of Mannar is uniquely influenced by southwest and northeast monsoons and is internationally known for its diversified and precious fisheries resources such as seagrasses, corals, chanks, pearl oysters, turtles, sea cows, crustaceans and finfishes including the marine ornamental fishes. Considering the rich biodiversity and unique nature of the fauna, the Gulf of Mannar Biosphere Reserve is also known as "Paradise of Zoologists". The islands along the stretch of Gulf of Mannar play an important role in sustaining the biological diversity and bio-geochemical cycles. It is also worth mentioning that in order to protect the fauna and flora, which are either vulnerable or endangered, the Gulf of Mannar including all the islands has already been declared as a National Marine Park. Various research findings made earlier in this ecosystem however reveal that there is a fast depletion of certain specific fisheries resources especially pearl oysters, seagrasses, sea turtles and sea cows and these resources are under ever increasing multifarious threat due to the shore-based industries and man-made activities. The capture fisheries data also reveal a decline of fish catch in the area from 1990-91 continuously. It is therefore highly felt that an awareness has to be created among public, industrialists and fishermen, to protect the Gulf of Mannar Biosphere Reserve.

2004. **Ramadoss, K.** 2000. Gastropod resources - scope for increased production. *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI, Tuticorin,* pp. 29-31.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Among the marine molluscs, gastropods constitute the major portion in terms of commercial and food value, when these univalves are exploited for food. The most beautiful shape and colour of the shells attract man to use them for ornamental purpose.

2005. **Ramadoss, V.** 2002. Studies on the Ecology and Biology of Butterflyfish *Chaetodon collare* in the Gulf of Mannar and Palk Bay. *Ph.D Thesis*, Madurai Kamaraj University, Madurai. 272 pp.

Address : Centre for Marine and Coastal Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai - 625 021, Tamilnadu, India.

Abstract : In the present study economically important and popularly known reef associated butterflyfish, *Chaetodon collare*'s biology and ecology were studied. In a period of 2years from January 1996 to July 1997, 200 specimens of *C. collare* ranging from 30 to 122 mm were collected and studied. Morphology and biometric characters such as total length, standard length, and weight of the fishes were studied. The meristic characters of dorsal spines, anal spines, dorsal rays and anal rays were observed. The relationship between standard length and other morphometric characters revealed that the pre-anal length had the fastest growth and the slowest growth was observed in pre-orbital length and in the length of 2nd anal spine. Pre-dorsal length, depth of the body, head length, pelvic fin length, pectoral fin length, snout length, length of the 3rd dorsal spine, eye diameter, post-orbital length, inter orbital space and depth at caudal peduncle have exhibited growth rates in the descending order. Most of the Morphometric combinations (99 out of 105) showed more than 25% of positive correlation between the two optional factors and the statistical calculations of the correlation coefficients of all combinations showed significance at 5% level. A total of 1,520 fishes of both sexes were used to study the length weight relationship, which showed the value of the exponent 'n' as less than 3 in the parabolic equation and this was due to the deeply compressed nature of the body of *C. collare.* Gut content analysis was done using Index of Preponderance Method, which showed significant difference in the feeding habits of adults and juveniles. The study confirmed that the fishes were omnivorous during their adult and juvenile stages. Physico-chemical parameters of surface waters of the study areas were also analysed. No variation was recorded in the surface water temperature of Palk Bay and Gulf of Mannar. In the Gulf of Mannar, surface water temperature ranged between 23.6ºC and 32ºC, whereas in the Palk Bay region it ranged from 26.2ºC to 32ºC. No major difference in pH values of surface water in the Gulf of Mannar (8.2) and Palk Bay (8.7) was observed. The same trend was recorded in salinity and dissolved oxygen concentrations of the surface waters of Gulf of Mannar (salinity 35.8 ppt and DO 7.7 ppm) and Palk Bay (salinity 35.3 ppt and DO 8.6 ppm). The level of dissolved nutrients such as phosphate, nitrate, nitrite, and silicate in the study locations were analyzed. The concentration of dissolved phosphate in the surface water of Gulf of Mannar was 10.67 ppb and in the Palk Bay it was 14 ppb. Similarly, the dissolved silicate in the Gulf of Mannar was 1.18ppm and the same in Palk Bay was 0.66 ppm. The concentration of dissolved nitrate in the surface water of Gulf of Mannar was 89.32 ppb and that in the Palk Bay was 64.41 ppb. Maturation and spawning stages were studied in the reproductive phase of *Chaetodon collare*. The spawning of butterfly fish occurs twice in a year; one during northeast monsoon and the other during southwest monsoon. In the present study maturity of gonad, both in male and female fish were observed and the development and percentage of occurrence of

gonad was related to the size of the fish. Fecundity of *C. collare* varied from 70,686 to 100,252 in individuals measuring a total length of 80 to 130 mm with body weight that ranged from 25 to 75g. The significant implications of the study include restraining fishermen from catching *C. collare* during monsoon seasons since; it can interfere with the spawning activities. The remaining periods can be used for fishing to fulfill the market requirements. Taking into account the export potential of *C. collare*, the study advised the exporters to attempt induced ovulation of *C. collare* to meet the aquarium demands. The study concluded that the butterfly fish *Chaetodon collare* is economically important and is suitable for culture in aquarium. The study also recommends communicating the findings to the fishermen communities in order to exploit this fishery resource on a sustainable yield basis so that conservation attempts will be fruitful.

2006. **Ramaiyan, V and P.J.P. Whitehead** 1975. Notes on Indian species of *Ilisha* (Pisces: clupeidae). *J. Mar. Biol. Assoc. India*, 17(1): 187-198.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Porto Novo - 608 502, Tamilnadu, India.

Abstract : Of all the Clupeids, species of *Ilisha* by different authors based on different criteria has resulted in conflicting views among systematists. There is an urgent need to revise the species of this genus and this has also been repeatedly emphasized by previous workers. The systematic revision of the genus could be best attempted only by considering all Indo-Pacific material. But a critical study of the Indian species could be the first step in right direction. The systematics of Indian species of *Ilisha* has been dealt with in the present study on the basis of the re-examination of the types of various nominal species deposited in the three European museums. A key to Indian species of *Ilisha*, modified from that of Whitehead (1972) is presented here with emphasis on the form of the swimbladder as a diagnostic character.

2007. **Ramaiyan, V., R. Kasinathan, S. Ajmalkhan, J.K. Paterson Edward and S. Rajagopal** 1996. Studies on the boidiversity of invertebrates (Annelids, Turbellarians, Bivalves, Gastropods and Crustaceans) and vertebrate (fishes) in the Gulf of Mannar. *Project Report Monograph Submitted to MOEN & F. Govt. of India*, 133 pp.

2008. **Ramalingam, J.R.** 2000. Production of export quality of Agar. *Golden Jubilee Celebrations Souvenir 2000, Mandapam R.C of CMFRI, Mandapam Camp*, pp. 81-83.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The seaweeds are the renewable and economically valuable wealth of the sea. The phytochemicals agar and algin are produced from the seaweeds. The red algae *Gelidiella acerosa* and *Gracilaria edulis* are the source of raw materials for agar industries and *Sargassum* and *Turbinaria* for algin industries. Annually 50 tons of agar and 500 tons of alginates are manufactured in India. Two grades of agar, are produced in India namely food grade and IP Grade. (Bacteriological grade). Gel strength is the main criterion for differentiating these two types of agar. *Gracilaria edulis* is used for food grade agar and *Gelidiella acerosa* for IP grade agar. The specifications for the food grade and IP grade agars are given.

2009. **Ramalingam, J.R., N. Kaliaperumal and S. Kalimuthu** 2002. Agar production from *Gracilaria* with improved qualities. *Seaweed Res. Utiln.*, 24(1): 25-34.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Agar is manufactured from the red algae *Gelidium*, *Gelidiella* and *Gracilaria*. It is one of the commercially important marine products. The agar produced from *Gelidium* and *Gelidiella* is considered as the first grade agar and fetches high price. The presence of sulphate content in *Gracilaria* agar affects the quality of the agar and it is usually sold at low price. It is used only as food grade agar. The different Indian and foreign technologies for production of *Gracilaria* agar with improved yield and quality are given in this paper.

2010. **Ramalingam, J.R., N. Kaliaperumal and S. Kalimuthu** 2003. Commercial scale production of carrageenan from red algae. *Seaweed Res. Utiln.*, 25(1&2): 37-46.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Carrageenan is one of the commercially important water soluble polysaccharides extracted from certain red algae and it is widely utilised in foods, dairy products and pharmaceuticals. In India, there is no carrageenan manufacturing unit and knowledge on the processing technologies of this phytochemical is very limited. Various methods available for the extraction of different types of carrageenan are reviewed in this paper.

2011. **Ramalingam, K.** 1960. The morphology and life history of *Echinochasmus bagulai* 1935, with ecological observations on its larval forms. *J. Mar. Biol. Assoc. India*, 2(1): 35-50.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Morphological descriptions of cercaria, redia, metacercaria and adult *Echinochasmus bagulai* are presented. The development of the marine cercaria and metacercaria to the adult *E. bagulai* is described. Incidentally this is the first record of a marine cercaria and a metacercaria from India. The two-year data on the ecological studies of the larval trematodes of *E. bagulai* have been analysed with reference to the host-parasite relationship and the effect of parasitism on the population.

2012. **Ramalingam, K.** 1963. Marine cercariae and their gastropod hosts from the Pamban mudflat. *Curr. Sci.*, 32(1): 25-26.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Indian marine cercariae have not received as much attention as the fresh water cercariae have received. A total of 448 specimens belonging to 7 genera and 8 species of gastropods were collected during May-June, 1962 from the Pamban mudflat located in the Rameswaram Island. Different hosts besides were examined and discussed.

2013. **Ramamirtham, C.P.** 1967. Fishery Oceanography. *Souvenir. 20th Ann. CMFRI.* pp. 94-98.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The ocean in itself is not a homogenous medium although it is a single-phase environment. The temperature, the amount of dissolved organic and inorganic matter, the amount of dissolved gases and the physical nature of the ocean are subject to various changes seasonally and regionally. The climatic conditions of the atmosphere also affect the ocean and the exchange of energy between the sea and the atmosphere is also important in this respect. The *In*-situ changes in the ocean affect the production of planktonic organisms, which form the food material for the fish. The spatial differences in the mass distribution of the oceans which can be estimated from temperature and salinity, give rise to ocean currents, which help the transport of fish eggs and larvae and which affect the movements of adult fish also, Thus the fluctuations in the environmental conditions have a profound influence on the periodic and seasonal migrations and occurrence of fish. Furthermore, the conditions in the aquatic environment and their changes influence the recruitment, survival and growth of fish. The environment also interferes with such biological activities as spawning and growth. Thus, for instance, the survival and abundance of all the food specimens of fish are affected by the environmental factors most decisively. Oceanography, which deals with the study of the physics, chemistry, as well as the biology of the oceans, is thus indispensable for the study of fishery conditions in a particular region.

2014. **Ramamoorthy, K and G.S. Thangaraj** 1980. Ecology of Artemia in the saltpans of Tuticorin, South India. The brine shrimp Artemia. Volume 3. Ecology, Culturing, Use in Aquaculture. *Proceedings of the international symposium on the brine shrimp Artemia salina.* (*eds*.) Corpus Christi, TX (USA), 20 Aug 1979. G. Persoone, P. Sorgeloos, O. Roels, E. Jaspers. pp. 105-114.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India.

Abstract : The present report records the occurrence and distribution of the brine shrimp Artemia in the salt pans of Tuticorin, South India. The environmental parameters salinity, temperature, oxygen, pH, particulate carbon, and the nature of the sediment, which influence the distribution of *Artemia*, have been studied. The evolution of the biota occurring in the saltpans, including the bacterial population has been investigated in relation to the brine shrimp population. The ecological significance of brine shrimp in this unique biotope is discussed.

2015. **Ramamoorthy, K., K. Sujatha, K. Sivasubramaniam and K. Subburamu** 2006. Organic priming with *Sargassum polycystum* extract on vigour and viability in cowpea *Vigna unguiculata* L. Walp. *Seaweed Res. Utiln.*, 28(1): 85-88.

Address : Seed Science and Technology Unit, Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai- 625 104, Tamilnadu, India.

Abstract : Pre-sowing seed soaking in boiled water extract of *Sargassum polycystum* was found to alter vigour parameters in cowpea cv. CO6, while the viability remained unaffected. The better performance of soaked seeds in 0.50 and 0.75 percent concentrations could be observed on speed of germination, seedling measurements and

dry matter production. The deterioration was minimum in treated seeds as indicated by higher dehydrogenase activity and lower lipid peroxidation.

2016. **Ramamurthy, K.** 1998. Plankton characteristics of the Coral reef environment of the Gulf of Mannar Biosphere Reserve, India. *Ph.D. Thesis*, Annamalai University, India. 143 pp.

2017. **Ramamurthy, S.** 1978. Prawn farm. *CMFRI Spec. Publ.* 3: 92-103.

Address : Central Marine Fisheries Research Institute, Mangalore, Karnataka, India.

Abstract : Several physical and biological risks are involved in prawn farming which have to be surmounted by suitable management systems to make it a viable enterprise. There are many species of prawns each with somewhat different environmental requirements. Aquaculture, like agriculture, cannot be carried out just anywhere. The site must have certain natural amenities like ample supply of quality water and soil and availability of seed prawns. It is also necessary that the farmer exercises control over the site through ownership, lease or other means of secure holding.

2018. **Ramanadan, R and P.I. Chacko** 1961. A preliminary report of the lobster fishery of Kanyakumari Coast. *Proc. 48th Sess. Indian Sci. Congr.,* p. 433.

2019. **Ramanathan, G.** 2005. Screening and standardization of antimalarial compounds from marine plants for possible utility as herbal medicine. *Ph.D., Thesis* submitted to Manonmaniam Sundaranar University, Tamil Nadu, India. 158 p.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam-629 502, Kanyakumari, Tamilnadu, India.

Abstract : Malaria is a life threatening parasitic disease transmitted by mosquitoes. Approximately 40% of the world population especially from world, poorest countries are at the risk of malaria. Though it was successfully eliminated in the temperate countries, more than 300 million acute illness and at least 1 million deaths annually are reported in tropical and sub tropical regions. Malaria kills an African child every 30 seconds. There are about 150 species of *Plasmodium* identified to infect vertebrates; of these, 4 species infect human beings. The first treatment for malaria was derived from the bark of Cinchona tree in South America. The emergence of drug resistant organisms necessitates to find out complementary/alternative medicines from natural origin for the treatment of malaria. Herbal medicine in the form of unpurified plant extracts either alone or in combination has been given top priority in recent years. Traditional medicine from terrestrial plants have been exhaustively screened for various human ailments. Marine plants have been recently recognized as a potential source of drug preparations for infectious diseases, but less attention has been focused with regard to standardization. Based on the antimicrobial potentiality of the marine halophytes, the present study has been mooted out to develop an antimalarial drug from marine halophytes through screening and standardization programme.

2020. **Ramanathan, N., V.K. Venkataramani and K. Venkataramanujam** 1990. Breeding biology of flat fish *Pseudorhombus triocellatus* (Bloch and Schn.) from Tuticorin waters, east coast of India. *Indian J. Mar. Sci.,* 19(2): 151-152.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : *Pseudorhombus triocellatus* breeds once a year for 2 to 3 months in Tuticorin and Kerala (India) waters. Eggs are released in a single batch. Spawning period extends from August to October. The size at first maturity is 71-80 mm total length. Females are more than males. Fecundity is related to total length and body weight.

2021. **Ramani Menon, K.** 1927. Zoantharia (except Scleractinae), ***In***: Littoral fauna of the Krusadai Island in the Gulf of Mannar. *Bull. Madras Govt. Mus. New. Ser. (Nat. Hist.)*, 1(1): 31-40.

2022. **Ramanujam, N., M.V. Mukesh and N.B. Preeja** 1992. Calcium carbonate accretion, mechanical properties and adaptive significance of the coral *Acropora cervicornis* in the windward side of Karaichalli Island, Gulf of Mannar. *J. Indian Assoc. Sedimentol.,* 11: 89-94.

Address : Department of Geology, V.O.C. College, Tuticorin 628 008, Tamil Nadu, India.

Abstract : Twenty Islands in the Gulf of Mannar are characterised by reefs with marked zonations. Among the dominant coral species, *Acropora cervicornis* was selected to study the mechanical adaptation of the corals to the hydrodynamic conditions in the windward side of the Islands. A series of the cross and transverse thin

sections were made from the bottom to tip of the specimen, to study the mineralization, porosity pattern and boring by other organisms. Compressive strength of the coral specimens reveal that the resistance of the corals to the wave power can be achieved not only by structural, mechanical and mineralogical properties of the skeletons but also by the morphological adaptations of the colony.

2023. **Ramanujam, N., M.V. Mukesh, H.M. Sabeen and N.B. Preeja** 1995. Morphological variations in some islands in the Gulf of Mannar, India. *J. Geol. Soc. India*, 45: 703-708.

Address : V.O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Islands in the Gulf of Mannar are sedimentary landforms developed during the low strand of sealevel during the last interglacial period. The reefs commenced to grow along with the pace of rising sea level. Islands such as Van, Koswari, Kariashuli, Vilangushuli in Tuticorn region can be called as Tuticorin group of Islands. The size, shape and orientation of the reef along with the wave parameters are crucial in determining the development and instability of the Islands. Oval or elliptical shape of the reef, small reef area and orientation along with the major wave direction are favourable for the development of the Islands. The non-eplliptical shape, bigger size of the reef and irregularity in rim topography are hindrances to their development. Apart from the said factors the sea level rise and mining of reef materials are also causative factors.

2024. **Ramanujam, N and H.M. Sabeen** 1996. The relationship between grain size characteristics and beach face slope between Kanyakumari and Thiruchendur. *J. Indian Assoc. Sedimentol*, 15(1): 51-58.

Address : PG Department of Geology and Research Centre, V.O. Chidambaram College, Tuticorin 638 008, Tamilnadu, India.

Abstract : The sediment distribution pattern in the area depends mainly on gradient of beach slope and wave climate. Medium class sediments dominate about 64 percent of the total area. The high wave energy carves out the beach slope, giving 70 percent of concave profiles and 25 percent of convex profiles. The concave profile of erosion has higher heavy mineral concentration. With reference to the surf scale parameter the entire coast is divisible into dissipative, intermediate and reflective. Intermediate beach types are seen in most of the area. Dissipative beach is present at one location only. The reflective beaches are moderately sorted. The bivariate plot shows that with the increase of grain size, beach gradient increases with well-sorted nature and positive skewness. Sediments of low gradient are leptokurtic and poorly sorted.

2025. **Ramanujam, N., V. Radhakrishnan, H.M. Sabeen and M.V. Mukesh** 1996. Morphodynamic state of beaches between Vaipar and Tiruchendur, Tamil Nadu. *J. Geol. Soc. India*, 47(6): 741-746.

Address : Department of Geology, V.O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The relationship between the surf zone processes and the morphodynamic state of beaches between Vaipar and Tiruchendur along the southeastern coast of Tamil Nadu (India) was studied through 46 beach profile measurements and other morphological features across and along the shoreline. The energy variations in the beach along with the morphological and sedimentological properties are distinguished by the surf-scale parameter. The dissipative beaches with higher wave heights and low beach gradients yield the higher amount of surf-scale parameter (22.0 to 154.3) whereas at the other extreme, the reflective beaches with steep beach gradients and lower wave height conditions resulted with low surf-scale value (0.5711 to 2.500). Intermediate beach states possessing dissipative and reflective elements with four transitional stages are recognised.

2026. **Ramanujam, N and M.V. Mukesh** 1998. Geomorphology of Tuticorin group of Islands. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*, MSSRF Publ., pp. 32-37.

Address : P.G. Dept. Geology and Research Centre, V.O.C. College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Gulf of Mannar comprises of 20 coral islands stretched between Tuticorin and Rameswaram. These islands are grouped into the Tuticorin group, Vembar group, Keelakkarai group and Mandapam group. Four islands, Van, Koswari, Kariyashuli and Vilangushuli are grouped into the Tuticorin group. Ramanujam *et al* (1995) reported the morphological variation of these islands system. The long-term behaviour of these islands depends on the rate of the sea level rise, on sediment supply and hydrodynamic forces related to wave climate, anthropogenic impacts such as construction of breakwater and discharges of effluents. Mining of reef materials also interferes with the islands evolution. These impacts caused reduction in the sediment budget. Insufficiency of sand supply caused islands to erode, initiating a tendency to migrate towards the mainland.

2027. **Ramanujam, N and M.V. Mukesh** 1998. Deterioration of coral Islands of Tuticorin group - Human Impacts :

A case study. *Proc. Technical workshop on Biodiversity of Gulf of Mannar Marine Biosphere Reserve*. MSSRF Publ., pp. 69-75.

Address : Post Graduate Department of Geology and Research Centre, V. O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The coral reef system as well as the ecosystem of the tropical rain forest, are the most matured marine ecosystems of our planet. They play an important role in global biogeochemical processes and in the reproduction of food resources in the tropical region. These systems are very sensitive to external impacts both natural and man-made which violate their homeostasis (Sorokin 1992). The formation of reef platforms of pleistocene and modem reef are reported in the Gulf of Mannar along the periphery of the twenty islands, extending 150 km from Tuticorin to Adams Bridge (Lat. 8.46° and 9.14° N and Long. 78.90° and 79. 14° E). This discontinuous chain of islands (Stoddart and Fosberg 1972) protects the low lands of Ramanathapuram and Chidambaranar Districts from cyclonic effects. These islands are broadly classified as Tuticorin, Vembar, Keelakarai and Mandapam groups. Most of the islands have the fringing, patch reef coral and mangroves. Air temperature is 25°C in January and 30°C in May.

2028. **Ramanujam, N and R. Sudarsan** 2003. A study of coastal transformation at Tuticorin as a result of emerged and submerged natural breakwaters of Van Island, Gulf of Mannar. *Environ. Geol.,* 43(5): 521-525.

Address : P.G. Department Geology and Research Centre, V.O.C. College, Tuticorin-628 008, Tamilnadu, India.

Abstract : Similar to artificial offshore structures, natural structures such as an Island also protect the low-lying shoreline and shape the pocket beaches. In the Gulf of Mannar, many long Islands have formed protruding from shorelines. Formation of these indirect morphological structures depends upon a number of factors, such as the width of the Island, offshore distance of the Island to the morphological structure, supply of sediments and other geological conditions. The hydrodynamic conditions between Tuticorin Harbour and Van Island have changed because of various factors over the years. Van Island coral reef formation had attracted man-induced mining causing irreparable damage to the fragile ecosystem. The emerged natural breakwater and the submerged coral reef, together with the artificial breakwaters of Tuticorin Harbour, have been contributory to quantifiable change in hydrodynamic conditions around Tuticorin. As a result, the transmission of wave power to the shoreline has increased and the salient growth at Salaipatorri Point, Tuticorin, has started to recede. The data published in 1978 is used for all dimensions of Van Island and receding salient growth at Salaipatorri Point.

2029. **Ramanujam, S.G.M.** 1935. Enteropneusta of Krusadai Island. *Curr. Sci.*, 3(9): 427.

Address : Department of Zoology, Presidency College, Madras, India.

Abstract : I have had an opportunity of visiting the area again and was able to obtain the forms contained in Prof. Narayana Rao's material. My first collection of Balanoglossids was made in September 1930 in the sandy areas of the Porites and Watchman's Bay.

2030. **Ramanujam, V., V.K. Venkataramani and M. Devaraj** 1993. A New Odenostomid fish *Stdenestomus tuticoriensis* sp. Nov. From Tuticorin Bay, South India. *J. Mar. Biol. Assoc. India*, 35(1&2): 201-204.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A new odenostomid fish *Solenostomus tuticoriensis* sp. novo collected from the Tuticorin Bay in the Gulf of Mannar is described and a comparison made with the other three closely related species of the same genus.

2031. **Rama Rao, K.** 1972. Role of critical tide factor in the vertical distribution of *Hypnea musiformis* (Walf). *Proc. Ind. Nat. Sci. Acad.*, 38B: 267-287.

2032. **Rama Rao, K., P.C. Thomas and K. Subbaramaiah** 1976. Fruiting behaviour of *Gelidiella acerosa* (Forsskal) Feldmann *et* Hamel, the perennial Agarophyte. *Phykos*, 15(1&2): 35-37.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : The fruiting behaviour of *G. acerosa* growing at the shores of Rameswaram, India was studied during 1973-74 and its bearing on the reproductive capacity of was investigated. January was the peak fruiting period and a second new maximum was observed in August. Differences in fruiting behaviour and reproductive capacity of the plant were attributed to the biotic factors viz., commercial harvesting, locality and plant habitat.

The assessment of fruting behaviour by stichidia number, which was used here, was thought to be easier than the assessment by spore counts.

2033. **Rama Rao, K.** 1977. Species of *Gracilaria* and *Hypnea* as potential sources of agar. *Seaweeds Res. Utiln.*, 2(2): 95-102.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Agar-agar is one of the most common seaweed products of economic importance the world over. Modern industries have found large number of uses for this product. Of late, the most notable of them is in food and pharmaceutical industries. Besides *Gelidiella* and *Gelidium*, the principal Agarophytes the world over, there are certain other red seaweeds, which yield quality phycocolloids. These occupy a pride of place in food and pharmaceutical industries because of the various properties of their phycocolloids (Krishnamurthy, 1971; Subba Rao *et. al.* 1977). Although the literature indicates some stray reports about the utilisation of red seaweeds other than conventional agarophytes yielding agar, such a comprehensive report from India does not exist. Therefore, an effort has been made in this review to update the information available on red seaweeds yielding phycocolloids.

2034. **Rama Rao, K.** 1977. Studies on the Indian Hypneaceae II. Reproductive capacity in the two species of Hypnea over the different seasons. *Bot. Mar.*, 20: 33-39.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

2035. **Rama Rao, K and K. Subbaramaiah** 1977. Regeneration and regrowth of *Gelidiella acerosa* (Forssk.) Feld. *et* Hamel at Kilakkarai, southeastern shores of India. *Indian J. Mar. Sci.*, 6(2): 175-177.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Greater growth in length (35 mm) was observed in the natural population as compared to that in regeneration (24 mm) and re-growth (29 mm) experiments. Growth rates in these experiments however exhibited irregular variation.

2036. **Rama Rao, K and V. Krishnamurthy** 1978. Studies on Indian Hypneaceae. 1. Seasonal variation in phycocolloid content in two species of Hypnea (Gigartinales, Rhodophyceae). *Bot. Mar*., 21(4): 257-259.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : The seasonal variation in quantity and quality of Agar (phycocolloid) in the two species of Hypnea, *H. musciformis* and *H. valentiae*, was studied in order to evolve a suitable time table for harvesting the algae. In *H. musciformis* the yield ranged from 27.2% to 49.9%, showing a seasonal variation with peaks in Oct 1967 and March 1969. A close relationship was found between yield and gel strength (*i.e.* quality). *H. valentiae* produced 27.2% to 38.95% over the test period, peaking in April 1970; yield and gel strength were correlated as in *H. musciformis*. In both species, maximum yield and gel strength approximately coincided with luxuriant growth in the field. The yield in *H. valentiae* was lower than that in *H. musciformis*, while gel strength was greater in the former. Comparisons are made with data for Hypnea and other Rhodophytes.

2037. **Rama Rao, K.** 1982. Biology of Hypnea species and their possible utilisation in India. *Seaweed Res. Utiln.*, 5(1): 11-20.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

2038. **Rama Rao, K and K. Subbaramaiah** 1982. Phenological studies of *Acanthopora spicifera* (Vahl.) Boergs, an agarophyte. *Seaweed Res. Utiln.*, 5(1): 25-28.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

2039. **Rama Rao, K., M.R.P. Nair and K Subbaramaiah** 1985. Experimental field cultivation of *Hypnea valentia* (Turn.) Mont. at Krusadai Island. *All India Symp. Marine Plants, Their Biology, Chemistry and Utilization,*

Dona Paula (India), 30 Oct 1983. Marine plants. Dona Paula, Goa, Oct 30 Nov 1, 1983. (*eds*) V. Krishnamurthy and A.G. Untawale. pp. 205-208.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : *Hypnea valentia* (Turn.) Mont. (Gigartinales, Rhodophyta) reproduces vegetatively in nature by specialized organs called "stellate bulbils" which are produced abundantly on the vegetative thalli. They drop off from the plant and grow into plantlets that within a week produce a second crop of the bulbils and the process is repeated for generations. Preliminary field experiments were conducted at Krusadai to cultivate the alga from the "stellate bulbils". Bare coral stones (50 cm^2 were kept in a m^2 area for the natural settlement of these "bulbils" and weekly observations were made for their settlement and growth. Maximum extension growth rate, biomass and rate of yield values of 18.4 mm/day in March, 3700 g/m^2 in June and 155 g/m^2 in May respectively were recorded. A total of 11,940 g/m^2 (wet) biomass was obtained in about five months time with a yield of 80 g/day/m^2. The prospects of the future commercial, cultivation of the alga are discussed.

2040. **Rama Rao, K and K. Subbaramaiah** 1986. A technique for the field cultivation of a Carrageenophyte *Hypnea musciformis* (Wulf.) Lam. *Symp. Ser. Mar. Biol. Assoc. India*, pp. 1190-1192.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : There is a growing awareness for utilizing species of Hypnea for producing carrageenan in India. The available natural resources of this species being limited, there is a need to cultivate it in the Indian waters. Hence, a basic technique for the cultivation of *Hypnea musciformis* in the lagoon of Krusadai Island was developed. The species was successfully cultured using the vegetative fragments as "seed" material by the long line rope method and four-fold increase in biomass in 25 days was achieved. After an initial rapid growth, the rate declined beyond 7 days. Potentialities for the large scale cultivation of the species are discussed.

2041. **Rama Rao, K.** 1991. Seaweeds as biofertilizers in Indian Horticulture. *Seaweed Res. Utiln.*, 14(2): 99-101.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : This paper presents a review of work done in India on the use of seaweeds as biofertilizers and in particular as LSF and evaluates the work in the light of work done elsewhere in the world.

2042. **Rama Rao, K.** 1992. Observations on the Morphology of two species of *Hypnea* in Indian waters. *Seaweed Res. Utiln.*, 15(1&2): 5-10.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Genus *Hypnea* is widely distributed in tropical waters of Pacific Ocean, Indian Ocean and Atlantic Ocean. *H. musciformis and H. valentiae* occur abundantly on the western coast and southeastern coast of India. In the present paper an attempt has been made to study in detail the distribution and the morphological features of *H. musciformis* and *H. valentiae.* The most important charecterstic features for identifying *H. musciformis* and *H. valentiae* are described in great detail.

2043. **Rama Rao, K and P.C. Thomas** 1992. Effect of different hormones on the growth of excised pieces of *Gelidiella acerosa* (Forsskal) Feldmann et Hammel. *Phykos*, 30(1&2): 147-152.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Indole Acetic Acid (IAA), Indole Butyric Acid (IBA), indole-3 aldehyde (IA) and ascorbic acid (AA) were examined for their effect on the growth of vegetative fragments of *Gelidiella acerosa*. IAA, IBA and AA had different optima supporting maximum growth.

2044. **Rama Rao, K., P.V. Subba Rao, P.C. Thomas, S.H. Zaidi, K. Subbaramaiah, N. Kaliaperumal, S. Kalimuthu, K. Muniyandi, J.R. Ramalingam, N. Najmuddin and V.S.K. Chennubhotla** 1993. Seaweed resources of Tamilnadu coast, sector IV - Kilakkarai - Rameswaram Island (Dhanushkodi), *Seaweed Res. Utiln.*, 16(1&2): 103-110.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Survey of the deep water area from Keelakkarai (Appa Islnad to Rameswaram Island (Dhanushkodi) was undertaken from December 1990 to January 1991 in the IV Sector survey of Deep water Seaweed Resources off Tamil Nadu coast, which formed the last phase of the survey from Rameswaram to Kanyakumari carried out during 1986-91. An area of 417.5 sq.km was surveyed yielding a total biomass of 18,162.5 tons (wet) seaweeds. Out of 167 stations surveyed in 13 transects, vegetation occurred only in 12 stations. Of the 29 species of Marine Algae recorded 8 belonged to Chlorophyta, 8 to Phaeophyta, 12 to Rhodophyta, and 1 to cyanophyta, One species of Seagrass *Cymodocea serrulata* was also recorded. Twenty species were found in estimable quantities, of which the following 8 species were abundant. *Halimeda macroloba, Spatoglossum asperum, Zonaria crenata, Sargassum ilicifolium, Amphiroa fragilissima, Hypnea musciformis, Botryocladia leptopoda* and *Lyngbya majuscula* with a biomass of 1325, 9775, 650, 1550, 1925, 300, 862.5 and 1012.5 tons (wet) respectively. The species of *Hypnea* and *Sargassum* could be exploited for the manufacture of phytochemicals.

2045. **Rama Rao, K.V and M. Badrudeen** 1973. *Inimicus sinense* (Valenciennes) (Synanceiidae: Pisces) A new record from India and Ceylon. *J. Mar. Biol. Assoc. India*, 15(1): 417-420.

Address : Zoological Survey of India, Marine Biological Station, 10 Leith Castle South St., Madras 28, India.

Abstract : The stonefish, *I. sinense* is recorded for the 1st time off the coast of Rameswaram Island (India) and Mannar Island (Ceylon) in the Gulf of Mannar area. A description of the species is given with illustrations.

2046. **Ramasamy, P and K. Ramalingam** 1989. The occurrence, site specificity and frequency distribution of *Bicotyle vellavoli* on *Pampus chinensis* and *Pampus argenteus. Inter. J. Parasitol.*, 19(7): 761-767.

Address : Department of Zoology, University of Madras, Guindy Campur, Madras - 600 025, Tamilnadu, India.

Abstract : The occurrence of *Bicotyle vellavoli* and copepods at 10 fishing centers along the coast of South India, the site specificity of *B. vellavoli* and its frequency distribution on *Pampus chinensis* and *P. argenteus* were studied. A higher level of prevalence and abundance of *B. vellavoli* was recorded on *P. chinensis* than on *P. argenteus* indicating specific differences in host susceptibility. The parasite was significantly less abundant on *P. chinensis* taken from Madras than on fish from Mandapam, and significantly more abundant on hosts from Madras than those from Pondichery. The largest numbers of *B. vellavoli* occurred on gill I with decreasing prevalence towards gill IV. The parasite exhibited preference for attachment to the most anterior region of the gills. The differences in *B. vellavoli* numbers between gills and sectors are not due to area differences. *B. vellavoli* was overdispersed in both host species populations, and the expected distribution on the basis of the negative binomial was found to be very close to the observed distribution on 70-160 and 270-350 mm size classes of *P. chinensis*, and on 70-260 mm *P. argenteus*.

2047. **Ramasankar, R., A.G. Murugesan, G. Karpagam and N. Sukumaran** 1998. Impact of Tuticorin thermal power plant wastes on the environment of the Gulf of Mannar. *Proc. VIIth National Conf. Tamilnadu Sci. Cong.*, 1: 109-116.

2048. **Ramasubramanian, R., R. Jeyaprakash, M. Sumathi and T.N. Ramasamy** 2006. Ameliorating efficacy of *Dictyota* sp. on growth and biochemical characteristics of match industry effluent treated *Abelmoschus esculentus* (L.) Medikus (Bhendi) seedlings. *Seaweed Res. Utiln.*, 28 (1): 139-144.

Address : Department of Plant Biology and Plant Biotechnology, Ayya Nadar Janaki Ammal College (Autonomous), Sivakasi, 626124, Tamilnadu, India.

Abstract : Ameliorating efficacy of *Dictyota* sp. at different concentrations *viz*., 100, 250 and 500 mg/l in 70% concentrated match industry effluent treated *Abelmoschus esculentus* (Bhendi) was analysed. Impact of effluent treatment resulted in a steep decline in growth characteristics, pigment content and other biochemical characteristics. The extracts of *Dictyota* sp., in 70% concentration of the effluent in different concentrations brought out considerable increase in germination percentage, growth and biochemical characteristics in bhendi when compared to effluent alone treated bhendi plants. Seaweed extract used in this study was found to be efficient in nullifying the toxic effect of effluent on growth of bhendi plants.

2049. **Ramasubramanian, S.** 2003. Protection of Gulf of Mannar through eco-development approach. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 74.

Address : Gulf of Mannar Biosphere Trust, Ramanathapuram - 623 503, Tamil Nadu, India.

Abstract : Gulf of Mannar Marine Biosphere Reserve is located in the southeastern tip of Tamil Nadu extending from Rameswaram in the north to Kanyakumari in the south. It encompasses a total area of 10,500 sq. km. with the core area covering 560 sq.km, which is notified as Gulf of Mannar Marine National Park. There are 21 uninhabited islands surrounded by coral reefs in the shallow portions of the sea. The extent of the islands varies from 0.25 ha to 130 ha. This reserve is very unique and harbours a variety of marine organisms and falls within the Indo-Malayan realm, which is one of the world's richest marine biodiversity regions.

2050. **Ramesh, P., N.S. Reddy, Y. Venkateswarlu, M.V.R. Reddy and D.J. Faulkner** 1998. Rameswaralide, a novel diterpenoid from the soft coral *Sinularia dissecta*. *Tetrah. Lett*., 39(45): 8217-8220.

Address : Indian Institute of Chemical Technology, Hyderabad-500 007, India; Scripps Institution of Oceanography, University of California at San Diego, San Diego, CA 92093-0212, USA.

Abstract : Rameswaralide (4), a novel diterpene having a 5-7-6 tricyclic skeleton has been isolated along with known terpenes, africanene, 4,5-seco-african- 4,5-dione, â-elemene and isomandapamate (3) from the soft coral *Sinularia dissecta* from the Mandapam coast, South India. The structure and stereochemistry of rameswaralide (4) were determined using spectroscopic methods and confirmed by selective reduction of the unusually table enol group of 4 to form dihydrorameswaralide (5).

2051. **Ramesh, P., V. Ravikanth, V.L.N. Reddy, T.V. Goud and Y. Venkateswarlu** 2001. A novel ceramide from the Indian marine sponge *Fasciospongia cavernosa*. *J. Chem. Res.* Part S, (6): 232-234.

Address : Natural Products Laboratory, Organic Division-I, Indian Institute of Chemical Technology, Hyderabad 500 007, Andhrapradesh, India.

Abstract : A new Ceramide 1, has been isolated along with a known compound 3,6-diacetoxy-cholest-7-en-3â,5á,6â-triol (2) from a marine sponge *Fasciospongia cavernosa* collected off the Mandapam coast in the Gulf of Mannar, India. The structures of 1 and 2 were determined by spectroscopic analysis.

2052. **Ramesh, R., N. Narayanasamy and M.P. Boraian** 1997. Getting Fisherfolk off the Hook: An exploratory PRA in southern India. *PRA Notes, Int. Inst. Envir. Dev.,* 30: 54-58.

Address : PRA Unit, Gandhigram Rural Institute, Gandhigram 624-302, Tamil Nadu, India.

Abstract : A report of the outcome of a Participatory Rural Appraisal (PRA) workshop which studied the fishing livelihoods in Kanyakumari District, Tamil Nadu. PRA exercises included a trade inventory, preference ranking, key problem analysis, seasonal, case and time use analysis, semi-structured interviewing and causal diagrams. Specific problems of fisherwomen were examined, and recommendations for improving livelihoods were made.

2053. **Ramesh, R., R. Purvaja, S. Ramesh and R.A. James** 2002. Historical Pollution Trends in costal environments of India. *Environ. Monitor. Assess*., 79(2): 151-176.

Address : Institure for Ocean Management, Anna University, Chennai, Tamilnadu, India.

Abstract : Seventeen sediment cores were collected from different coastal ecosystems of Tamil Nadu, India that include coastal lagoon (Pulicat), polluted rivers in Chennai (Adyar and Cooum), Coral reef (Gulf of Mannar) and a perennial river (Tamiraparani). Radiometric dating has been used to determine the modern sedimentation rates in these ecosystems. The Pulicat Lake and the polluted rivers (Adyar and Cooum) yield an average sediment accumulation rate of 12.34 and 7.85 mm yr^{-1}, respectively. In the Gulf of Mannar coral reef, the sedimentation rate averages 17.37 mm yr^{-1}, while the rate in Tamiraparani River is 11.00 mm yr^{-1}. In the Tamiraparani River basin, the deposition rates were an order of magnitude higher when compared to the erosion rates, which may be due to bank erosion and the intense human activity. In general high rates of sedimentation observed in the coastal ecosystems not only reflect the capacity of the coastal regions as sinks for trace metals but also denote increased input of pollutants into the coastal environments in the recent past. The deposition rates of heavy metals Fe, Mn, Zn, Cu, Cr and Ni in the depth profiles have been computed using sedimentation rates and their distribution is discussed. It can be seen that the mean deposition rates of all the measured elements in the Tamil Nadu coastal ecosystems are high compared with rates determined for the sediments of the deltaic regions of India and the Bay of Bengal.

2054. **Ramkumar, R., A. Nithyanandam and J.K. Patterson Edward** 2003. Hydrography and phytoplankton diversity in artificial reef areas of Tuticorin, Southeast coast of India. *Nat. Sem. Reef Ecosystem Remediation,* 24th-26th Sep'03, SDMRI, Tuticorin, India, p. 36.

Address : Suganthi Devadason Marine Research Institute, 44 Beach Road, Tuticorin-628 001, India.

Abstract : Artificial reef modules made of ferro cement were deployed in Tuticorin coastal waters. The hydrography and phytoplankton of the AR area was assessed and compared with a control station for 8 months. The water quality of the artificial reef area differed than the control area and is very much nutrient rich supporting a variety of phytoplankton species. A total of 22 phytoplankton species were recorded from AR stations, which is dominated by *Pleurosigma* sp. The artificial reef area is supporting a variety of flora and making the environment ecologically sound than the control area.

2055. **Ramkumar, R., A. Nithyanandam and J.K. Patterson Edward** 2003. Recruitment of epibenthic communities on artificial reefs in Tuticorin coastal waters, Southeast coast of India. *Nat. Sem. Reef Ecosystem Remediation,* 24th-26th Sep'03, SDMRI, Tuticorin, India, p. 37.

Address : Suganthi Devadason Marine Research Institute, 44 Beach Road, Tuticorin-628 001, India.

Abstract : Recruitment of epibenthic organisms on artificial reefs deployed in different depths was studied for a period of one year from June 2002 to May 2003. Survey was made using underwater visual census and the samples were collected by hand picking. Algal mats were formed all over the modules and the epibenthic communities recruited includes barnacles, sponges, hydroids, molluscs, echinoderms and ascidians. The percentage occurrence of organisms varied between the AR sites and was high on the modules deployed in the deeper area and dominated by barnacles. The present investigation clearly indicates that the artificial reefs support a variety of faunal communities belonging to various ecological niches and make the area ecologically sound. The assemblage of epibenthic communities in different AR stations and their seasonal variation are discussed.

2056. **Ramkumar, R and J.K. Patterson Edward** 2004. Recruitment of epibenthic communities on artificial reefs in Tuticorin coastal waters, Southeast coast of India. *J. Mar. Biol. Assoc. India,* 46(1): 108-112.

Address : Sugandhi Devadason Marine Research Institute, Tuticorin, Tamilnadu, India.

Abstract : Recruitment of epibenthic organisms on artificial reefs deployed in different depths off Tuticorin coastal waters was studied for a period of one year from June 2002 to May 2003. Algal mats were formed all over the modules and the epibenthic communities recruited included barnacles, sponges, hydroids, molluscs, echinoderms and ascidians. The percentage occurrence of organisms varied between the AR sites and was high on the modules deployed in the deeper area with particular domination by barnacles (55 %). The studies indicate that the artificial reefs support a variety of faunal communities belonging to various ecological niches and make the area ecologically sound. The assemblage of epibenthic communities in different AR stations and their seasonal variations are discussed.

2057. **Ramkumar, R., S. Senthil Kumar and J.K. Patterson Edward** 2005. Antibacterial activity of the epidermal layer of coral associated fishes of Tuticorin coast. *Indian J. Fish.*, 52(1): 119-124.

Address : Sugandhi Devadason Marine Research Institute, Tuticorin, Tamilnadu, India.

Abstract : The methanolic extracts of epidermal layer of 10 species of coral fishes were screened against ten human pathogens using standard disc diffusion method. The extracts of epidermal layar of fish exhibited higher antibacterial activity than other species. The ethyl acetate phase of the partitioned crude extract showed broad spectral activity indicating the non-polar nature of the active substance. The highest inhibition was observed against *Streptococcus pyogenis.* The extract showed promising activity against *Escherichia coli, Streptococcus pyogenes, Bacillus subtilis, Staphylococcus aureus, Proteus mirabilis* and *Vibrio cholerae.* The crude extracts which exhibited potential activity were partially purified by column chromatography and again tested for antibacterial activity. The purified extract inhibited all the 10 pathogens assayed at 30 mg concentration.

2058. **Rangarajan, K and S. Mahadevan** 1961. On a New Species of *Northria* (Polychaeta, Annelida) from the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 3(1&2): 179-185.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A small Polychaetous Annelid inhabiting a peculiar, flattened tube made of lamellibranch shell fragments dredged from the Gulf of Mannar opposite Pudumadam has been referred to the Family Onuphidae, Genus Northria and described as a new species, *N. mannarensis.* A round head bearing five occipital tentacles, posterior lateral being long, a pair of club-shaped frontal tentacle and a pair of thick palpi on the ventral side, two pairs of eyes, a pair of tentacular cirri on an achaetous -segment, an achaetous anal segment with a pair of anal cirri, origin of gill as a short filament on the 8th setiger, first two setigers larger and pointing forwards, ventral cirrus becoming a pad-like structure on the 4th setiger, disappearance of the cirriform process of the posterior lip of

parapodia on the 15th setiger, gill and dorsal cirrus of same length in 10th setiger, presence of compound, bidentate, hooded setae and simple, bidentate, hooded setae in first two setigers, bilimbate, capillary setae from the 5th setiger, two bidentate hooded subacicular hooks in the posterior segments and the presence of compound, bidentate, hooded setae in the last four setigers are the distinguishing features of this species. The specific characters of the present form are compared with those of the hitherto known species under the genus.

2059. **Rangarajan, K and C. Sankarankutty** 1961. A note on an abnormal *Leonnates jousseaumei*. (Family: Nereidae-polychaeta). *J. Mar. Biol. Assoc. India*, 3(1&2): 265-267.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The power of regeneration of lost or damaged parts is very well known. In most of the Nereidiform polychaetes new segments replace the lost segments and they can be generally recognised by being smaller than the rest at first. Moreover, not only can new segments arise at the hind end, but also a new head can be formed at the anterior end. These regenerated heads are smaller at first than the rest of the body, but soon grow to a normal size. This extensive power of regeneration generally remains latent till injury provides the stimulus and is of extreme value to the polychaetes.

2060. **Rangarajan, K.** 1968. A New Species of *Callogobius* (Family Gobiidae: Pisces) from Gulf of Mannar, India. *J. Mar. Biol. Assoc. India*, 10(2): 347-353.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The genus Callogobius enjoys a wide distribution in the Indo-Pacific region. Koumans (1953) has recorded the following five species from the Indo-Australian Archipelago: *Callogobius centrolepics* M. Weber; *Callogobius hasseltit* (Bleeker); *Callogobius liolepis* (Bleeker) Koumans; *Callogobius sclateri* Steilldachner and *Callogobius snelliusi* Koumans. Out of these only *Callogobius hasseltit* (Bleeker) was known to occur in Indian waters (Munro, 1955), the rest being confined to the Pacific Ocean. Since then another species, *Callogobius seshaiyai* Jacob and Rangarajan has been recorded from India (Jacob and Rangarajan, 1959, 1960). On 24-12-1961 three specimens of fish ranging in total length from 23.0 to 41.5 mm were collected from Vedalai, Gulf of Mannar, South India (Lat. 9° l6'N., Long. 79° 08' E.) from a depth of about one metre. The presence of transverse as well as longitudinal papillated ridges on the head clearly assigns these specimens to the genus *Callogobius*. A critical study reveals that although these specimens resemble closely *C. liolepis* than the other species of *Callogobius*, yet differ markedly from it in many important meristic and morphometric characters and as such are designated here as *Callogobius mannarensis* sp. nov.

2061. **Ranga Rao, S and M.N. Kutty** 1968. Resistance to desiccation and oxygen debt in wedge clams. *Proc. Symp. Mollusca, MBAI,* 2: 595-606.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The wedge clams, *Donax cuneatus* Linnaeus and *Donax faba* Gmelin acclimated to about 30°C and exposed to air, indicated that at room temperature (average 30° C) *Donax faba* have a longer survival time (94 hours) than *D. cuneatus* (69 hours) as suggested by their 50% survival time. Survival of *D. cuneatus* exposed to air was studied at two lower temperatures (17 and 12 ° C) as well. While the survival of *D. cuneatus* at 17° C does not appear to be markedly different from that at room temperature, at 12° C the 50<70 survival time of *D. cuneatus* was considerably reduced (29 hours). The amount of mantle cavity fluid in both *D. cuneatus* and *D. faba* exposed to air declined gradually with increase in the duration of exposure. The relative amount of the mantle cavity fluid was considerably higher in *D. faba* than in *D. cuneatus*. Oxygen debt estimated from measurements of oxygen consumption of animals exposed to air up to 48 hours, indicated that in *D. cuneatus* and *D. faba* the post-exposure oxygen consumption increased 33 and 1.7 times their pre-exposure levels respectively. It is possible that *D. faba* has better anaerobic abilities with more capacity to withstand desiccation, which may explain the longer survival time of *D. faba* than that of *D. cuneatus* when exposed to air under the conditions described.

2062. **Rangaswami, G.** 1973. Need for expansion of fisheries education and Research in Tamil Nadu. *Seafood Export J.*, 5(1): 49-54.

Address : Tamil Nadu Agricultural University, Coimbatore, Tamilnadu, India.

Abstract : The need for increasing fish production in India is being increasingly realized at all levels. Nearly two-thirds of our population eat protein deficient food, the deficiency ranging up to 50% in protein quantity and quality in most cases. There are several limitations in improving the quantity and quality of the protein contained

in the food grains we eat and hence it will be almost impossible to wipe out the deficiency through eating more quantities of food grains. There are limitations for substantially adding to the quantity of animal protein consumed by an average man in India.

2063. **Rani, G and S. Bharathan** 2001. Occurrence of *Cladophora albida* (Nees) Kuetzing from southern coastal waters of India. *Seaweed Res. Utiln.,* 23(1&2): 1-4.

Address : S.D.N.B. Vaishnav College for Women, Chennai - 600 044, Tamilnadu, India.

Abstract : The occurrence and morphology of *Cladophora albida* (Nees) Kuetzing collected from Kulasekarapattinam are given in this paper. This is a new record to the green algal flora of Indian shores.

2064. **Rani, P and S.M. Sathakkathullah** 1992. Holding and spawning of the Edible Oyster, *Crassostrea madrasensis* during off season. *Mar. Fish. Infor. Serv. T & E Ser.*, 118: 13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The spawning of *Crassostrea madrasensis* brood stock by thermal stimulation was discussed.

2065. **Rani, P and M.E. Rajapandian** 1998. On the Microalgal species as feed for conditioning adult Oyster *Crassostrea madrasensis* (Preston). *J. Mar. Biol. Assoc. India,* 39: 159-162.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The rate of removal of different microalgal cells in suspension at specific time interval in respect of six species differing in sizes such as *Tetraselmis* sp., *Cheatoceros* sp., *Chiarella* sp., *Dicrateria* sp., *Isochrysis* sp., *Chromulina* sp., *Crassostrea madrasensis* has been studied. The study revealed that oysters exhibit a significant degree of selectivity in the rate of filtration of certain algae. Further it is recorded that the filtration rate is not uniform throughout the experimental period of 24 hours. Oysters showed periods of high filtering activity and periods of relative quiescence. This study helps in developing proper feeding protocol for oyster broods based on the species of algae, quantification of cells and timings.

2066. **Rao, D.M and K. Satyanarayana Rao** 1986. *Nemipterus peronii* (Valenciennes 1830) (Pisces: Nemipteridae - a new record from Indian waters. *J. Bombay Nat. Hist. Soc.,* 83(1): 236-241.

Address : Department of Zoology, Andhra University, Waltair - 530 003, Andhrapradesh, India.

Abstract : Twenty specimens of *Nemipterus peronii* were collected from the hand line catches obtained from the northern fishing grounds off Tuticorin (8° 48'N 78° 11'E) on 22-1-1980.

2067. **Rao, K.R.** 1972. Zebra fishes (Ptervoicinal : Scorpacnidac) valued as Aquarium fishes. *Seafood Export J*. 4(1): 25-30.

2068. **Rao, M.R, K.V. Sridevi, U. Venkatesham, T.P. Rao, S.S. Lee and Y. Venkateswarlu** 2000. Four new sesquiterpenoids from the Soft Coral *Nephthea chabrollii*. *J. Chem. Res.,* 2000 : 245-247.

Address : Natural Products Laboratory, Organic Chemistry Division-I, Indian Inst. of Chemical Technology, Hyderabad 500 007, India; School of Pharmacy, National Taiwan University, Taipei-100, Taiwan.

Abstract : Chemical examination of the soft coral *Nephthea chabrolii* collected from the Mandapam coast in the Gulf of Mannar, afforded nine sesquiterpenoids of which four (1-4) are new. The structures of the new compounds (1-4) have been established by the interpretation of spectral data (UV, IR, ^{1}H NMR, ^{13}C NMR, ^{1}H-^{1}H COSY, NOESY and mass) and chemical methods.

2069. **Rao, P.J., V. David and T. Shanmugaraj** 1998. Community based marine resources management in the Gulf of Mannar Biosphere Reserve, *Bay of Bengal Programme*, 10: 25-28.

2070. **Rao, P.P.S.** 1991. Biological investigation of Indian marine algae 4. Screening of some Green, Red and Brown seaweeds for their antimicrobial activity. *Seaweed Res. Utiln.,* 14(1): 37-43.

Address : Central Salt and Marine Chemical Research Institute, Bhavnagar - 364 002, Gujarat, India.

Abstract : Five different solvents viz., diethyl ether, methanol, acetone, chloroform and ethanol were used to obtain crude extracts from nine dry seaweed samples belonging to green, red and brown algae. These crude extracts were screened against ten gram-positive and gram-negative bacteria to test from their antibacterial

activity, as well as the efficacy of the solvents. Most of the seaweed samples possess antibacterial activity against both gram-positive and gram-negative bacteria tested. The diethyl ether extract exhibited greater antibacterial activity as compared with the rest.

2071. **Rao, P.S., K. Rama Rao and K. Subbaramaiah** 1977. Screening of certain red seaweeds for phycocolloids. *Seaweed Res. Utiln.*, 2(2): 82-86.

2072. **Rao, P.S., Y.B.K. Chowdary and K. Subbaramaiah** 1991. Karyology of *Gelidiella acerosa* (Forsskal) Feldmann *et* Hamel. *Cytologia.* 56(2): 187-189.

Address : Central Salt and Marine Chemicals Research Institute, Mandapam-623 518, Tamilnadu, India.

Abstract : *Gelidiella acerosa* (Gelidiales, Rhodophyta) is the principal agarophyte in India. *Gelidiella* is represented by five species in India. *Gelidiella acerosa* is commonly found in the intertidal region both on the east and west coasts. It is being harvested throughout the year from southeastern shores of India. Rao reported chromosome number in this species collected from Veraval coast (west coast). In the present study the karyological observations in this species from Erwadi are presented.

2073. **Ratcliffe, C., A. Andreason and H. Copper** 1977. Assessment of problems and needs in marine small-scale fisheries. *RAS/74/031-Working paper No.15*. pp. 15.

Address : Swedish funds-in-Trust, FAO of the US/UNDP, Rome.

2074. **Rathinavel, S., S.A. Fathima, V. Ashok and N. Vijayanand.** 2005. Biofertilising efficiency of seaweed liquid extract of *Caulerpa scalpelliformis* on cluster bean. *Nat. Symp. Marine Plants, their chemistry and utilization.* Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, 23-25 June 2005. p 35.

Address : Centre for Research in Botany, Saraswathi Narayanan College, Madurai- 625022, Tamilnadu, India.

Abstract : The biopotential of preferential form of solvent extract and suitable concentration of seaweed liquid extract of *Caulerpa scalpelliformis* enhancing the growth and physiology of cluster bean plants were evaluated. Among the different forms of seaweed liquid extract, the cold and boiled liquid extracts increased seed germination and seedling growth upto 1% and 5% concentrations respectively against their controls. The alcoholic extract was found to be unsuitable, as it had no significant influence on seed germination and seedling growth. The foliar application of cold seaweed liquid extract at different concentrations *viz*., 0.1%, 0.5%, 1%, 2%, 5% and 10% in cluster bean plants exhibited differential responses in growth and physiological characteristics. The growth parameters like length of shoot and root, plant height, leaf area, fresh and dry weights were increased in most of the concentrations of cold seaweed liquid extract but found maximum at 1% against control Similarly biochemical characteristics viz. photosynthetic pigments, carbohydrates, ascorbic acid, amino acid, carotenoids, phenol and protein were increased at lower concentrations of cold seaweed liquid extract. Further, cold seaweed liquid extract exhibited increase in the activity of nitrate reductase and phenylalanine ammonialyase but there was decrease in the activity of protease. Our results highlight the beneficial application of cold seaweed liquid extract as certain biochemical parameters in crop plants render strength and defense mechanism to the various biotic and abiotic stress, besides enhancing the growth and productivity.

2075. **Rathnakumar, K., S.A. Shanmugam, T.J. Abraham, and P. Jeyachandram** 1995. Studies on the preparation of Shrimp pickles in different style and their acceptability. *FAO Fish Report*, 514: 179-186.

Address : Fisheries College and Research Institute, Tuticorin - 682 008, Tamilnadu, India.

Abstract : Four different styles of shrimp pickle, namely Canadian style, Southeastern style, Asian style and Regular hot style, were prepared from fresh shrimp (*Penaeus semisulcatus*) and assessed for acceptability. Details are given of the methods of preparation used. All the pickles with pH less than 4.5 had low levels of viable bacteria and kept well for 9 months without any adverse changes in palatability.

2076. **Rau, T.K.** 2006. Incidence of diamonds in the beach sands of the Kanyakumari coast, Tamil Nadu. *J. Geol. Soc. India*, 67(1): 11-16.

Address : Geological Survey of India, Hyderabad - 560 068, Andhrapradesh, India.

Abstract : Micro and macro diamonds were recovered and studied from the heavy mineral concentrates of beach samples from the southern tip of India. Ranging in size from 0.30 mm x 0.30 mm to 1.50 mm x 2.05 mm,

the diamonds are the modified forms of octahedron, dodecahedron and cube and their combinations. Bigger sizes are represented by the broken/cleaved fragments. The diamonds exhibit varied tints of which white, pink and yellow are prominent. This is the second report of diamonds from the beach sands of India and the first of its kind from the Kanyakumari coast with charnockite and khondalite suites of rocks exposed in the hinterland, which shows an important structural grain in the form of the WNW-ESE trending Achankovil shear zone passing close to the present occurrence. The possible ultra-high pressure metamorphic and shock origins of these diamonds in SGT are discussed.

2077. **Ravikumar, S and K. Kathiresan** 1995. Influence of tannin, amino acids and sugars on fungi of Marine halophytes.

2078. **Ravikumar, S and M. Babuselvam** 2005. Current trends in marine microbial technology. *Research Papers Published in Proc. Nat. Symp. Recent Trends in Microbial Biotechnology*, December 29-30, 2005. Sri Sankara Arts & Science College, Kanchipuram, (ed). R. Balagurunathan.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Marine environment with rich biodiversity harbors potential microorganisms that could be harnessed for the production of antibiotics, growh hormnes, food additives, industrial enzymes, vitamins and fine chemicals. After 40 years of intensive research, chemistry of marine natural products has become a mature field. Since 1995, there are signals of decreased interest in the search of new metabolites from traditional sources such as macro algae and octocorals. On the contrary, metabolites from microorganism are a rapidly growing field, due at least in part, to the suspicion that a number of metabolites obtained from algae and associated microorganisms may produce invertebrates. Recently, molecular methods have successfully been applied to study the microbial diversity in marine sponge and to gain evidence for an involvement of bacteria in the biosynthesis of the bryostatins in the bryozoan *Bugula nertina*.

2079. **Ravikumar, S and S. Lazarus** 2000. Pollution threats to marine biodiversity. *Proc. Sem. on Marine Biodiversity*, (eds.) S. Lazarus, and S.G. Prakash Vincent, *ICAS Publication No.* 3.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : In late 1990, eleven eminent marine biologists met at the Smithsonian Institution in Washington D.C. (U.S.A) to examine the basic dimensions of the marine biological diversity issue. Their most startling conclusion was that the entire marine realm, from estuaries and coastal waters to the open ocean and the deep sea is at risk. While this risk is most obvious in estuaries and coastal waters, where human activities are most intense, no place in the ocean is too remote that it has not been touched by human activities. The vast expanses of Open Ocean are driven by the photosynthesis of microscopic phytoplankton whose rapid life cycles make them vulnerable to even temporary changes that affect large areas of sea surface. The deep sea is also at risk in part for the other reasons. In the cold, lightless abyssal realm that predominates even in the tropics, life processes for many species appear to be very slow and life spans are long. For example it has been estimated that the abyssal clam *Tinodaria callistiformis* takes 100 years to reach the length of 8.4mm. Slow growth rate and the sluggish reproduction that accompanies this make it difficult for deep-sea ecosystem to recover even after stresses have been removed. Depletion of metal ores and accumulation of wastes by deep sea mining for manganese nodules and ocean dumping of toxic sewage sludge or radio active wastes have the potential to harm vast areas of the biologically diverse deep sea realm. Nearshore or offshore, the way in which people threaten biological diversity can be grouped into classes of proximate or direct threat. Human activities damage life in the sea in ways that can be grouped into five broad classes: overexploitation, physical, alteration, marine pollution, introduction of alien species and global atmospheric changes. In this article, the effect of pollution on marine diversity is dealt with in detail.

2080. **Ravikumar, S., A.N. Shiefa and S. Nazar** 2000. Novel extremophilic cyanobacteria from solar saltpan of Kanyakumari district. *Seshaiyana*, 8(2): 12-13.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam-629 502, Kanyakumari, Tamilnadu, India.

Abstract : Interest in the microalgae has been greatly developed in the last few years. They have been assessed as a potential source of several biological metabolites. Successful culture of marine algae (diatoms) was achieved

by Miquel during 1980-93. Few marine cyanobacterial genera have been defined and characterized with respect to their salt tolerance and no general concept has been presented to explain the mechanism of salt tolerance in marine cyanobacteria. The cyanobacterial cell must have proliferated under low water potential and ionic stress of the marine environment. The salt tolerant cyanobacteria include both nitrogen fixing as well as non-nitrogen fixing forms, although the ability to resist salt stress seems to be more common in the unicellular diazotropic cyanobacteria. The various mechanisms which operate during salt stress is to achieve available cellular energy for other essential activities (Apte, 1987). Marine cyanobacteria are known to produce a number of storage compounds. The integration of physiological, biochemical and molecular genetic approaches is beginning to provide better insight into the process of cyanobacterial osmoregulation, N_2 fixation and pigment production and their interaction during salt stress.

2081. **Ravikumar, S., V. Masilamani, R. Krishnamoorthy, M.K. Palaniappan and P. Sahul Hameed** 2001. A comparative study on the distribution of Polonium-210 in the ecosytem of Athangarai estuary (Palk Strait) and Punnaikayal estuary (Gulf of Mannar). *Proc. Nat. Sem. Atom Energ. Ecol. Environ. February 2001*. pp.135-142.

Address : Environmental Research Laboratory, Jamal Mohamed College, Trichy - 620 020, Tamilnadu, India.

Abstract : This paper presents the distribution of Po-210 in the ecosystem of two estuaries namely Athangarai estuary (Palk strait) of River Vaigai and Punnaikayal estuary (Gulf of Mannar) of River Tamiraparani. Measurements were made on the Po-210 levels of water, sediment and selected biota collected from the two different estuaries. Analyses of the results indicate that Punnaikayal estuary tends to accumulate Po-210 in the environmental matrices tested at relatively higher level as compared to Athangarai estuary. In water, dissolved concentration of Po-210 ranged from 1.2 mBq/l. (Athangarai estuary) to 1.8 mBq/l (Punnaikayal estuary). Polonium-210 concentration in sediment was also significantly higher in Punnaikayal estuary (8.9 Bq/Kg) than in Athangarai estuary (6.3 Bq/Kg). The Po-210 activity in the biota fell within the range of 5.6 to 1,334.1 Bq/Kg. The bivalve mollusc *Meretrix casta* was identified to concentrate higher level of Po-210 in their soft tissues, suggesting that it could be used as a sentinel organism for Po-210 in an estuarine system. The significance of the results is discussed.

2082. **Ravikumar, S., G. Ramanathan, N.Suba, and I . Jeyaseeli** 2002. Quantification of Halophilic *Azospirillum* from mangroves. *Indian J. Mar. Sci.*, 31(2): 157-160.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Bacterial density of *Azospirillum* was found high in the roots of *Avicennia marina* (148.88 X 10^4 g^{-1} dry weight) and rhizosphere sediment of *Suaeda monoica* (20.0 X 10^3 g^{-1} dry weight). The growth, production of Indole Acetic Acid (IAA) and the rate of nitrogen fixation in *Azospirillum brsilense* were found to be maximum. At 3% of NaCl, it showed better growth and production of IAA, however the rate of nitrogen fixation was slowed down at 1% NaCl and was completely arrested at 1.5%. The percentage of germination in coastal crop plants increased by 70% in black gram and 45% in rice with the inoculation of *Azospirillum brasilense* compared with control. The saline tolerant *Azospirillum* is recommended as biofertilizer for improving crop yield in coastal agricultural fields.

2083. **Ravikumar, S., L. Anburajan, G. Ramanathan and N. Kaliyaperumal** 2002 Screening of seaweed extracts against antibiotic resistant post-operative infectious pathogens. *Seaweed Res. Utiln.*, 24(1):95-99.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Fifty-five seaweed extracts belonging to 11 species of seaweeds were tested against post operative infectious drug resistant bacteria *viz., E.coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus pyogens*, and *Staphylococcus aureus*. Among the seaweed extracts, the acetone extracts of *Caulerpa cupresoides* shows maximum inhibitory activity against *E.coli* and propanal extracts of *Gracilaria edulis* shows maximum inhibitory effect against *K. pneumoniae*. Acetone extracts of *Padina tetrstromatica* and *Laurencia cruciata* show maximum inhibitory activity against *P. aeruginosa*, butanol extract of *Hypnea musciforms, Caulerpa cupressoides* and *Chaetomorpha linoides* show maximum inhibitory effect against *S. aureus*.

2084. **Ravikumar, S., S. Shanthy, S. Thadedus Maria Ignatiammal and S. Nazar** 2003. Mangrove and associated plants in Manakudi artificial mangrove ecosystem (Southwest coast of India). *Seshaiyana*, 11(2): 9-10.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India; E-mail: ravibiotech201320@yahoo.com

Abstract : The coastline of Kanyakumari is nearly 68 kms long. The perennial rivers empty along the coastal

line. The river Pazhayar is one of the most important surface water resources of Kanyakumari District. At its confluence with the Arabian Sea near Manakudi village it forms the Manakudi estuary. In the upper reaches of the estuary there are small Islands. One of the Islands has artificially regenerated mangroves. Besides the mangrove plants some associated plant species are also found beyond the mangrove environment. These associated plants have interactions in terms of enhancing nutrient availability and protecting the mangrove plants from natural disaster. Hence, the present study was done to find out the mangrove and associated plant species in Manakudi mangrove ecosystem.

2085. **Ravikumar, S.** 2005. Challenges and Strategies for globalizing marine halophilic herbal medicines. *Proc. Nat. Sem. Bioprospecting and Bioresources*, December 8-9, 2005. St. Xavier's College, Palayamkottai, (ed.) N.Nagarajan.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : The demand for new drugs to treat diseases we previously considered easily curable is steadily increasing. This is particularly true of infectious illness as pathogenic; microorganisms continue to develop mechanisms of resistance to our current drug supply. In addition, in recent years, AIDS has sown havoc in southern Africa and other parts of the world. The methods by which we search for drugs have changed greatly for the last few decades with the progress in genomics, combinatorial chemistry and the knowledge of how bacteria develop drug resistance. Despite these changes, natural products continue to play a major role in drug discovery, as the diversity of the compounds they harbour and their role in the living environment continue to invite scientists to embark on new chemical discoveries. The success of marine drug discovery has relied upon the enormous diversity of plants and animals found mainly in shallow waters throughout the tropical oceans. It is reported that there are 35 sps of mangrove plants belonging to 16 genera, 624 species of seaweeds belonging to 215 genera , 14 species of seagrasses belonging to 6 genera and 458 species of mangrove associates belonging to 39 genera contributes to the marine halophytic potential. Marine halophytic species diversity is high and drug discovery can capitalize on the vast number of species represented. The collection of marine halophytes and their drug evaluation continues today with good success. When we consider our own rich marine biodiversity, its pharmaceutical potential is infinite and will remain undiscovered unless research into drug development establishes the medicinal value of the advantage of having a seaweed industry consisting of two kelps, three *Gelidium* species and a *Gracillarial Gracilariopsis* species. Literally hundreds of bioactive metabolites have subsequently been discovered. Major programs now exist in the USA and Japan and there are significant research programs worldwide. But, dearth of information is available on the drugs from marine halophytes. Since the early investigations of the 1970s, significant advances have been made in marine drug discovery. Academic researchers began to collaborate with pharmacologists and in the 1980s; the potential of the oceans became clear, with many unique bioactive substances being extracted from marine plants. Most of the compounds initially discovered were not effective in treating diseases, but some were found to posses important biochemical properties that have influenced our understanding of human diseases. However, there is no question that these resources are limited and that collectable marine organisms are likely to be almost completely explored within the next 20 years. Where will scientist's turn to ensure a continuing flow of new drugs? The answer to this question is complex, as drugs can now be developed by many methods including computer aided drug design and combinatorial synthesis. The drug discovery activities within the pharmaceutical industry still focuses intensely on the terrestrial environment. This is not surprising, given that lines of communication between medical and marine researchers have never been firmly established. Marine environments are unfamiliar to most pharmaceutical companies and so they have been hesitant to initiate independent programs. This is slowly changing, as exciting molecules are isolated from marine organisms. Hence, active participation of industries in developing drugs from marine halophytes is the need of the hour. The challenges and strategies for developing marine herbal drugs of Indian origin will be discussed in detail at the time of conference.

2086. **Ravikumar, S., T. Diana Victoria, M. Babuselvam and S. Sangeetha** 2005. Standardization of marine herbal formulation from *Acanthus illicifolius* for possible commercial utility. *Proc. Nat. Sem. Bioprospecting and Bioresources*, December, 8-9, 2005. St. Xavier's College, Palayamkottai, (ed). N. Nagarajan.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Tamilnadu, India.

Abstract : Mangroves are woody plants found as interface between land and the sea. Mangroves provide food and a wide variety of traditional products and artifacts for mangrove dwellers. Numerous mangrove plants are being used in folklore medicine, and recently, extracts from mangroves and mangrove dependent species have proven activity against human, animal and plant pathogens; however, the toxicological studies on the effect of

medicinal plant preparation have not been standardized scientifically. The present study has been undertaken to standardize the marine herbal formulation from *Acanthus illicifolius* for commercial application. The results of the study revels that, no mortality was observed at a dose as high as 3,500 $mg.kg^{-1}$. The body weight and food consumption value were found to be increased with the increasing duration of the experiment and found significant when compared with the control. The behavioral response of the test animal indicates that, the sedation and hyperactivity was found more than the control but the hematological and histopathological properties are found normal in treated animals.

2087. **Ravikumar, S., S. Nazar, A. Nural shiefa and S. Abideen** 2005. Antibacterial activity of traditional therapeutic coastal medicinal plants against some pathogens. *J. Environ. Biol.*, 26(2): 383-386.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Antibacterial activity of 10 traditional coastal medicinal plant species from southwest coast of India were tested against 12 human bacterial pathogens and two cattle pathogens. Among the plant species tested, a butanolic extract of *Bacopa monnieri* showed maximum inhibitory activity against the human pathogen *Escherichia coli*, whereas the butanolic extract of *Aristolichia indica*. L showed maximum inhibitory activity against the cattle pathogen *Listeria monocytogen*. The mean zone of inhibition indcates that the growth of *Salmonella enteritidis* and *Pseudononas aeruginosa* were highly inhibited by the coastal medicinal plant extract then the other bacterial species and also the antibacterial activity was found higher in the butanolic extract than water extract.

2088. **Ravikumar, S., A. Shanmugaraja, R. Raghupathy Raja Kannan and B. Muniyandi** 2005. Impact of pesticide toxicity on halotolerant solar saltern cyanobacterium *Phormidium tenue* (Menegheni) Goment. *Proc. Marine Resources*, Department of Botany, S.T.Hindu College, Nagercoil, p40-49 (ed.) M. Sukumaran.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanyakumari, Tamilnadu, India.

Abstract : Filamentous, non-heterocystous cyanobacteria, *Phormidium tenuae* was isolated from Tamaraikulam solar saltpan of Kanyakumari District. They were allowed to grow in different concentration of various pesticides under different salinity levels in laboratory conditions. The growth and macro molecular content of the two cyanobacterial species were studied and differential protective mechanisms by the *Phormidium tenue* against pesticidal toxicity have been discussed to be used further for the bio removal of pesticide in solar salt pan to obtain good quality of salt.

2089. **Ravikumar, S., A. Shanmugaraja, R. Raghupathy Raja Kannan, M. Mathevan Pillai and B. Muniyandi** 2005. Heavy metal removal in saltpan by halotolerant cyanobacteria *Phormidium tenue* (Menegheni) Goment. *Proc. Marine Resources*, Department of Botany, S.T.Hindu College, Nagercoil, p36-38. (ed.) M. Sukumaran.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam 629 502, Kanynakumari, Tamilnadu, India.

Abstract : Extreme halotolerant solar saltern cyanobacterium was isolated and identified as *Phormidium tenue* and allowed to grow under different concentration of heavy metals (Zinc and Cadmium) at various salinity levels. Compared with zinc, cadmium enhanced the biomass production at higher concentrations., whereas the increased content of protein and pigments were noticed in lower concentration of heavy metals. The stimulatory effect among growth parameters reveals that, 100ppm concentration of zinc could be eliminated at 40 ppt salinity and upto 1ppm level of cadmium could be removed at 80 ppt of water salinity.

2090. **Ray, I and K.V. Venkatesh** 1975. Fluorescent tracer studies in Tuticorin area, Gulf of Mannar. *Indian J. Mar. Sci.*, 4(1): 93-95.

Address : Geological Survey of India, Offshore Mineral Exploration, Marine Geological Division, Calcutta, 700016, West Bengal, India.

Abstract : Fluorescent tracer tests were carried out in the Tuticorin Harbour area to study the direction of sediment transport. Both offshore and beach experiments carried out during Jan 1972 indicated a southerly movement of tracer sand, particularly towards SSW-SW-WSW, possibly caused by wind and current prevailing during the period of experiments.

2091. **Ray, S.B., G. Rajagopalan and B.L.K. Somayajulu** 1990. Radiometric studies of sediment cores from Gulf of Mannar. *Indian J. Mar. Sci.*, 19(1): 9-12.

Address : Geological Survey of India, Bhubaneswar - 751 012, Orissa, India.

Abstract : Gulf of Mannar (India) sediments contain 19.2 to 61.4% $CaCO_3$, 1.9 to 5.2% organic matter, 7.2 to 18.8 ppm U and 3.0 to 16.7 ppm ^{232}Th, the last two on a calcium carbonate free basis. $^{234}U/^{238}U$ activity ratio ranges from 1.09 to 1.19 (mean 1.14 ± 0.02), indicating the authigenic nature of U in the sediments. High U concentrations prevail throughout the cores (length 150 cm) analysed in this study. The ^{14}C based deposition rates are 60.1 and 114 cm/10^3 yr for the shallow (water depth 1000 m) cores whereas they range from 2.2 to 11.4 cm/10^3 yr for the cores from the deeper (water depth 2000 m) regions. The authigenic deposition rates of U in the cores from shallow water regions are 130 and 314 micrograms/cm^2/10^3 yr during the past 3000 yr which compare well with such rates derived from anoxic coastal regions of the Atlantic and Pacific oceans.

2092. **Ray, S.M and K. Satyanarayana Rao** 1984. Manual on marine toxins in bivalve molluscs and general consideration of shellfish sanitation. Workshop on marine toxins in bivalve molluscs and general consideration of shellfish sanitation, Tuticorin (India), 3 May 1984. *CMFRI Spec. Publ.*, 16: 100.

Address : Moody College of Marine Technology, Texas A&M University, Galveston, Texas, USA.

Abstract : The manual discusses shellfish culture and shellfish poisoning under the following headings: 1) symptoms and treatment of shellfish poisoning; 2) public health and economic significance of shellfish quality; 3) geographic and seasonal distribution of shellfish poisoning; 4) transvectors of shellfish poisons; 5) source and nature of shellfish poisons; 6) prevention and control of shellfish poisons; 7) miscellaneous shellfish poisonings; and 8) general considerations of shellfish sanitation: techniques for monitoring quality and purification of shellfish.

2093. **Razouls, C.** 1984. Biomass of mesozooplankton in the Indian Ocean during the cruise SAFARI-2 (MD 27). Marine biology. Results from oceanographical cruises of the M.S. Marion Dufresne and from littoral investigations of the Japonaise. Biologie marine. Resultants de campagnes oceanographiques de M.S. Marion Dufresne et de prospections littorals de la vedette japonaise. *Comite National Francais des Recherches Antarctiques, Paris, France No.* 55 : 69-74.

Address : Lab. Arago, 66650 Banyuls sur Mer, France.

Abstract : 68 vertical hauls of mesozooplankton have been sampled (WP2 net with 0.200 mm of mesh aperture) in the Indian Ocean (latitude: 10° N 15° S; longitude: 80° 90° E) from depths 50 m, 100 m, 200 m and 600 m to the surface. The biomass heterogeneity for the whole of the stations and depths is rather weak (cv = 32-47%) considering the extent of the collecting area and the duration (24 days). Only the Gulf of Mannar - transect 1 - seems richer (2,500 mg multiplied by m^2) for all the vertical layers between 200 m and the surface, while the mean biomass of the two other transects are 618 mg multiplied by m^2 (50 m to the surface) and 1,500 mg multiplied by m^2 (600 m to the surface). The biomass concentration decreases with the depth, from 12.4 mg multiplied by m^3 to 1.20 mg multiplied by m^3 for the layers 50-0 m and 600-200 m, respectively. It fits well with the equation of a hyperbolic tangent. The caloric content of the biomasses (with ashes) is ranging from 4.07 cal multiplied by mg for the transect 1 to 3.28 cal multiplied by mg for the other stations.

2094. **Reddiah, K.** 1967. *Scambicornus brachysetosus* spp., (Copepoda *Lichomolgidae*) from a holothurian in the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 9(1): 126-131.

Address : Zoological Survey of India, Southern Regional Station, Madras-4, India.

Abstract : *Scambicornus brachysetosus* n.sp., collected from a holothurian, *Holothuria atra* Jager in the Gulf of Mannar is described and compared with the other species of the genus.

2095. **Reddiah, K.** 1970. The Appa Island and its fringing reef in the Gulf of Mannar. *J. Mar. Biol. Assoc. India.* 12:57-63.

Address : Zoological Survey of India, Madras-4, India.

Abstract : The topographic features of Appa Island, one of the chain of twenty islands in the Gulf of Mannar, hitherto very little known, are described. The northern part of the island is sandy while a good portion of its southern half is rocky, with a wellformed fringing reef. Studies on the formation of rocks reveal that the Island's elevation is the highest among the neighbourhood Islands in the gulf. The most common fauna of the reef flat with vigorous growth of reef building corals and their associated organisms have been outlined.

2096. **Reddy, N.S., T.V. Goud and Y. Venkateswarlu** 2002. Seco-sethukarailin, a novel diterpenoid from the soft coral *Sinularia dissecta*. *J. Nat. Prod.*, 65(7): 1059-1060.

Address : Natural Products Laboratory, Organic Division-I, Indian Institute of Chemical Technology, Hyderabad, 500 007, Andhrapradesh, India.

Abstract : Seco-sethukarailin (1), a novel diterpenoid, has been isolated along with known sesquiterpenes Delta$^{9(15)}$ africanene, beta -elemene, african-1-ene, 6R,7R-6,7-epoxycaryophyll-3(15)-ene, and known diterpenoids sethukarailin and isomandapamate, from the soft coral *Sinularia dissecta* collected from Mandapam Coast, South India. The structure of the novel diterpenoid seco-sethukarailin (1) was characterized by interpretation of spectral data.

2097. **Reeta Jayasankar, J.R. Ramalingam and N. Kaliaperumal** 1990. Biochemical composition of some green algae from Mandapam coast. *Seaweed Res. Utiln.,* 12(1&2): 37-40.

2098. **Reeta Jayasankar** 1992. On the successful culture of *Gracilaria edulis* from spores. *Mar. Fish. Infor. Serv. T & E. Ser.,* 117: 15-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Gracilaria* is a commercially valulable agarophyte and its many species are distributed throughout the temperate and tropical seas. The experiement was started in natural environment of Gulf of Mannar near CMFRI jetty. Observations were made after 40 days and the results are discussed in this paper.

2099. **Reeta Jayasankar** 1993. Seasonal variation in biochemical constituents of *Sargassum wightii* (Graville) with reference to yield in alginic acid content. *Seaweed Res. Utiln.,* 16(1&2): 13-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Seasonal variation in biochemical constituents of *S. wightii* with reference to yield in alginic acid content has been reported. The lipid content showed a reciprocal relation, while carbohydrate a positive correlation with alginic acid content.

2100. **Reeta Jayasankar and J.R. Ramalingam** 1993. Photosynthetic pigment of marine algae from Mandapam coast. *Seaweed Res. Utiln.,* 16(1&2): 41-44.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Thirty species of marine algae collected from different localities of Mandapam coast (Gulf of Mannar) were analysed for their photosynthetic pigments such as chlorophyll and carotenoids. The lowest value of chlorophyll as well as carotenoids content was found in Rhodophyceae. The grouping and separation of algae based on coloration has been practiced for over 100 years (Harvey, 1841). Pigments such as chlorophyll and carotenoids play important roles in photosynthesis. Several studies have been conducted in the algal pigment by Ramus *et al.,* (1976); Brody *et al.,* (1959); Jones *et al.,* (1965) and Waaland *et al.,* (1974). As there is no detailed work in this line on Indian seaweeds, the present study of thirty species of marine algae belonging to Chlorophyta, Phaeophyta and Rhodophyta from Mandapam coast has been carried out.

2101. **Reeta Jayasankar** 1993. On the yield and quality of sodium alginate from *Sargassum wightii* (Graville) by pre-treatment with chemicals. *Seaweed Res. Utiln.,* 16(1&2): 63-66.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

2102. **Reeta Jayasankar and N. Ramamoorthy** 1993. Some observations on the growth of *Chlorella salina*. *Seaweed Res. Utiln.,* 16(1&2): 139-144.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Growth of *Chlorella salina* was studied in different salinities (10, 20, 30 and 40 ppt), pH (6.0 - 10.0) and dilutions (100-400 ml). Maximum growth was observed at 40 ppt after 35 days, at pH 10 after 51 days and at 300 ml after 34 days of inoculation. The experiments were conducted for 60 days under controlled conditions. At pH 8, 9 and 10, *C. salina* shows two growth peaks, one after 16-24 days and the other after 42-54 days of inoculation whereas at pH 6 and 7, it records one growth peak after 16-19 days of inoculation. This shows that *C. salina* can adjust to a wide range of salinity and pH.

2103. **Reeta Jayasankar and G. Kulandaivelu** 1999. Fatty acid profiles of marine red alga *Gracilaria* spp. (Rhodophyta, Gigartinales). *Indian J. Mar. Sci.* 28 (1): 74-76.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, Kerala, India; Department of Plant Sciences, Madurai Kamaraj University, Madurai 625 021, Tamil Nadu, India.

Abstract : Species of *Gracilaria* from Gulf of Mannar were analyzed for their fatty acid composition. The major fatty acids such as myristic acid, myristoleic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid and linoleic acid were analyzed by gas liquid chromatography. The qualitative and the quantitative distribution of above fatty acids exhibited wide variation among the species of different habitats. The fatty acid content of the species collected from the same locality also showed quantitative variation depending on their distribution and the availability of light intensity to the particular species.

2104. **Reeta Jayasankar and G. Kulandaivelu** 1999. *In vivo* flourescence kinetics of *Gracilaria* spp. subjected to different salinities. *Indian J. Fish.,* 46(4): 359-365.

Address : School of Biological Sciences, Madurai kamraj University Madurai-625 021, Tamilnadu, India.

Abstract : *Gracilaria* species were subjected to different salinities under laboratory conditions and changes in the photosynthetic oxygen evolution and flourescence kinetics were followed. The plants which were subjected to more or less the normal salinity conditions exhibited low values of variable flourescence and quantum yield. Prolonged treatment increased the quantum yield but the pigment content and the photosynthetic rate reduced significantly. Among the two species tested, *Gracilaria edulis* was found to be very sensitive to low salinity (15 ppt) and *G. crassa* to higher salinity (45ppt).

2105. **Reeta Jayasankar and K. Paliwal** 2002. Seasonal variation in the elemental composition of *Gracilaria* species of the Gulf of Mannar, Tamil Nadu coast. *Seaweed Res. Utiln.,* 24(1): 55-59.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Seasonal variation of the different cations such as Sodium (Na^+), Potassium (K^+), Magnesium (Mg^{++}), Calcium (Ca^{++}) and Iron (Fe^{++}) was analysed in three species of *Gracilaria* of Gulf of Mannar from August, 1994 to July, 1995. Significant interspecific variation in the elemental composition was observed. *G. crassa* showed higher concentration of Magnesium, Calcium and Iron whereas Sodium and Potassium dominated in *G. edulis*. Accumulation of cation content was high during March in *G. crassa*. In general, a declining cation concentration was recorded as $K^+ > Na^+ > Ca^{++} > Mg^{++} > Fe^{++}$.

2106. **Reeta Jayasankar.** 2005. Effect of salinity on physiology of *Gracilaria* spp. (Gigartinales, Rhodophyta). *Seaweed Res. Utiln.,* 27(1&2): 19-24.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Gracilaria edulis* and *G. crassa* were subjected to different salinities such as 15, 25, 35 and 45 ppt in the growth chamber in controlled environmental conditions. The effects of salinities on photosynthetic activities, absorption spectrum and the pigment constituents were recorded. The Photosynthetic activity (P_{max}) reduced in all the treatments, when the plants were removed from the natural habitat. The decline was marginal in 35 ppt salinity (6.4%) compared to 15- 65 % in other salinities within 0-6 days of treatment in *G. edulis.* Similarly, in *G. crassa* the P_{max} declined by 4.3% in 35 ppt treatment compared to 53-75% in others during the same period. Further, from 6-12 days of treatment, there was a perceptible reduction in P_{max} activity in all the samples. The chlorophyll and the accessory pigment concentration increased in both the species at 35 ppt salinity. The absorption peak of the samples treated under hypo and hyper saline conditions showed shifts from the original place.

2107. **Reeta Jayasankar, R. Ramakrishnan, K. Nirmala and C. Seema** 2005. Biochemical constituents of *Gracilaria edulis* cultured from spores. *Seaweed Res. Utiln.,* 27(1&2): 39-44.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Gracilaria edulis* was cultivated in west coast of India off Narakkal by reproductive method using the carpospores. The culture period was from November to March with regular sampling of growing plants for the estimation of biochemical constituents, quantitative and qualitative estimation of agar. The biochemical constituents like protein and carbohydrate content increased corresponding to the age of the plant whereas the lipid content declined. Harvesting of the crop can be determined from the qualitative and the quantitative estimation of agar along with other biochemical constituents. It was found out that crop harvested after 121 days of culture period had better quality of agar and also high protein content.

2108. **Rekha Nair, J.** 2005. Silverbelly fishery of Palk Bay and Gulf of Mannar with special reference to "*Leiognathus jonesi*" (James, 1967). *Indian J. Fish.,* 52(2): 189-195.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Silverbellies constitute an important group of demersal fishery resource along Tamilnadu coast. They are exploited by trawl and a variety of artisanal gears like shore seines, boat seines and gill nets. The southeast region contributed nearly 85% of the silverbelly landings of India and Tamilnadu's share was 70%. Out of 20 species of silverbellies known from India, 15 species are found in varying proportions from the PalkBay and Gulf of Mannar. Good fishery for silverbellies at Rameswaram was recorded from February to September and October to March at Pamban, during the years 1996-2000. The length-weight relationship of *L. jonesi* was W = 0.000076197 L 2.38. The growth parameters L and K (annual) were 161 mm and 0.71 respectively. The MSY was estimated at 209.7 t.

2109. **Renganathan, T.K.** 1982. On the occurrence of a colonial ascidian, *Lissoclinum fragile* (Van Name, 1902) from India. *Curr. Sci.*, 51(3): 149.

Address : Department of Zoology, V. O. Chidambaram College, Tuticorin - 628 003, Tamilnadu, India.

Abstract : The present note deals with the colonial ascidian, *Lissoclinum fragile*, as this form has not been reported so far from India. It is recorded for the first time at Tuticorin, Kanyakumari, Mandapam, Rameswaram, Krusadai Island and Shingle Island in the southeast coast and at Vizhinjam harbour area from the west coast of India.

2110. **Renganathan, T.K., N. Balakrishnan Nair and K. Dharmaraj** 1982. Ecology of marine fouling organisms in Karapad Creek, Tuticorin Bay, southeast coast of India. *Indian J. Mar. Sci.*, 11(2): 132-137.

Address : Department of Aquatic Biology and Fisheries, University of Kerala, Trivandrum 695007, India.

Abstract : The settlement of marine fouling organisms at Karapad Creek in Tuticorin, Tamil Nadu, India was studied for 1 yr by exposing an array of test panels. The community composition and major groups of foulers are described. The nature of fouling assemblages over 3 series of test panels is recorded. Barnacles, sponges, bivalves and ascidians are the dominant fouling organisms in the area. Occurrence, relative abundance and periods of peak settlement of the major groups and intensity of fouling during different months and varying durations are determined. Interrelationships of different fouling organisms and the impact of environmental factors on fouling are briefly discussed.

2111. **Renganathan, T.K.** 1983. Breeding season of a colonial ascidian, *Eudistoma* sp. of Tuticorin Coast, India. *Comp. Physiol. Ecol.*, 8(2): 135-137.

Address : Deparment of Zoology, V.O. Chidambaram College, Tuticorin-628 003, Tamilnadu, India.

Abstract : The present study was undertaken with a view to finding out whether *Eudistoma* of Tuticorin is a continuous breeder or not. The breeding season was determined by looking for the incidence of fully developed larvae in the atrial cavity. Breeding season of *Eudistoma* sp. revealed that it was a continuous breeder with a peak period coinciding with rainfall. Temperature and salinity had no effect on its breeding activity.

2112. **Renganathan, T.K.** 1984. Behavior of the larvae of a colonial ascidian *Eudistoma viride* from Tuticorin coast of India. *Environ. Ecol.*, 2(2): 157-158.

Address : Department of Zoology, V.O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The larval behavior was observed in one of the commonly occurring colonial ascidians, *Eudistoma viride* , of the Tuticorin coast, India, by keeping them in 250 ml beaker of sea water in the laboratory. The larval behavior varied. Though the duration of free-swimming life was between an hour to 12 hours, it was between 2 to 3 hours in a good majority of larvae.

2113. **Renganathan, T.K.** 1984. Breeding season of a fouling colonial ascidian *Lissoclinum fragile* of Tuticorin Coast, India. *Environ. Ecol.*, 2(4): 323-325.

Address : Department of Zoology, V.O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Breeding season of *L. fragile* revealed that it was not a continuous breeder. There were two peaks in a year and these peaks had no correlation with any of the factors studied, namely, temperature, salinity and rainfall. No correlation could be arrived at between the percentage of colonies bearing larvae and colonies bearing embryos.

2114. **Renganathan, T.K and F. Monniot** 1984. Additions to the ascidian fauna of India. *Bull. Mus. Natl. Hist. Nat. France 4e Ser. A. Zool. Biol. Ecol. Anim*., 6(2): 257-262. Dep. Zool.

Address : V.O. Chidambaram College, Tuticorin - 628 003, Tamilnadu, India.

Abstract : Two polyclinid ascidians are added to the marine fauna of India. *Aplidium multiplicatum* is a widely distributed species in tropical waters. *Sidnyum indicum* is a new species belonging to a genus hitherto unknown in the tropical Indian Ocean.

2115. **Renganathan, T.K and S. Krishnaswamy** 1985. Some colonial ascidians from Indian waters. *Indian J. Mar. Sci.*, 14(1): 38-41.

Address : School of Biological Sciences, Madurai Kamaraj University, Madurai - 625 021, Tamilnadu, India.

Abstract : Three colonial ascidians are reported of which 2 are new and 1 is a first record from Indian waters. *Ecteinascidia krishnani* of the family Perophoridae and *Polyandrocarpa chendurensis* of the family Pyuridae are new species and *Botrylloides magnicoecum* (Hartmeyer, 1912) is a new record.

2116. **Renganathan, T.K.** 1990. Systematics and ecology of Indian ascidians. *Proc. Specialists' Meet on Marine Biodeterioration with Reference to Power Plant Cooling Systems, Kalpakkam (India), 26 April,1989.* pp.263-271.

Address : V.O. Chidambaram College, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Ascidians form an important group of marine fouling organisms. They have many unique features and as such are an interesting group of organisms. However, they have not been studied to any great detail from the Indian coasts. The paper gives an account of the information available on Indian ascidians and describes their systematic and ecological features.

2117. **Rengarajan, K and P. Sam Bennet** 1994. Perch fisheries in India. *CMFRI Bulletin,* 47: 137.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This publication deals with the present status, catch potential, biology of component species and the fishery of major perches at important centres in India like Vizhinjam, Muttom, Tuticorin and Keelakarai. Bibliography is provided at the end.

2118. **Rengarajan, K and B.C. Mohapatra** 1995. Effects of some heavy metals copper, zinc and lead on certain tissues of *Liza parsia* in different environments. *CMFRI Spl. Publ.*, 61: 6-12.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : India is a developing country and it is tremendously advancing towards the industrial progress and developments. This development results to some level of pollution, both in atmosphere and hydrosphere, the latter has been blessed by Mother Nature providing a long coastline of over 6100 km with excellent marine wealth in both east and west coasts, and a number of rivers flowing on both directions into the sea forming reasonably broad estuarine systems. The brackish water area available in the country is estimated to be about 1.4 million hectares. The conservation of estuarine and brackish water environments is of paramount importance and their monitoring of pollution is highly essential.

2119. **Rengaswamy, V.S.** 1986. Research Institutes around Mandapam. *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp,* pp. 17-20.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The area around Mandapam is very rich in marine resources like fishes, prawns, seaweeds, corals etc. Hence it is quite logical to situate research institutes to investigate the exploitation of these resources for the benefit of our national progress. The important Research Institutes located here are the Regional Centre of Central Marine Fisheries Research Institute, Marine Algae Research Institute of (CSMCRI). the Anti-corrosion testing laboratory (CECRI) and Marine Archeological station under Tamil University, Thanjavur.

2120. **Rengaswamy, V.S., V. Gandhi, A. Raju, G. Mohanraj, K. Dorairaj and J. Xavier Rodrigo** 1993. Abundance of milkfish fry in relation to lunar periodicity in the nearshore waters around Manoli Island, Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 35(1&2): 74-79.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, Kerala, India.

Abstract : Observations on the occurrence of milkfish *Chanos chanos* fry carried out at Manoli Island from April 1983 to June 1984 in relation to the lunar periodicity are presented in this paper. During this period 137, 175 fry were obtained, with a peak occurrence in May. Large quantities of fry were collected during daytime of new moon period. The study also indicated the peak occurrence of fry in the initial flow of water during high tide. The possibilities of large-scale collection from adjoining areas appear to be bright.

2121. **Rengaswamy, V.S., R. Marichamy, S. Rajapackiam and D. Sundararajan** 1999. Collection and transportation of groupers for farming. *Proc. Fourth Indian Fisheries Forum*, 24-28 November, 1996, Kochi, Kerala. (eds.) M.M. Joseph, N.R. Menon, N.U. Nair. Mangalore, India Asian Fisheries Society, Indian Branch. pp. 401-403.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The occurrence of commercially important groupers in high percentages in the nursery ground near Vellapatti, North of Tuticorin, Tamil Nadu, India in Gulf of Mannar Coast reveals the resources of the species for collection and scope for farming *Epinephelus tauvina* dominates the catches of mini-shore-seine, popularly known as 'Ola-valai'. The peak season for the collection of young ones in the size range 70-200 mm is October-January, though it is observed round the year. The estimated catch, effort, species composition and size distribution are presented in the paper. The monthly catch of this valuable species is estimated to be 15,000. The techniques employed in the collection of adult, mature specimens of the size range 530-850 mm, weighing 2-12 kg are described. The feeding strategy and conditioning of the collected specimens in holding tanks/cages are discussed. The technology evolved for the transportation of young specimens as well as brood stocks to different culture sites are highlighted. The present observations reveal the scope for large scale farming of groupers in cages and coastal ponds as well as to promote the export trades of live specimens.

2122. **Renuga Bai, N., M.R. Basil Rose and P.D. Mercy** 1998. A naturally occurring agglutinin in the extract of the seaweed *Turbinaria ornata*. *Seaweed Res. Utiln.,* 20(1&2): 63-69.

Address : Holy Cross College, Nagercoil, Kanyakumari, Tamilnadu, India.

Abstract : Saline extract from the receptacles of *Turbinaria ornata* contains a potent agglutinin specific for the determinants on pig erythrocytes. Cross adsorption studies reveal that it is a hemeagglutinin. Agglutination inhibition tests have been performed with extracts using a number of simple sugars, oligosaccharides and glycoproteins as inhibitors. *Bovine thyroglobulin* was the potent inhibitor. Physico-chemical characteristics of the agglutinin is studied.

2123. **Rethnam, J.** 2003**.** Permit fisherfok to collect algae in Gulf of Mannar. *The Hindu* 22nd *September* 2003.

Address: State Fisheries Department of Chennai, Tamilnadu, India.

Abstract: The fisherfolk also demand that they be permitted to collect sea algae around the 21 islands in Gulf of Mannar, as it is the most viable source of livelihood for fishermen in the area.

2124. **Ridley, S.O.** 1883. The coral-fauna of units descriptions of new species. *Ann. Mag. Nat. Hist.,* 11(5): 250-262.

2125. **Robson, G.C.** 1926. Notes on the Cephalopoda 1. Description of two species of Octopus from Southern India and Ceylon. *Ann. Mag. Nat. Hist.,* (9) 17: 159-167.

2126. **Rohan Arthur** 2000. Coral bleaching and mortality in three Indian reef regions during an *El Nino* southern oscillation event. *Curr. Sci.,* 79(12): 1723-1729.

Address : Centre for Ecology Research and Conservation, 3076/5, IV Cross, Gokulam Park, Mysore - 570 002, Karnataka, India.

Abstract : The 1997-1998 El Nino Southern Oscillation (ENSO) event, which elevated Sea Surface Temperatures (SSTs) of tropical oceans by more than 30°C, was one of the most extreme ENSO events in recent history. Such increases in SSTs above the seasonal average can trigger widespread bleaching in coral reefs. This study examined bleaching in three Indian coral reef regions in relation to SSTs using quantitative rapid assessment methods between April and July, 1998. The Gulf of Kutch reefs showed an average of 11% bleached coral with no apparent bleaching-related mortality. In contrast, bleached coral comprised 82% of the coral cover in lagoon reefs of Lakshadweep and 89% of the coral cover in the Gulf of Mannar reefs. Bleaching-related mortality was high -26% in Lakshadweep and 23% in Mannar. The coral mass mortality may have profound ecological and socioeconomic implications and highlights the need for sustained monitoring for coral reef conservation in India.

2127. **Royan, J.P.** 1980. Laboratory and field studies on an Indian strain of the brine shrimp Artemia. *The brine shrimp Artemia. Volume-3. Ecology, Culturing, use in Aquaculture. Proc. International Symposium on the brine shrimp Artemia salina*. Corpus christi, Texas, USA, August 20-23, 1979. (*eds.*) G. Persoone, P. Sorgeloos, O. Roels and E. Jaspers. 1980. pp. 224-230.

Address : National Institute of Oceanography, Dona Paula 403004, Goa, India.

Abstract : The Tuticorin strain of the brine shrimp *Artemia* was studied under both laboratory and field conditions. Studies on the survival of the nauplii at different temperatures and salinities revealed that the nauplii prefered a salinity of 35 ppt and a temperature of 27° C. Biochemical changes during the larval stages showed a decreasing trend in protein, lipid and caloric contents. The effects of different inert feeds such as Spirulina, rice bran and yeast on the growth of Artemia are also discussed.

2128. **Russell, B.C.** 1991. On the validity of *Nemipterus furcosus* (Valenciennes) (Nemipteridae). *Cymbium.* 15(1) *Suppl*: 35-41.

Address : Northern Territory Museum, P.O. Box 4646, Darwin, N.T. 0801, Australia.

Abstract : The nemipterid fish *Nemipterus furcosus* (Valenciennes) has been misidentified by most recent authors as *N. peronii* (Valenciennes). *N. furcosus* is here recognised as a valid species, and is redescribed. *N. peronii* is recognised as a senior synonym of *N. tolu* (Valenciennes). Synonyms of *N. furcosus* include *Dentex upeneoides* Bleeker, *D. ovenii* Bleeker, *D. hypselognathus* Bleeker, *D. sundanensis* Bleeker, *Nemipterus worcesteri* Evermann & Seale, *N. robustus* Ogilby and *N. guntheri* Ogilby. *N. furcosus* is widely distributed throughout the tropical West Pacific from southern Japan to north eastern Australia, and in the eastern Indian Ocean including the Gulf of Mannar, Sri Lanka, the Andaman Sea, Strait of Malacca and north Western Australia.

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2129. **Sachidanandham, A.** 1972. Are our mechanised fishing boats viable? *Seafood Export J.,* 4(1): 57-70.

2130. **Sadananda Rao, D., K.G. Girijavallabhan, S. Muthusamy, V. Chandrika, C.P. Gopinathan, S. Kalimuthu and M. Najmuddin** 1991. Bioactivity in marine algae. *Indo-United States Symp. Bioactive Compounds from Marine Organisms with Emphasis on the Indian Ocean, Goa (India), Feb 1989*. (eds) M.F. Thompson, R. Sarojini and R. Nagabhushanam. pp. 373-377.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies were conducted on 30 marine algal organisms collected from Mandapam, Tamil Nadu for their hemolytic and antimicrobial activities. The results indicate that *Enteromorpha compressa, Cladophoropsis zoolingeri, Padina gymnospora, Sargassum wightii,* and *Gracilaria corticata* show antibiosis against Gram-negative bacteria and against the Gram-positive cultures of *Bacillus.* Strong hemolytic activity was shown by *C. zoolingeri* and *Grateloupia lithophila*.

2131. **Sadhuram, Y., T.V.R. Murty, P. Chandramouli and K.S.R. Murthy** 2005. Event driven software package for the database of integrated coastal and marine area management (ICMAM) (developed in "C") (Q2 02383 *Data acquisition and processing;* Q2 02124 *Coastal zone management*) *NIO, Dona Paula, Goa. March 23, 2006.*

Address : National Inst. of Oceanography, Regional Center, Visakhapatnam, Andhrapradesh, India.

Abstract : National Institute of Oceanography (NIO, RC, Visakhapatnam, India) had taken up the Integrated Coastal and Marine Area Management (ICMAM) project funded by Department of Ocean Development (DOD), New Delhi, India. The main objective of this project is to classify the Coastal Waters of East Coast of India, by compiling and collecting various data sets, viz., physical, chemical, biological, micro-biological, meteorological and climatilogical. The data was compiled for the stations, viz., Digha, Konark, Puri, Gopalpur, Visakhapatnam, Krishnapatnam, Pondicherry, Nagapatnam and Tuticorin. A huge database was generated for the above stations and also few cruises were organized on board Sagarpurvi, to collect data. Based on the overall information, the coastal waters will be classified which will help the state governments and pollution control boards to plan the future industries/activities along the coast. The project was successfully completed and the final reports were submitted to D.O.D. in the year 2003. An event driven software package was developed for the above database. The Graphical User Interface (GUI) software using 'C' language helps to retrieve the required parameter at a particular place/station. This is very helpful to search for the data of a particular station. The present developed software is a set of 'C' language programs, linked by number of functions and user defined header files. This software is used for rapid retrieval and display of physical, chemical, biological, micro-biological, meteorological and climatilogical data. Data are stored as sequential access disk files for rapid access. Programs are interactive and have graphics capability. A wide range of display and analysis outputs are available. Routines are described from a user's point of view, with output examples.

2132. **Sahubar Hussain, M.S.M and V. Ramaiyan** 1990. Biometric analyses to identify populations of *Ilisha melastoma* (Schneider, 1801) from coastal waters of South India. *J. Mar. Biol. Assoc. India*, 32(1&2): 170-176.

Address : Department of Zoology, V.O. Chidambaram College, Tuticorin - 628 003, Tamilnadu, India.

Abstract : The present investigation deals with the analyses of delineating populations of Indian shad *Ilisha melastoma* based on morphometric characters. A total number of 828 specimens obtained during 1982 to 1983 from commercial catches from Madras, Porto Novo, Point Calimere, Mandapam, Tuticorin, Cape Comorin, Vizhinjam, Calicut, Mangalore and Karwar, were considered for this analysis employing 17 body measurements. The allometric equations were tested and the fitness was analysed by plotting a sample (male and female separately) and by calculating the correlation coefficient for all combinations of characters. Besides, 95% confidence zones were calculated taking the standard length as an independent variable and other characters as dependent variables. Though there were no significant differences between sexes at 95% confidence zones, statistical calculations of regression coefficients of all combinations of characters from nine stations showed significance at 5% level in certain combinations, which were eliminated from further intersample analyses. Based on the sum of the statistical differences between 17 parameters (in combinations) the samples were judged by the method of rejective limits of 25% probability level. These results suggest that although *I. melastoma* is found distributed all long the east and west coasts of S. India, it tends to form localized stocks.

2133. **Sahul Hameed, P., S.S.N. Somasundaram, M.M. Shahul Hameed, V. Masilamani and S. Ravikumar** 1998.

Radium-228 in some bivalve molluscs from Gulf of Mannar, India. *Rad. Prot. Env.*, 21(2): 83-87.

Address : P.G. Department of Zoology, Jamal Mohamed College, Tiruchirappalli, Tamilnadu, India.

Abstract : This paper presents the results of the measurements of beta emitting natural radionuclide ^{228}Ra in water, sediment and some bivalve molluscs of Gulf of Mannar, which is a marine province of the south east coast of India. The dissolved ^{228}Ra concentration in seawater ranged from 4.10 to 5.20 m Bq.l^{-1} (mean: 4.5 m Bq.l^{-1}) and in sediment samples ranged from 30.70 to 42.50 Bq. kg^{-1} (mean: 36.83 Bq. kg^{-1}). The ^{228}Ra concentrations in water and sediments gradually decline from Cape Comorin to Mandapam. The results further indicated the differential accumulation of the radionuclide with enhanced bioaccumulation in shells, The brown mussel *Perna indica* was identified to accumulate higher concentration of ^{228}Ra in their soft tissues (6.30 - 7.70 Bq. kg^{-1} wet) and shell (21.06 - 26.03 Bq. kg^{-1} wet) suggesting that they could serve as a biomonitor of ^{228}Ra radionulide in the marine environment.

2134. **Sahul Hameed, P and S.S.N. Somasundaram** 1998. A survey of bivalve molluscs in Gulf of Mannar, India. *Indian J. Fish.*, 45(2): 177-181.

Address : P.G. Department of Zoology, Jamal Mohammed College, Trichy-620 020, Tamilnadu, India.

Abstract : Out of 55 species of bivalve molluscs collected from Gulf of Mannar, 49 species belonging to two subclasses, four orders and eighteen families were identified and classified. Mandapam and adjacent Islands maintain a rich bivalve diversity than the other areas. A depleting trend on bivalve species diversity in the Gulf of Mannar was evident from the present study when compared with earlier records and the significance of the study is discussed.

2135. **Sahul Hameed, P and S.S.N. Somasundaram** 1999. Accumulation of Pb-210 in some bivalve molluscs of Gulf of Mannar, India. *Sustainable Environment.* pp. 272-277.

Address : P.G. Department of Zoology, Jamal Mohammed College, Trichy, Tamilnadu, India.

Abstract : Presented here is the natural radioactivity distribution of beta emitting radionuclide, ^{210}Pb in water, sediment and some bivalve molluscs trom three stations of Gulf of Mannar in the south east coast of India. It is observed that the dissolved ^{210}Pb concentration in sea water range from 4.2 m Bq.l^{-1} to 6.7 m Bq.l^{-1} (mean: 5.3 m Bq.l^{-1}), and the activity in sediment range from 27.6 Bq. kg^{-1} to 45.4 Bq. kg^{-1} (mean: 37.1 Bq. kg^{-1} dry). The concentration of 210Pb in water and sediment samples gradually declined from Cape Comorin to Mandapam. Generally higher ^{2l0}Pb concentrations are observed in the shells (10.2 - 30.5 Bq. kg^{-1} dry) of bivalves than the soft tissues (1.3 - 5.5 Bq. kg^{-1} dry). Among five bivalve species analysed, the brown mussel *Perna indica* registered higher level of ^{210}Pb concentration in both shell and soft tissues than the others tested. Hence, the *P. indica* could serve as a biomonitor of ^{210}Pb radionuclide in a marine system. The concentration factors (Cfs) of ^{210}Pb for the bivalves ranged from app. 102 to app. 103. The significance of ^{210}Pb activity in the bivalve molluscs of Gulf of Mannar is discussed.

2136. **Sahul Hameed, P and S.S.N. Somasundaram** 1999. Radiation ecology of Krusadai Island, Gulf of Mannar, India. pp. 192-197. ***In***: *Environmental Protection.* (*eds*) A.K. Thukral and G.S. Virk. Scientific publishers, Jodhpur, India.

Address : P.G. Department of Zoology, Jamal Mohamed College, Tiruchirappalli, Tamilnadu, India.

Abstract : Krusadai Island, a marine province in the east coast of India, has a rich floral and faunal diversity, and living resources. Since the background radiation and the distribution of natural radionuclides (Po-210, Pb-210 and Ra-228) in the ecosystem of Krusadai island have not hitherto been studied, the present investigation is undertaken to generate a baseline data on the radiation profile of this island. Abiotic samples, such as water and sediment, and biotic samples, such as plankton, seaweeds, crustaceans, molluscs and fishes, were subjected to analyses of Po-210, Pb-210 and Ra-228. The ambient ã-radiation levels were measured and ranged from 10 to 40 µR/hr. The concentration of Po-210, Pb-210 and Ra-228 in water sample was found to be 2.80, 4.20 and 3.80 mBq/l, respectively. Seaweeds registered a higher level of Po-210 (30.0 Bq/kg) than Pb-210 (4.40 Bq/kg) and Ra-228 (1.50 Bq/kg). The general trend was that Po-210 was concentrated to a higher degree in all the environmental matrices than Pb-210 and Ra-228. The soft tissues of organisms accumulate higher levels of Po-210 (11.20-54.60 Bq/kg) than shells and bones (0.70-34.10 Bq/kg) whereas the shells and bones contain more of Pb-210 (2.00-11.20 Bq/kg) and Ra-228 (1.20-8.20 Bq/kg) than the soft tissues (0.20-1.70 Bq/kg and 0.20-2.00 Bq/kg, respectively). Among animals, a higher rate of accumulation of these radionuclides was observed in bivalve molluscs. Hence, the bivalve molluscs were used as a biological indicator for these radionuclides in the island marine environment. The significance of these radionuclides in the abiotic and biotic components of the Krusadai island is discussed.

2137. **Sahul Hameed, P., S.S.N. Somasundaram, V. Masilamani, S. Ravikumar and H.E. Syed Mohamed** 1999. Radioecological study in Mandapam Coast, Gulf of Mannar, India. *Proc. 8th Nat. Symp. Env.,* pp. 131-133.

Address : P.G. Dept of Zoology, Jamal Mohamed College, Trichy 620 020, Tamilnadu, India.

Abstract : A systematic study on the distribution of natural radionuclides in the environmental matrices of Mandapam coast has been undertaken to understand the radiation profile of this marine ecosystem. The ambient gamma radiation levels in the coastal belt of Mandapam was estimated and the environmental samples such as water, sediment and biota (Plankton, seaweeds, coral, molluscs, crustaceans and fish) were subjected to analyses of ^{210}Po, ^{210}Pb, ^{226}Ra and ^{228}Ra. Ambient gamma radiation level in this region fluctuated from 10 - 50 μR/h. The results indicated a non-uniform distribution of these radionuclides in the biota. The general trend was that ^{210}Po was concentrated to a higher degree than ^{210}Pb, ^{226}Ra and ^{228}Ra. The soft tissues of the organisms accumulated higher ^{210}Po content while the hard parts namely, the shells contained more of lead and radium. The results of the present study are discussed in this paper.

2138. **Sahul Hameed, P.** 2001. Radioecological studies in the ecosystem of Gulf of Mannar, southeast coast of India. *Proc. Nat. Sem. Atom. Energ. Ecol. Environ.,* pp 84-91.

Address : P.G. Department of Zoology, Jamal Mohamed College, Tiruchirappalli, Tamilnadu, India.

Abstract : Gulf of Mannar, a marine province in the southeast Coast of India, situated between India and Srilanka along the longitude from 78° 08' E to 79° 30' E and latitude from 8°35' N to 8°25'N. It runs from Pamban island including Rameswaram to Kanyakumari along India's Southeast coastline to a distance of about 170 nautical miles (315 Km) with an average depth of 12m. The Gulf maintains a rich faunal and floral biodiversity. It is largely due to the presence of diversified habitats such as seaweed beds, coral reefs, coral islands, mangroves, rocks, sandy and muddy shores etc. Hence, the Gulf of Mannar has been declared as Marine National Park by the Tamil Nadu State Government and as the Marine Biosphere Reserves by Government of India. The floral and faunal wealth of this Gulf has been documented time to time (Cater, 1880; Thurston, 1895; Iyengar and Parthasarathy, 1927; Thomus, 1972; Satyamoorthy, 1952; Hameed and Somasundaram 1998). However, the radioecological study remains fragmentary. Further study of radioactive substances and radiation in relation to marine environment is felt essential because man depends constantly on living and nonliving resources of sea. It is therefore considered that a thorough knowledge of radiation ecology is a prerequisite for judicious utilization of natural resources in our developmental activities. This study is also imperative in view of the forthcomming Kudankulam Atomic Power project, which is also located in the Gulf of Mannar. Radioecological data generated in the fragile and biologically rich Gulf, of Mannar would be useful input as pre-operational data and as a basis to assess the environmental impact of Kudankulam Nuclear Power project when it becomes operational.

2139. **Sakthivel, A., H. Balaji Raghavendra Rao, D. Anbarasu and T. Devaki** 2003. Hepatoprotective role of *Gracilaria edulis* (red algae) on D-Galactosamine induced hepatitis in rats. *SDMRI Res. Publ.,* 3: 105-107.

Address : Department of Biochemistry and Molecular Biology, University of Madras, Guindy Campus, Chennai 600 025, Tamil Nadu, India.

Abstract : Treatment with D-Galactosamine, a hepatotoxin (200 mg of D-Galactosamine dissolved in physiological saline/kg body weight/day for a period of two days) induced hepatic damage in albino rats, with significant alterations in the activities of marker enzymes AST, ALT, LDH and ALP and proteins. Administration of *Gracilaria edulis* alcoholic extract (300 mg/kg body weight/day for 21 days) counteracted the action of D-Galactosamine on liver markers showing hepatoprotection.

2140. **Sakthivel, M and R. Perumal** 1996. Dosage effects of vitamins on food utilization growth and survival in eye stalk ablated and non-ablated tiger prawn *Penaeus monodon*. *J. Ecotoxicol. Environ. Monit.* 6(2): 83-92.

Address : Zoological Research Laboratory, Kamaraj College, Tuticorin - 628 003, Tamilnadu, India.

Abstract : Feed trials were conducted for a period of eight weeks to evaluate the effects of varying levels (mg/kg) of ascorbic acid, pyridoxine and folic acid on Feed Conversion Ratio (FCR), growth and survival of eyestalk ablated and non-ablated *Penaeus monodon*. The results indicated that the vitamin deficient diet can cause mortality in eyestalk ablated prawns within two to three weeks, whereas no mortality was observed in non-ablated prawns. But the experimental diets having 750 mg of ascorbic acid/kg or 10 mg of pyridoxine/kg or 5 mg of folic acid/kg were found to significantly ($P<0.05$) promote the growth and survival rate in the eyestalk ablated prawns.

2141. **Sakthivel, M.** 2001. Marine ornamental fishes in India - Status, problems and management strategies. *Nat. Sem. Marine and Coastal Ecosystems: Coral and Mangrove - Problems and Management Strategies, 26-27 Sept. 2001, Tuticorin,* p.33-44.

Address : P.G. Department of Zoology, Kamaraj College, Tuticorin-628 003, Tamilnadu, India.

2142. **Sakthivel, M.** 2003. Rejuvenation and reclamation of selected corals and coral reefs in Gulf of Mannar. *Report submitted to Ocean Science and Technology Cell,* Department of Ocean Development, Government of India. 122 p.

Address : P.G. Department of Zoology, Kamaraj College, Tuticorin-628 003, Tamilnadu, India.

Abstract : Van Island, Kaswari Island and Hare Island in Gulf of Mannar were selected as the study areas for this investigation. These islands have an original area of 16.00ha, 19.50ha and 129.04ha respectively. Van Island and Kaswari Island are situated 6 km and 7 km away from Tuticorin respectively. And the Hare Island is situated 7 km from Mandapam camp. In this report, we recorded the present state of zooplankton, sponges, corals and coral reefs, polychaetes, molluscs, echinoderms, coral reef associated fishes and the bioeroding organism of Van Island, Kaswari and Hare island with the help of line transect method which is economical under water, easily understood and require no elaborate equipments. The different species of Zooplankton are abundantly present in these three islands. The mean density of zooplankton in the Gulf of Mannar is 75 ind/lit. Sponges are sessile benthos. More than 270 species of sponges are present in Gulf of Mannar. In our study areas, most of the sponges are found in reef flats. Around 35 species of corals and coral reefs were recorded from these islands. More number of polychaetes was present in our study areas. The mollusca comprises 20-30% of the total species present in reef. The important families are Muricidae, Conidae and Mitridae. The vulnerable one is found to be *Sepia* spp. About 10 species of echinoderms were present in our study areas. Different types of coral reef fishes are abundantly present in these three islands. The important families are *Chaetodontidae* (butterfly fish), *Scaridae(parrotfish), Apogonidae* (cardinal fish), *Pomacentridae* (damselfish and Clown fish) and Scorpaenidae (scorpion fish).

2143. **Sakthivel, M., G. Ramalingam and A. Pushparaj** 2005. Field study on corals and coral living organisms in Van Tivu, in the Gulf of Mannar. *Fish. Technol.,* 42(1): 11-16.

Address : Zoological Research Laboratory, Kamaraj College, Tuticorin, Tamilnadu, India.

Abstract : The results of the study on corals in the Van (Tivu) Island in the Gulf ot Mannar, are presented. Eighteen species of stony corals were recorded in our study area. *Favia, Porites, Acropora, Tubipoira,* and *Montipora spp.,* were found to contribute about 80% of the total coral population in Van tivu. The northeast and southwest transects were found to have higher percentage of corals. The molluscs alone contributed about 30% of the total reef fauna. The northeast transect had a good numerical data of molluscs. The vulnerable molluscan species from this area was found to be *Sepia* spp. Different types of coral reef fishes were present in Van tivu. The notable ones are Butterfly fishes (*Chaetodontidae*), Parrot fishes *(Scaridae),* Clown and Damsel fishes (*Pomacentridae*) and Lion and Scorpion fishes (*Scorpaenidae*). Coral reef destruction was found to be caused by bio-eroding organisms. The common bio-eroders observed during our field study were lion fish, butterfly fishes *Chaetodontidae*, Damsel fishes wrasses, *Echinometra mathei* (Echinoderm) Parrot fishes *Scaridae* and *Lambis* spp. (Gastropods) and *Tridacna* spp. (Bivalves).

2144. **Sakthykumari, I., A. Vijayan, and V.U. Bhagan and M. Anbu** 2004. Study on marine sediment quality across the coast of Kanyakumari, India: Status of heavy metals. *Asian J. Chem*., 16(3&4): 1577-1582.

Address : Department of Chemistry, S.T. Hindu College, Nagercoil-629 002, Tamilnadu, India; Department of Chemistry, St. Jude's College, Thoothoor, Regional Research Laboratory, CSIR, Trivandrum-695 019, Kerala, India.

Abstract : This article gives information about the trace metal contamination along the western coast of the Kanyakumari district, Tamil Nadu, India. The results obtained from the analysis of heavy metals such as zinc, cadmium, lead, copper and iron in marine sediment samples collected during July-November 2001 are presented here. The results of chemical analysis indicate that the concentration of zinc was found to be very high at stations S11 of Mondaikkadu and S16 of Thengapattanam. The deposition of cadmium and lead in the sediment was very high at stations S6 of Kadiapattanam zone. High concentration of iron was observed at stations S4 and S17 and copper content was found to be very high at stations S7 and S10.

2145. **Salim, R.V.** 1995. A preliminary survey of existing and potential marine parks and reserve sites in Sri Lanka, India and Pakistan. *Papers distributed at IUCN Regional Meeting on Marine Parks and Reserves, Tehran, Iran,* 1975.

2146. **Salin, K.R., T.M. Yohannan and C. Mohanakumaran Nair** 2005. Fisheries and trade of seahorses, *Hippocampus* spp., in southern India. *Fish. Manage. Ecol.,* 12(4): 269-273.

Abstract : Seahorses (*Hippocampus* spp.) are a major commodity fished from the shallow coastal seas of the south coast of India where there is an abundance of sea grasses, sponges and corals. They are in great demand for export as traditional medicines, curios and aquarium fish. Organised fishing and trade of seahorses exist in India along the Palk Bay and Gulf of Mannar coasts. At the Palk Bay coast, seahorses are targeted by divers along with sea cucumbers (*Holothuria* spp.) and gastropods (e.g. *Murex* spp., *Xancus pyrum* Hornell). In the Gulf of Mannar, most of the seahorses are landed as bycatch of shrimp trawling. Seahorses are also fished from Kerala as a bycatch of trawling, although no organised fishery and trade exist. Five species of seahorses were identified from the Palk Bay coast, whereas only two species were obtained from Kerala. Most seahorses from India are exported to Singapore, Hong Kong, Malaysia and the United Arab Emirates. The volume of dried seahorse trade from India was estimated to be 9.75 t as derived from catch data in 2001, which was much higher than official statistics of 4.34 t during 2001-2002, suggesting the major part of the exports might be through non-conventional means and goes undeclared. Some aspects of the impact of large-scale fishing and trade on conservation of these seahorses are discussed.

2147. **Sambandam, K.P.** 1988. A comparative study of prawn seed resources of estuaries in Ramnad District, Tamil Nadu. *Symp. on Tropical Living Resources*, 12-16.

2148. **Sambandam, K.P.** 1994. A comparative study of Prawn seed resources of Estuaries in Ramnad Dist. Tamil Nadu. *J. Mar. Biol. Assoc. India,* 36(1&2): 57-62.

Address : Department of Fisheries, Brackishwater Extension and Survey, Ramnad - 623 535, India.

Abstract : The availability of prawn seeds in Kottakkarai, Uppar, Vaigai and Kottakkudy Estuaries were studied during 1986-87. The prawn seed survey was conducted by operating velon dragnets in different biotopes. Suitable site for the collections have also been investigated. Seeds of *Penaeus indicus*, *Penaeus merguiensis, Metapenaeus monoceros, Metapenaeus dobsoni, Penaeus semisulcatus* and *Penaeus monodon* were encountered in these estuaries in the order of abundance. Among these estuaries, Kottakkudy and Uppar have a rich potential for many culturable species of prawn seeds. Further information on the seasonal and spatial distribution pattern of the prawn seeds in relation to salinity and temperature are presented and discussed.

2149. **Sambandamurthy, P.S.** 1962. Surface plankton of the Pearl Bank, Thollayiram Par off Tuticorin. *Madras J. Fish.,* 1(1): 75-76.

2150. **Sam Bennet, P.** 1961. Further observations on the fishery and biology of "Choodai" (*Sardinella* sp.) of Mandapam area. *Indian J. Fish.,* 8(1&2): 152-168.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The paper deals with a general account of the Choodai fishery in the Mandapam area, with particular reference to data on *Sardinella albella* collected during May 1958 to March 1960. Age and size groups of fish occurring in the commercial landings of Palk Bay and Gulf of Mannar are discussed. Old large fish and young small fish predominated in commercial catches from the Palk Bay; commercial catches from the Gulf of Mannar are mainly composed of young fish of medium size. There is a slight predominance of females over males up to 80mm. The sex composition of catches during the period may be stated as 40.8% females, 31.3% males and 27.9% indeterminates. The index of relative abundance of *Sardinella albella* is more than that of *Sardinella gibbosa* in the Palk Bay; in the Gulf of Mannar *S. gibbosa* is relatively more abundant than *S. albella.*

2151. **Sam Bennet, P.** 1961. *Peroderma cyclindricum* Heller. A copepod parasite of *Sardinella albella*. *J. Mar. Biol. Assoc. India*, 3(1&2): 70-74.

Address : Central Marine Fisheries Research Institute, Vizhinjam, Kerala, India.

Abstract : The genus *Peroderma* Heller (1868) includes four species, *P. cylindricum* Heller, *P.branchiate* Basset-Smith, *P. petersi Richiardi* and *P. bellottii Richiardi*. According to Wilson (1917) the last two species are poorly described and certainly do not belong to Peroderma. As Basset-Smith (1868) had only a single specimen he did not make any attempt to study the appendages. This precludes a detailed comparison of his species with the genotype. Brian (1906) and Wilson (1917) have considered *P. cylindricum* and *P. branchiate* as synonymous. The object of the present paper is not to discuss the synonymy but to give a detailed description of *P. cylindricum*. The original description of the species was supplemented by Monterosso (1922, '26 and '30) who gave a description of the structure and histology of the mature adult and the juvenile. A perusal of the available literature on the genus shows that information of the appendages is still incomplete. A rich collection of specimens facilitated a detailed study.

2152. **Sam Bennet, P.** 1964. On *Bomolochus sardinellae* sp. Nov. (Copepoda cyclopoida) parasitic on *Sardinella albella. J. Mar. Biol. Assoc. India*, 6(1): 84-88.

2153. **Sam Bennet, P and A. Chellam** 1977. *Peroderma tasselum* sp. nov. (Lernaeoceriformes; Copepoda) parasitic on the fish *Stolephorus commersonii* Lacepede. *Indian J. Fish*., 22: 279-282.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The female of a copepod parasite, *Peroderma tasselum* sp. nov. parasitic on the fish *Stolephorus commersonii* is described from Tuticorin, southeast coast of India. The species can be distinguished from the only other known species of the genus, *P. cylindricum*, by the characteristic shape of the trunk.

2154. **Sam Bennet, P.** 1980. *Pumiliopsis spathepedes* sp.nov, a cyclopoid copepod parasitic on the eye of *Sardinella sirm. Indian J. Fish.*, 27(1&2): 273-278.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The female of a new species of copepod parasite, *Pumiliopsis spathepedes* is described from the eye of the sardine, *Sardinella sirm* from Tuticorin, Southeast coast of India. It has been compared with the only other known species in this genus namely *P. sardinellae*. The species can easily be distinguished from all the other bomolochids hitherto known by the enormously developed fifth leg.

2155. **Sam Bennet, P., S. Lazarus, R. Thiagarajan and G. Luther** 1986. The present status of our knowledge on the lesser sardines of Indian waters. *CMFRI Spec. Publ.,* 28: 1-43.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of research carried out at Waltair, Mandapam. Tuticorin and Vizhinjam and at other centres on the lesser sardines over the past up till 1978 are reviewed in detail. During the period 1958 to 1978 there was an increasing trend of production of these fishes along the different coasts of India, the average annual landing nearly doubling from 36,000 t in 1958-67 to 70,000 t in 1968-78. The bulk of the catches came from Tamil Nadu, including Pondicherry, (32.6%), Kerala (32.2%) and Andhra Pradesh (26.5%). Fishing was mostly by the labour-intersrive traditional methods in close-shore waters, better catches coming from 30-55 m depths. Shore seines, boat seinse and gill nets were the principal gears employed in the fishery though gill nets were the most effective.

2156. **Sam Bennet, P and G. Arumugam** 1988. New trends in the traditional marine fisheries at Tuticorin. *CMFRI Spec. Publ.*, 40: 22-23.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Quiet changes have taken place during recent years in the fishery by traditional craft and gear at Tuticorin. This study refers to the changes due to the introduction of mechanisation of traditional fishing craft. Since 1985, over 90 Tuticorin-type boats have been fitted with inboard engines of 10 Hp, mainly of the Kangaroo-make. These boats operate drift nets and hooks and lines for demersal as well as pelagic species of fish. Data collected two years before and two years after the introduction of mechanisation of the indigenous craft have been compared. Operational parametres and benefits of mechanisation are discussed. The fishermen are benefited by increased catch per unit as well as increased price for the catch by arriving earlier.

2157. **Sam Bennet, P and G. Arumugam** 1989. New trends in the traditional marine fisheries at Tuticorin. *CMFRI Bulletin,* 44(1): 155-158.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : During the past two decades revolutionary changes have taken place in the craft and gear employed in the coastal indigenous fisheries An important ingredient in the craft development in indigenous fisheries was the introduction of mechanisation on a large scale with the financial support of Governmental agencies in the 1960s. Encouraged by the Government many small scale fishermen took up mechanisation of craft. However, this has developed into industrialisation of lucrative pelagic and demersal fisheries benefitting the people who could operate large fishing boats. small scale and indigenous fishermen were left in the sarna old state with their traditional methods of fishing artisanal fishermen have withstood the onslaught by large scale mechanisation of fishing operations and have rallied round in recent years to introduce power to their traditional crafts. This study deals with the introduction of machines to traditional craft employed at Tuticorin with inboard engines and is confined to observations spread over a period of four years from 1983 to 1986. The impact of introduction of engines to traditonal crafts are brought out and discussed.

2158. **Sam Bennet, P., G. Arumugam and T.S. Balasubramanian** 1990. Tagged tiger shark *Galeocerda cuvieri* landed at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 104: 14-15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : A tagged tiger shark *Galeocerda cuvieri* was caught in a mechanized Tuticorin type boat. The fish weighed 130 kg and the morphometric measurements are given.

2159. **Sam Bennet, P and G. Arumugam** 1991. The present status of small-scale traditional fishery at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 113: 1-16.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The traditional crafts and gears used for small scale fishery are discussed and the annual fish catch in this region are also given.

2160. **Sam Bennet, P and G. Arumugam** 1993. Impact of motorization on the traditional fishery at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 123: 8-11.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The present study is an analysis on the impact of motorization on traditional fishermen and deals with the total fish catch of various gears using motorized crafts as compared with total catch by non-motorized crafts.

2161. **Sam Bennet, P and G. Arumugam** 1993. Advancement in traditional fishing methods for nearshore fisheries around Tuticorin, Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 35(1&2): 105-108.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Recent years have witnessed a silent diversification of traditional fishing methods all along the east and west coasts of India. This is especially so around Tuticorin. Two recent innovations in fishing gear added great impetus to the capture of nearshore fish and prawns. One such gear is the 'Thallumadi' a smaller modified version of the shrimp trawl. It is operated round the year from a single non-mechanised Tuticorin type boat. Another gear is the improved drift gill net the 'Disco net'. It is normally operated from a powered Tuticorin type boat. By and large these nets are dependable and good many traditional fishermen are benefited from them by way of improved catch. Operational parameters, species composition and catch-per-unit are given for 'Thallumadi' from 1979 to 1986 and for 'Disco net' from its introduction in 1987 season.

2162. **Sam Bennet, P. and G. Arumugam** 1993. Small-scale shore seine fishery at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 123: 5-8.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Catch effort in kilogram during the period 1987-91 are reported.

2163. **Sam Bennet, P., M. Rajamani and G. Arumugham** 1993. Live lobster export from Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 123: 19-20.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The average annual production of spiny lobster in India is around 2000 tons and this is adequate to meet the increasing demand in the internal and export market.

2164. **Sam Bennet, P and G. Arumugam** 1993. Heavy landing of brown pomfret at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 123: 20-21.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The bumper catch and estimated effort of brown pomfret are discussed.

2165. **Sam Bennet, P and G. Arumugam** 1994. Catamaran fishery for *Hilsa toli* at Tuticorin. *Mar. Fish. Infor. Serv. T & E. Ser.,* 126: 14-15.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The estimated catch of *Hilsa toli* landed by catamaran at Tuticorin south fish landing centre is discussed.

2166. **Sam Bennet, P and G. Arumugham** 1994. Perch fishery by traditional methods at Tuticorin. *CMFRI Bulletin,* 47: 26-35.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : The perch fishery at Tuticorin, Tamil Nadu, India by traditional fishing units are dealt with. Rocky areas up to 50 m depth support many species of perches falling under ten broad families. On an average perches contribute 10.9% in the total fish landings by traditional gears. Lethrinids, Serranids and Nemipterids form the bulk of perch landings with Lethrinids alone contributing 38.1%. Drift nets, hook and lines and bottom set gill nets are the important gears in the fishery. Perch fishery by motorised as well as non-motorised units are described in detail.

2167. **Sampson Manickam, P.E.** 1986. Shrimp industry in and around Mandapam, *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp,* pp. 30-31.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

2168. **Sampson Manickam, P.E., M.R. Arputharaj and P. Vedavyasa Rao** 1988. A survey of the exploitation of juveniles of green tiger prawn, *Penaeus semisulcatus*, along Palk Bay and its impact on the prawn fishery of the region. *CMFRI Spec. Publ.,* 40: 20-21.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The green tiger prawn *Penaeus semisulcatus*, contributes to over 50% of the total prawn catch landed along the Palk Bay coast. Intense fishing for juvenile prawns, which inhabit the seagrass ecosystem near the shore, is taking place all along the coast. The results of a survey carried out on this exploitation pattern are reported. The prawn catch, the bulk of which is composed of juvenile *P. semisulcatus*, is found to vary from 2 kg to 10 kg per unit per day. The size of the exploited *P. semisulcatus* ranges from 31 mm to 100 mm total length with the dominant size group at 45-70 mm. As the catch is composed exclusively of small-sized juvenile prawns and since the nets are operated in the seagrass beds that form the nursery grounds for the prawn resources, the impact of this exploitation on the overall *P. semisulcatus* resource in the region is discussed.

2169. **Samuel, D.** 1976. A digenic trematode infection in the edible oyster *Crassostrea madrasensis* (Preston). *Indian J. Fish.*, 23(1&2): 153-159.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The cercaria of *Bucephalopsis haimeanus*, a digenic trematode, parasitic on the edible oyster *C. madrasensis* from Karapad oyster farm at Tuticorin is reported. The cercaria belongs to Gasterostome type having forked caudal rami. The morphology of the parasite is described, and the effect of parasitism, namely, sterility and change in flesh weight in the oyster is discussed.

2170. **Samuel, D.** 1983. Early larval development of edible oyster *Crassostrea madrasensis* (Preston). *Proceedings of the symposium on coastal aquaculture, held at Cochin from January 12 to 18, 1980. Part-2: Molluscan culture.* MBAI, Cochin, India, 6: 483-487.

Address : Department of Zoology, Christian College, Kattakada, Trivandrum-695 572, Kerala, India.

Abstract : Mature male and female edible oyster *Crassostrea madrasensis* selected from the Tuticorin oyster farm were stripped and the eggs were artificially fertilized in glass containers. 91.5 to 92.2 percentage of eggs underwent successful fertilization and the larvae were reared upto umbo stage in one experiment. The size of the mature egg varied from 49 to 59µ. 85% of the fertilized eggs successfully reached the straight hinge-stage in 18 to 24 ½ hours. The umbo stage was reached in 11 days, provided *Chlorella salina* was supplied as food.

2171. **Samuel Paulraj, G. Rajannan, G. Gopalaswamy and B.S. Raman** 1984. Tolerance of certain marine organisms to fertilizer plant effluent. *Fert. News*, 29(5): 43-47.

Address : Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu, India.

Abstract : A bioassay study was conducted to find out the safe concentration of fertilizer factory effluent on the commercially important marine fish species of Tuticorin coast, viz., *Mugil cephalus, Chanos chanos, Penaeus indicus* and *Crassostrea madrasensis*. The study was conducted for about 10,000 minutes and LD_{50} for 24 hours, 48 hours and corresponding lethal doses were determined.

2172. **Sandhya Sukumaran and C. Kasinathan** 2004. An interesting note on floating corals. *Mar. Fish. Infor. Serv., T&E Ser.,* 182: 10.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : It is believed that a floating stone kept near the fire faced Hanuman temple in Rameswaram was one of the stones used to build the legendary bridge in Ramayana between India and Srilanka. The floating stone on a closer examination reveals that it is a coral. Corals of the genus *Favia, Platygyra* etc., are kept floating in a tank filled with water. This is in conformity with the massive floating coral belonging to the genus *Favia* kept floating in the aquarium at Mandapam regional center of CMFRI.

2173. **Sandhya Sukumaran and C. Kasinathan** 2006. A note on the landing of a slender sunfish near Rameswaram. *Mar. Fish. Infor. Serv. T&E Ser.,* 187: 18.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstracts : A sun fish *Ranzania laevis* (Pennant) (Slender mola), belonging to the family Molidae measuring 620mm in total length and 7kg weight was caught in shore seine on 25-01-06 from Gulf of Mannar near Rameswaram.

2174. **Sankarankutty, C.** 1961. On a new Genus of Porcellanidae (crustacea - Anomura). *J. Mar. Biol. Assoc. India,* 3(1&2): 92-95.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A new genus *Pseudoporcellanella* (Family-Porcellanidae) has been created to accommodate a new species *P. manoliensis.* The description of the new genus and species has been given and its affinities have been discussed.

2175. **Sankarankutty, C.** 1961. On the porcellanid crab, *Porcellanella triloba* a commensal on sea pen; with remarks on allied species. *J. Mar. Biol. Assoc. India,* 3(1&2): 96-100.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Porcellanella triloba* White which is a common porcellanid crab commensal on the sea pen *Pteroeides esperi* Herklots has been redescribed in this paper. *Porcellanella piela* Stimpson is here considered as a synonym of *P. triloba* White and reasons have been given for doing so.

2176. **Sankarankutty, C.** 1962. On the occurrence of *Athanas dorsalis*. (Decapoda Alpheidae) in the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 4(2): 167-171.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623 520, India.

Abstract : Banner (1960) in a revision of the genus *Athanas* Leach has provided a key for the identification of the species belonging to this genus from the Indo-pacific region. The genus *Athanas,* which was once separated from a closely related genus *Arete* Stimpson based on the number of segments of carpus in the second pereiopod (5 in *Athanas* and 4 in *Arete)* and biunguiculate third pereiopod in *Arete* and uniunguiculate in *Athanas,* has already been merged together (Banner 1960) and *Arete* now stands as a synonym of *Athanas.* Of the 28 species so far known from the whole of the Indo-Pacific region, only 8 species are known to occur in Indian Ocean. Out of the above 8 species, only 1 species is on record from the coasts of Indian Peninsula (Kemp 1915). Except for *A. orientalis* Pearson and *A. polymorphiis-Kergp,* which appear to be endemic in distribution *(A. orientalis* was reported from Ceylon and *A. polymorphus* from Chilka Lake), the rest of the 6 species have all a very wide range of distribution at least from the east coast of Africa to Indonesia. This evidently indicates that alpheids as a whole is so far a little known group as far as Indian region is concerned and except for the exhaustive accounts by Coutiere (1903 & 1906), who made a. thorough study of alpheids of the Laccadive and Maldive Archipelagos, there is practically no work dealing with this group of decapods. The only male specimen of *A. dorsalis* was collected on 3-11-1961 from *Stomopneustes* sp., which is found attached to the undersides of rocks in the Gulf of Mannar near the shore at a depth of about one metre, a little towards the west of C.M.F.R.I. pier. The shrimp is practically invisible on the sea urchin since it is jet-black thereby completely merging with the dark colour of sea-urchin. Despite further attempts no more specimens could be collected. Though *A. dorsalis* is already known to occuur as commensal on sea urchin, till now there has been no account of its occurrence from the coasts of Indian Peninsula, although Coutiere (1903) reports the species from Laccadives and Maldives.

2177. **Sankarankutty, C.** 1963. On three species of porcellanids (Crustacea-anomura) from the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 5(2): 273-279.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The present report is based on a small collection of porcellanids from the Gulf of Mannar off Tuticorin

and has been found to be of interest since it includes a new species and yet another species which has not so far been recorded from the coasts of Indian peninsula. All three species were found to live as commensal on coelenterates and were collected from depths ranging from 18 to 25 metres using aqualung. Compared to the very exhaustive works on Brachyura by Alcock and by later workers, Porcellanidae has been a less known family as far as the Indian region is concerned the contributions from India being by Henderson (1893), Southwell (1906 & 1909), Gravely (1927) and Sankarankutty (1961). The present collection is deposited along with the reference collections of the Central Marine Fisheries Research Institute, Mandapam Camp.

2178. **Sankarankutty, C.** 1965. On decapoda brachyura from the Gulf of Mannar and Palk Bay. *Proc. Symp. on Crustacea, MBAI,* 1(2): 347-362.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623 520, India.

Abstract : Materials forming the basis of the present investigation are 88 species of Brachyura representing the families Dromiidae, Dorippidae, Calappidae, Leucosiidae, Hymenosomidae, Parthenopidae, Pinnotheridae, Gonoplacidae, Portunidae, Grapsidae, Ocypodidae and Xanthidae collected from the Indian coast of the Gulf of Mannar and Palk Bay. Of the total of 88 species, *Zalasius indica* is new to science, *Portunnus samoensis* (Ward) is perhaps known only from the type locality and *Rhabdonotus pictus* A. Milne Edwards has so far been reported only by A. Milne Edwares (1978) and De Man (1888); the additional records for the Indian region are *Dromidiopsis craniopsis cranioides* (De Man), *Dorippe polita* Alcock and Anderson, *Elamena sindensis* Alcock, *Halimus aries* (Latreille), *Metopograpsus frontalis* Miers, *M. thukuar* (Owen), *Thalamita spijifera* Borradaile, *T. parvidens* Rathbun, *Charybdis* (Charybdis) *anisodon* (De Haan), *Portunus pubescens* (Dana) and White, *Philyra verrucosa* Henderson and *Aethra scruposa* (Linnaeus) are species of interest. A brief outline on the species of Brachyura associated with the various habitats of this area has been given, in so doing only species typical of the particular habitat is included.

2179. **Sankarperumal, G and A. Palavesam** 1990. Effect of sodium chloride, ammonium chloride and low temperature shock on hatchability and survival of the eggs of *Chironomus circumdatus* (Kieffer) (Diptera : Chironomidae). *Proceedings of 10th Annual Session of AEB & Symposium on Environmental Pollution on Biosystems",* Loyola College, Chennai. pp. 169-179.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

2180. **Santhakumari, V and M. Saraswathy** 1981. Zooplankton along the Tamil Nadu coast. *Mahasagar*,14(4):289-302.

Address : National Institute of Oceanography, Cochin-682 018, India.

Abstract : Zooplankton abundance along two sectors at Cape Comorin and Tuticorin of Tamil Nadu coast, southeast coast of India was studied. High biomass contributed by Ostracods, Salps, Chaetognaths *etc*., were observed along Tuticorin transect. In the Cape Comorin area copepods and decapods were dominant. The dense swarm of the ostracod *Cypridina dentate* (34556/100m^3) off Tuticorin was a noteworthy feature. The fluctuations in numerical abundance and percentage composition of all the major planktonic groups are illustrated and discussed.

2181. **Santhakumari, V.** 1985. Epizoic and ectoparasitic protozoans from planktonic copepods of the southwest and southeast coasts of India with the description of a new species. *J. Mar. Biol. Assoc. India,* 27(1&2): 29-38.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

Abstract : Of the 10 species of Protozoa recorded, one, *Acineta sajirae* sp., is new to science. The 10 species and a few cysts are described with illustrations. *Trochilioides trivialis* and *Paracineta pleuromammae* are new records from the Indian Ocean. *Ephelota gemmipara* is recorded for the first time. *A. sajirae* is an ectoparasite found infesting the appendages and the body proper of different species of planktonic copepods collected from 4 sectors, off Tuticorin, off Cape Comorin, off Karwar, and off Ratnagiri. The nature of association, host, associate relationship and the rate of infestation are discussed.

2182. **Santhanam, R., N. Sukumaran and M.N. Kutty** 1980. Survival of fishes and crustaceans of Tuticorin Bay to Graded Increase in Temperature. *Indian J. Mar. Sci.,* 9(4): 296-297.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract: With a view to finding out the influence of high temperature on the fish and crustacean fauna of Tuticorin Bay where the discharge of heated water from thermal plant may be possible, species of fishes, viz.,

Gobius optomus, Scatophagus argus, Therapon jarbua, Tetradon leopardus, Mugil sp. and *Syngnathus carce* and species of crustaceans, viz., *Penaeus indicus and Squilla* sp. were subjected to graded increase (0.5°C/15 min) in temperature. Among the species *T. jarbua* was most tolerant and *Squilla* sp. the least.

2183. **Santhanam, R., K. Venkataramanujam and G. Jagatheesan** 1985. Prawn picking - A sustenance for rural women folk. *Fish. Chimes,* 1985. 5(5): 35-36.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : An account is given of the handpicking of prawns in Pullavazhi by rural women.

2184. **Santhanam, R and R. Raghavan** 1989. Planktonic molluscs that indicate ocean currents. *Sci. Rep. New Delhi*, 26(9): 517-518.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Molluscs live on the sea bottom and are abundant in warmer parts of the ocean. Some molluscan species like *Janthina, Limacina* and *Clione* drift in vast swarms into the North Sea from the Atlantic Ocean due to water current and winds, and hence serve as useful indicators to understand the movements of water masses and fishery resources.

2185. **Santhanam, R and P. Velayudhan** 1991. Mass culture of zooplankton for coastal aquaculture. *Fish Chimes*, 11(3): 39-40.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Details are given of the mass culture of *Brachionus plicatilis* and Cladoceran species such as *Daphnia* and *Moina* . These zooplankton species serve as ideal food items for fish and prawn larvae.

2186. **Santhanam, R and P. Velayuthan.** 1991. Low cost feeds for marine prawn farming. *Seafood Export J.*, 23(6):8-9.

Address: Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The use of artificial feeds in prawn farming has become common practice due to its inherent qualities over natural food items. The different ingredients used in pellet feed preparation, method to prepare pelleted feed and the ration requirements of prawns in relation to their size are described in this paper.

2187. **Santhanam, R., A. Srinivasan and M. Devaraj** 1993. Trophic model of an estuarine ecosystem at the southeast coast of India. *Proc. on Trophic models in Aquatic Ecosystems.* (*Eds*) V. Christensen and D. Pauly. Manila, Philippines, *ICLARM.*, 26: 230-233.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The present investigation details the trophic connections existing among the planktonic, pelagic and benthic components of the Pullavali brackishwater, a tropical estuarine ecosystem at the southeast coast of India where such studies have not been made hitherto. The production and loss of energy (gC. m^2.$year^{-1}$) at successive trophic levels were estimated for a habitat area of 1.5 km^2 adopting random sampling, standard methods of R.B. William and assumptions of D.J. Crisp. A box trophic model postulated, using observed and assumed data of this estuaries ecosystem, showed a net primary production of 410 gC. m^2.$year^{-1}$, secondary production of 92.25 gC. m^2.$year^{-1}$, benthic production of 37.75 gC. m^2.$year^{-1}$, pelagic fish yield of 2 gC. m^2.$year^{-1}$ and demersal fish yield of 0.25 gC. m^2.$year^{-1}$. A comparison made with a shallow temperate estuary (Bogue Sound, North Carolina, USA) showed that the net primary production in the tropical estuarine ecosystem was higher than that of the other ecosystem. However the Pullavali brackishwater and Bogue Sound showed more or less similar efficiency in the different trophic levels as evidenced by the total fish yields, 0.55% and 0.50% of net primary production, respectively.

2188. **Santhanam, R and A. Srinivasan** 1994. Impacts of sewage and thermal pollution on the water quality, plankton and fishery potentials of Tuticorin coast, S. India. *Proceedings on Coastal Zone Canada '94, Cooperation in the Coastal Zone, Halifax, NS (Canada), 20-23 Sep' 1994.* (*eds*) P.G. Wells and P.J. Ricketts. 3: 1191-1201.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The Tuticorin coastal waters (South India) are under the constant influence of organic matter - rich sewage and heated water's from the nearby coal-fired thermal power plant. The present investigation (April 1990-March 1991) deals with the impacts of sewage and thermal pollution on the water quality, plankton and fishery potentials of the Tuticorin coast at two stations.

2189. **Santhanam, R., A. Srinivasan, V. Ramadhas and M. Devaraj** 1994. Impact of Trichodesmium bloom on the plankton and productivity in the Tuticorin Bay, southeast coast of India. *Indian J. Mar. Sci.*, 23(1): 27-30.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : *Trichodesmium thiebautii* bloom was noticed on 2 Mar 1989 in Tuticorin Bay, and hydrobiological investigations were carried out between 2 and 8 Mar 1989, when the bloom culminated. While the water temperature (29.1° -30.8° C), salinity (35-35.4 ‰) pH (8.2-8.9), nitrite (0.36-1.96 µg-at/l), phosphate (0.32-2.53 µg-at/l) and particulate organic carbon (7.12-29.54 g/m^3), showed generally higher values in association with maximum bloom density, dissolved oxygen (3.2-5.2 ml/l) and nitrate (0.2-0.78 µg-at/l) concentration recorded minimal values. Density of *T. thiebautii* ranged from 0.01 to 17.5 x 10^6 filaments/l during the bloom period. While the maximum species diversity (1.49) was associated with minimum bloom density, the maximum chlorophyll-*a* (535.26 mg/m^3), primary production (512 mg C/m^3/h and microzooplankton (72,000 no/l) coincided with the maximum bloom density. Interestingly, the total number of other phytoplankton and macrozooplankton were at minimum levels (*i.e.*, 120 cells/l) in association with the maximum bloom density.

2190. **Santhanam, R and K. Venkataramanujan** 1996. Impact of industrial pollution and human activities on the coral resources of Tuticorin and methods for conservation. *Proc 8th International coral reefs Symposium, Panama* p.177.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

2191. **Santhanam, R.** 2003. New Ornamental fish found in Indian seas. *The Hindu* 20th *December* 2003.

Address: Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract: Marine ornamental fish species in the Indian seas recorded are 77. New species of anemone fish or clown fish, *Amphiprion polynnus, Aphiprion bicinctus, Amphiprion sebae* and *Amphiprion percula* have been recorded in Seas.

2192. **Santhanam, R.** 2004**.** Ornamental fish. *The Hindu* 8th *May* 2004.

Address: Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract: The newly discovered Bi-colour fish (green and white), also known as 'Hog fish,' has very good export potential. The fish has been found in different parts of the world and not along the Indian coast.

2193. **Santhanam, R.** 2004**.** MoU for Marine Research. *The Hindu* 13th *May* 2004.

Address: Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract: A new bicoloured Hogfish, *Bodianus* sp., (Family: Labridae) has been found in the Keelakkarai coast of the Gulf of Mannar at a depth of 10 meters. Bodianus namely *Bodianus bilunulatus* and *B. Diana* have so far been recorded from the Indian sea against a total of 33 species found across the globe.

2194. **Santhanam, R.** 2004**.** Abnormally big cup corals found in Gulf of Mannar. *The Hindu* 28th *May* 2004.

Address: Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract: Two abnormally huge cup corals belonging to the species *Turbinaria undata* were found around four islands in the Gulf of Mannar. They were found during SCUBA diving around the islands of Van and Kaswari. This species provides shelter to molluscan species and finfish varieties, including ornamental fish.

2195. **Santhana Ramasamy, M and A. Murugan** 2001. Development of fouling organisms on pearl oyster *Pinctada fucata* during a period of 2 months. *Phuket Mar. Biol. Cent. Spl. Publ.*, 25(1): 57-58.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu India.

Abstract : *Pinctada fucata* is heavily fouled in Tuticorin waters. A two months experimental study showed that common fouling organisms were diatoms, coelenterates, bryozoans, crustaceans, tunicates, and polychaetes. The fouling pattern from the primary layer has been studied in detail and is discussed.

2196. **Santhana Ramasamy, M and A. Murugan** 2002. Studies on the effect of heavy metals on the enzymatic activity of bacteria isolated from mangrove sediments in Tuticorin coast. *SDMRI Res. Publ.* 2: 181-184.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: fouling_2000@yahoo.com

Abstract : Bacterial strains were isolated from the mangrove sediments of Tuticorin coast, Tamil Nadu, India. The percentage composition of Amylolytic, Proteolytic and Lipolytic bacteria were 76, 41 and 21 respectively. Majority of the total heterotrophic bacteria appear to be Amylolytic. Five potential amylolytic strains (a, b, c, d and e) were isolated. The effect of heavy metals copper, mercury, cadmium and nickel on enzymatic activity of the five isolated strains were studied. Controls were also maintained. In general the enzymatic activity of the strains was decreasing with increasing concentration of heavy metals. Though some strains (a, d, e) showed tolerance to copper, the activity was less when compared to control.

2197. **Santhana Ramasamy, M and A. Murugan** 2003. An investigation on the chemical antifouling defense in the marine algae *Padina tetrastromatica* Hauck distributed in Tuticorin coast of Gulf of Mannar. *Nat. Sem. Reef Ecosystem Remediation*, 24th-26th Sep'03, SDMRI, Tuticorin, India. p. 41.

Address : Suganthi Devadason Marine Research Institute 44 Beach Road, Tuticorin-628 001, India.

Abstract : The seaweed, *Padina tetrastromatica* Hauck was investigated for chemical antifouling defense. Interestingly, the seaweed harboured epibiotic bacteria. But, only 5 of the 50 epibiotic bacterial strains isolated from the seaweed showed inhibitory activity against the fifteen biofilm bacterial strains isolated from fouling panels. But, the methanolic extract of the *P. tetrastromatica* showed broad spectral inhibitory activity against all the fifteen biofilm bacterial strains. The THB of the surrounding water was estimated as 25 x 10^4 CFU/ml whereas the epibiotic bacteria on the surface of the *P. tetrastromatica* were 9 x 10^3 CFU/cm^2. The macrofoulers were visibly absent in *P. tetrastromatica.* Though the seaweed exhibited wide spectral inhibitory activity against all the biofilm bacterial strains, the presence of epibiotic bacteria on its surface could be explained to the selective inhibition. The study indicated the chemical defense exhibited by the seaweed *P. tetrastromatica.*

2198. **Santhana Ramasamy, M and A. Murugan.** 2003. Potential antibacterial activity of the chemically defended egg mass of the muricid gastropod *Chicoreus ramosus* against human pathogens. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 42.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : The gastropod egg masses are subjected to intense pressure like other marine forms and are also susceptible to predation and fouling. But, they are reported to have evolved mechanisms to avoid predation and fouling. Considering this unique adaptive strategy, the methanolic extracts of the egg masses of the muricid gastropod *Chicoreus ramosus* were screened against ten human pathogenic bacteria. At 10µg concentration, the extract inhibited all but two of the pathogens. 'Prominent inhibition of all the pathogens was observed at a concentration of 75 µg. The highest inhibition was observed for E. *coli* and lowest for *Klebsiella pneumoniae.* The extract showed promising activity against *E. coli, Bacillus subtilis, Enterobacter aerogenes, Staphylococcus aureus, Proteus vulgaris, Salmonella paratyphi* and *Serratia marcescens.* The antibacterial activity was observed in the fresh and developing egg masses and the well developed egg masses did not show inhibitory activity, which can be construed as an adaptation to avoid auto-toxicity to the developing embryos. The study indicated that the antibacterial property might have been derived from the adults and is localized to the internal matrix of the egg masses.

2199. **Santhana Ramasamy, M and A. Murugan** 2003. Antifouling property and possible chemical defense strategies in the starfish *Pentaceraster affinis* from Tuticorin, southeast coast of India. *SDMRI Res. Publ.*, 3: 129-132.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628001, Tamil Nadu India; E-mail: fouling_2000@yahoomail.com

Abstract : The extract of the starfish *Pentaceraster affinis* was screened for antifouling property. The ethanol extract of the starfish showed promising antibacterial activity against biofilm bacteria. It also inhibited the byssal production and attachment in the brown mussel *Perna indica* and the toxicity assay showed that the extract is not toxic. The EC_{50} and LC_{50} were 100 µg/ml and 193 µg/ml respectively. The low epibacterial density and visible absence of epibionts on the surface of the starfish indicate the fouling reducing activity.

2200. **Santhana Ramasamy, M and A. Murugan** 2003. Correlation between bacterial epibiosis and fouling deterrent activity of *Distaplia nathensis* and *Polyclinum constellatum*. *SDMRI Res. Publ.*, 3: 165-167.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628 001, Tamil Nadu

India; E-mail: fouling_2000@yahoomail.com

Abstract : The ascidians *Distaplia nathensis* Meenakshi and *Polyclinum constellatum* Savigny collected from Tuticorin, Gulf of Mannar harbour varied in numbers of epibiotic bacteria. The antimicrobial assay of the organic extracts of the ascidians against the biofilm bacteria showed varying inhibitory activity. It has been observed that the epibiotic bacterial number was low in ascidians, which exhibited higher antimicrobial activity, and vice-versa. The presence of epibacteria in spite of the wide spectrum antimicrobial activity exhibited by the ascidians indicated the possible selective inhibition against specific and fouling-reducing adaptation.

2201. **Santhana Ramasamy, M and A. Murugan** 2005. Potential antimicrobial activity of marine molluscs from Tuticorin, southeast coast of India against 40 biofilm bacteria. *J. Shellfish Res.*, 24(1): 243-251.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin-628 001, Tamil Nadu, India; E-mail: muruganrsa@sancharnet.in

Abstract : Methanol: water (1:1), methanol: dichloromethane (1:1) and acetone extracts of molluscs comprising 77 whole body, four inks, four opercula, 10 egg masses, and 10 digestive glands were screened for antimicrobial activity on marine biofilm bacteria. The methanol: water (1:1) whole body extracts of *Nerita albicilla* and *Nerita oryzarum* showed broad spectral inhibitory activity against 93% and 95% of the 40 biofilm bacteria. The egg masses from 10 gastropods showed activity against more than a quarter of the biofilm bacteria. The methanolic extract of *Chicoreus virgineus*, *Chicoreus ramosus* egg masses, and acetone extract of the egg mass of *Rapana rapiformis* showed broad-spectrum antibacterial activity against all the 40 biofilm bacterial strains. The activity in gastropod egg masses was localized to their internal matrix. Overall screening showed activity in 38.1 % of the methanolic extracts followed by 13.3% of methanol: water, 12.4% of methanol: dichloromethane, and 3.8% of acetone extracts. Gastropods showed good activity when compared with bivalves and cephalopods.

2202. **Saraswathi, S.J., B. Babu and R. Rengasamy** 2003. Seasonal studies on the alginate and its biochemical composition 1: *Sargassum polycystum* (Fucales), Phaeophyceae. *Phycol. Res.*, 51(4): 240-243.

Address : CAS in Botany, University of Madras, Guindy Campus, Chennai 600 025, Tamilnadu, India.

Abstract : Investigations were made on the brown seaweed *Sargassum polycystum, C. Agardh* collected from Rameswaram Coast, Tamil Nadu. The alginates extracted from leaf, stem and entire thallus of *S. polycystum* were investigated for their viscosity and chemical constituents, namely â-D-mannuronic acid (M-block), á-L-guluronic acid (G-block) and alternating sequences of â-D-mannuronic acid and á-L-guluronic acid (MG-block) for six different seasons between August 1998 and November 1999. Significant seasonal variation ($P < 0.05$) was observed with high yield of alginate in February. The alginate extracted from the 'leaf' region showed a maximum yield whereas the 'stem' region exhibited maximum viscosity. The amount of G-block was found to be more than M- and MG-blocks in all the samples tested. The amount of G-block was high in 'stem' followed by 'leaf and entire thallus. A positive correlation was recorded between viscosity and G-block. Among the three alginates, the ratio of M/G was low in the 'stem' followed by 'leaf' and entire thallus.

2203. **Saravanakumar, R., S. Aunto Princy Vyla, R. Jeya Shakila and G. Jeyasekaran** 2005. Fatty acid composition of marine algae and seagrass of Gulf of Mannar coast. *Nat. Symp. Marine Plants, their chemistry and utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, dated 23-25 June 2005. p 37.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Fatty acid composition of four species of green seaweeds, two species of red seaweeds, a single species of brown seaweed and seagrass were determined by gas chromatography to examine the potential sources of health beneficial **ν**-3 fatty acids. Fatty acid profile of marine seaweeds was significantly different among each other. In green seaweed *Enteromorpha* sp., palmitic acid (C16:0) was predominant (33.86%) and small proportion of lauric acid (C14:0), eicosatrienoic acid (C20:0) and eicosapentaenoic acid (C20: 5) were detected. Saturated fatty acids, C16:0 and C17:0 were predominant in green seaweed, *Caluerpa* sp. and smaller proportions of C18:3 (n-6) and C21:0 were also determined. Green seaweed *Chaetomorpha* sp. contained C16:0 (16%), C18: 2 (10%) and C18: 3 (8%) in higher proportions. In green seaweed (*Codium* sp.) C16:0 and C14:0 were predominant and smaller proportions of oleic acid (C18: 1) and linoleic acid (C18: 2) were detected. Red seaweed, *Gracilaria* sp. had C16:0 (23-26%) in higher proportions along with palmitoleic (C16:1), stearic (C18:0) and eicosatrienoic acids (C20:3). In brown seaweed, *Padina* sp, C16:0 was predominant (41 %) followed by C18:0 (14%) C 14:0 (8.1) and C20:3 (9%). The seagrass *Halodule pinifolia* contained larger proportions of many fatty acids such as C16:0 (37%), C18: 2 (15%), C18: 3 (12%). The proportion of **ν**-3 fatty acids was higher (10%) in brown seaweed *Padina* sp. followed by red seaweed, *Gracilaria* sp. (6 %).

2204. **Sarma, A.** 1978. Paleoecology: Coastal Tamilnadu, south India: Chronology of raised beaches. *Proc. Am. Philos. Soc*., 122(6): 411-426.

Address : Department of Asian Studies, Temple University, Philadelphia, PA-19122, USA.

Abstract : There are several marine terraces in Tamilnadu whose elevations have been mentioned. The younger marine terraces probably are late Pleistocene formations. The higher marine terraces are of marginal archaeological interest. The tectonically derived (uplift-associated) terraces are of extreme archaeological interest. Regions with spot elevations of 3 and 6 m are especially interesting, as the archaeological material in these provided clues to chronology of the uplift. The 3 and 6 m uplifted areas were found to be associated with archaeological sites ranging from the second century BC to the first century AD, and sites extending from the seventh century AD to the thirteenth century AD. These terraces and uplifted areas are all overlain by Quaternary deposits in the districts of Kanyakumari, Tirunelveli, and Ramnad. Some of these deposits are composed of corals, limestones mixed with organic debris, and marine shells. In the coastal Tanjore district, these coastal terraces are uniquely different, being mostly alluvial sediments deposited over beach ridges. In South Arcot and Chingleput, beach sands predominate which, as such, obliterate the uplift evidences.

2205. **Sarma, N.S and S.R. Rao** 2005. Anti-HIV and anti-cancer activities of a diterpene and a sesquiterpene from soft corals off the Indian coast. *Proc. Andhra Pradesh Akad. Sci*., 9(2): 183-184.

Abstract : A new diterpene ether of the Sclerophytin family viz., Sclerophytin F methyl ether and a known sesquiterpene isolated from the soft corals *Cladiella kremfi* and *Nephthea* sp., of the Lakshadweep Islands and the Gulf of Mannar respectively were tested in vitro for anti-HIV and anti cancer activities. Sclerophytin F methyl ether showed moderate activity as an anti-HIV agent, and the sesquiterpene, a mild suppressing action against CNS-cancer.

2206. **Sarojini Menon, V., B. Leelambika and M.S. Krishnamurthy.** 1993. Some observations on the distribution of macrophytes in Tuticorin coast. *Seaweed Res. Utiln.,* 16(1&2): 57-62.

2207. **Sarvesan, R.** 1969. Some observation on parental care in *Octopus dollfusi* Robson (Cephalopoda: Octopodidae). *J. Mar. Biol. Assoc. India,* 11(1&2): 203-205.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : Some of the octopi are well known for their complex behaviour during the brooding period. The present paper describes certain remarkable habits observed in a brooding adult of *Octopus dollfusi* Robson. ***O. dollfusi*** appears to be a species of restricted distribution, having been recorded so far only from Nias, Amoy and Ennore (Madras). However it seems to be a common littoral form on the southeastern coast of India.

2208. **Sarvesan, R.** 1974. Cephalopods. *CMFRI Bulletin,* 25: 63-83.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The cephalopods (squids, cuttlefish and octopi) are exclusively marine molluscs. These are commercially important and are fished in large quantities in several countries. The average annual world catch of cephalopods during the period 1963-1969 was 901 thousand tonnes which is about 30% of the average total world mollusc production of 2,971 thousand tons for the same period. Represented by over 650 species (Choe, 1966) cephalopods occur in all the oceans of the world, and are distributed from shallow inshore areas to deep oceanic waters. They widely range in size from tiny sepiolids to giants like *Architeuthis* sp., which grow to a size of over 60 feet in total length. They provide food for man and form part of the diet of animals such as whales, seals, oceanic birds and certain valuable food fishes.

2209. **Sarvesan, R.** 1976. On the occurrence of *Sepia trygonina* (Rochebrune) (Cephalopoda: Sepiidae) in Gulf of Mannar. *Indian J. Fish.*, 23(1&2): 256-260.

Address : Central Marine Fisheries Research Institute, Madras-600 008, Tamilnadu, India.

Abstract : The report confirms the occurrence of the cuttlefish, *S. trygonina* in Indian waters. A brief description of the species based on specimens of one male and one female collected from Gulf of Mannar off Tuticorin is given.

2210. **Sasaki, K.** 1994. *Johnius mannarensis* Mohan (Sciaenidae); a valid species distinct from *J. macropterus* (Bleeker). *Jap. J. Icthyol.,* 41(1): 65-67.

Address: Department of Biological Sciences, Kochi University, 2-5-1 Akebono-cho, Kochi 780, Japan.

Abstract : Mohan described *Johnius* (Johnius) *mannarensis* from three specimens collected off Pamban, Gulf of Mannar, southeast coast of India, increasing to three number of species possessing a chin barbel included in the subgenus at that time. Trewaves, however, recognized only two species: *J. amblycephalus*, characterized by cycloid body scales, and *J. macropterus*, with ctenoid body scales. *J. mannarensis* Mohan, 1969, was placed under the synonymy of the latter, an action subsequently followed by Mohan. In the present paper, however, I recognize *J. mannarensis* as a valid species, distinct from *J. macropterus*. Mohan distinguished *J. mannarensis* from *J. macropterus* on the basis of dorsal fin soft ray counts (given as 27 and 30-33, for each species, respectively) and three proportional measurements (head, chin barbel and second and spine lengths). Reexamination of both species (28 *J. mannarensis*; 40 *J. macropterus*) supports Trewavas statement that they cannot be distinguished from one another on body proportions. However, examination of several meristic and morphological characters, including the number of dorsal fin soft rays, demonstrated that the two species are clearly different.

2211. **Sastry, V.M.V.S and G.R.K. Rao** 1994. Antibacterial substances from marine algae: Successive extraction using benzene, chloroform and methanol. *Bot. Mar.*, 37(4): 357-360.

Address : Department of Biochemistry, Institute of Medical Science, Banaras Hindu University, Varanasi - 221 005, India.

Abstract : Three different solvents viz., benzene, chloroform, and methanol have been used successively to obtain crude extracts from five different algae. These extracts were tested against both gram-positive and gram-negative bacterial strains for the antibacterial activity. The chloroform extract exhibited the greatest antibacterial activity. All the algae sampled, *Saragassum wightii* (Grev.) J. Ag., *Padina tetrastromatica* Hauck (Phaeophyceae); *Gracilaria corticata* J. Ag., *Acanthophora delilei* Lamx (Rhodophyceae) and *Halimeda tuna* (Ellis *et. al.*) Lamx (Chlorophyceae) were collected from the Mandapam coast on the southeast coast of India at latitude 9° 45' N and longitude 79° 0' E during the winter season (second and third week of October) annually (1988, 1989, 1990).

2212. **Satheesh, S and S. Godwin Wesley** 2005. Settlement pattern of seaweeds on suspended test panels in Kudankulam coastal waters. *Nat. Symp. Marine Plants, their chemistry and utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, 23-25 June 2005. p 55.

Address : Department of Zoology, Scott Christian College, Nagercoil - 629 003, Tamilnadu, India.

Abstract : Quantitative information about macro algal settlement on submerged hard substrates in marine waters is scanty. Seaweed settlement on natural and artificial hard substrate is of ecological importance as the macro algae provide shelter and food to variety of marine biota. The settlement pattern of seaweeds on hard substrate is studied by suspending wooden panels in Kudankulam coast for a period of one year from May 2003 to April 2004. The panels are exposed on short-term basis and observations are made at fortnightly intervals. *Gracilaria* sp., *Enteromorpha* sp., and *Ulva* sp., are the common seaweeds settled on the panels. The abundance of seaweeds on panel was high during pre-monsoon season and low during post-monsoon months. The biomass for fifteen days exposure period ranged from 0.004 g/10cm^2 to 2.5g/10cm^2. The influence of hydrological parameters such as surface water temperature, salinity, pH and nutrients on the settlement pattern are also analyzed.

2213. **Sathiadhas, R.** 1982. Mechanisation of indigenous crafts with outboard motors in Tamil Nadu - An impact study. *Mar. Fish. Infor. Serv. T & E. Ser.*, 38: 17-19.

Address: Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The details of number of catamarans fitted with outboard engines in Kanyakumari and Tireunelveli coast were detailed.

2214. **Sathiadhas, R.** 1989. Comparative economic efficiency of sail boats operating different gears in Tamil Nadu. *Mar. Fish. Infor. Serv. T & E. Ser.*, 97: 8-16.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The present study was carried out in Tuticorin region of Tamilnadu. The main objectives of the study were to identify the present status of the utilization of wind energy for fishing operations, to compare the costs and returns of traditional fishing practices and to determine how far the utilization of wind energy in near shore trawling is economically viable as compared to other existing practices.

2215. **Sathiadhas, R and K.K. Panikkar** 1989. Costs and earnings of trawlers operating at Tuticorin fisheries harbor (Tamil Nadu). *Mar. Fish. Infor. Serv. T & E. Ser.*, 100: 1-8.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Quarterly average operating costs and returns per unit of trawlers at Tuticorin fisheries harbor are given. Moreover, the annual income and expenditure statement of trawlers of different size are discussed.

2216. **Sathiadhas, R and R.E. Benjamin** 1990. Economics of mechanised fishing units along Tamil Nadu Coast. *Seafood Export J.*, 22(1): 15-30.

Address : Department of Economics, Madurai Kamaraj University, Madurai-625 021, Tamilnadu, India.

Abstract : The main thrust in the marine fisheries sector during the first three Five year plan periods and the following three Annual Plans was on the motorisation of fishing Crafts existing at that period and introduction of new mechanised fishing boats. The export demand coupled with high unit value realisation of prawns added the speed of the growth of the mechanised fleets. The enhanced mobility of fishing crafts led to the exploitation of hitherto unknown-and under exploited species of fish and induced many fishermen to shift from traditional to mechanised fishing. With the advent of mechanisation in the fisheries sector, development of diversified fishing methods in the artisanal fishery has also gathered momentum. Mechanisation not only led to intensification of fishing but also paved the way for the growth of an organised seafood export industry and consequent increase in employment opportunities. However, the mechanised fleets were highly depending on trawl fishing and prawn catches for their sustenance. Initially the 7.6 and 9.1 metre size boats were designed and introduced for gillnetting.

2217. **Sathiadhas, R and R.E. Benjamin** 1991. A note on the operational cost and returns of seasonal "mixture madi" operations along Kanyakumari coast. *Seafood Export J.*, 23(1): 24-27.

Address : Department of Economics, Madurai Kamaraj University, Madurai - 625 021, Tamilnadu, India.

Abstract : The south west coast of Tamil Nadu, India, has high fishery potential. Colachel is a natural harbour and an important landing centre. Mechanised fish landings at Colachel, economics of its operations and distribution pattern of some of the commercially important marine fish during July-September 1989 are discussed together with data on average operational expenditure, species-wise catch particulars, marketing and distribution pattern of catch. Details of wages, average fuel expenditure and net income are given in respect to the use of mechanised boats. Fish landings, marketing and distribution pattern of fish catches, price structure and revenue are also discussed.

2218. **Sathiadhas, R and K.K. Panikkar** 1991. Socioeconomics of traditional fishermen in Tirunelveli coast of Tamil Nadu. *J. Mar. Biol. Assoc. India*, 33(1&2): 175-181.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : An investigation on the socioeconomic condition of traditional fishermen was carried out in Alanthalai fishing village near Tiruchendur, along Tirunelveli Coast of Tamil Nadu. Information pertaining to housing pattern; ownership of means of production, employment status, occupation, annual income, indebtedness, marketing problems, etc. was collected from all families of the village by interviewing the heads of households. The analysis of housing pattern indicates that 31% of families live in temporary structures (huts). 28% in semipermanent (tiled roof) and 41 % in permanent structures (concrete). About 70% of the houses have less than 500 sq. ft. of living space. The average size of family is 6. Almost all (98%) are in favour of dowry system and not in favour of inter-caste marriages. About 90% of the fishermen are against family planning. Catamaran is the lone craft operating in this area. About 38% of the fishermen households own Catamaran units and 7% has only nets. 60% of the catamaran owners possess less than 2 types of nets, which is not sufficient for efficient operation throughout the year. The average initial investment of a catamaran unit works out to Rs. 9,950. Chalavala alone accounts 55% of the total investment on gears. Other sardines constitute 83% of the annual catch of a catamaran. The major source of income for 71% of the families is active fishing, for 11% fishery related activities and for the rest (18%) other activities. The average annual income of a fisherman household works out to Rs. 4,886. About 44% of the fishermen families are in debt. The average outstanding debt per indebted household is Rs. 2,915. About 49% of the loan amount is utilized for productive purposes. The flow of credit from institutional agencies is only 34%. Easy availability of credit through institutional agencies, opportunities for supplementary occupations and better infrastructure facilities for marketing are some of the suggestions given for the economic improvement of traditional fishermen.

2219. **Sathiadhas, R., R.E. Benjamin and R. Gurusamy** 1991. Technological options in the traditional marine fisheries sector and impact of motorization on the economics of gillnet fishing along Tuticorin coast, Tamil Nadu. *Seafood Export J.*, 23(4): 26-36.

Address : Department of Economics, Madurai Kamaraj University, Madurai - 625 021, Tamilnadu, India.

Abstract : Existing technological options of artisanal fishery sector and impact of motorization by comparing the costs and earnings of motorized and non-motorized boats carrying out same type of gillnet fishing in Tamil Nadu, Tuticorin Coast of India is assessed. Based on key economic indicators, non-motorized boats operating gillnets were found to be economically more efficient than the motorized boats. However, in terms of number of fishing days, level of income generated and net operating income of the owner, the performance of motorized units was found to be better.

2220. **Sathiadhas, R.** 1993. Productivity and profitability of prawn farming practices - An economic analysis. *CMFRI Spl. Publ.,* 55: 16-25.

2221. **Sathiadhas, R and P.K. Johny** 1995. Marketing channel and price spread of Aquaculture products. *CMFRI Spl. Publ.,* 61: 60-68.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Liberalization of the Indian Economic policies has given maximum thrust to Exports. Fish and fishery products are the main item having immense potential and good scope to increase our exports. India is exporting a variety of marine products comprising shrimps, lobsters, squid, cuttlefish and a number of commercial finfishes valuing about Rs. 1,767 crores during 1992-'93. Among the various fishery products, shrimps command a leading position in the global market by virtue of its ever-increasing demand and competitive international prices, which contribute to about 70% of our fishery, export earnings. However, there is not much scope for increasing our shrimp exports by depending on capture fisheries, hence prime importance has been given for the development of aquaculture.

2222. **Sathiarajan, R.** 1988. Importance of domestic fish marketing in the development of fisheries in India. *CMFRI Spec. Publ.,* 40: 87-88.

Address : Integrated Fishery Project, Cochin, Kerala, India.

Abstract : Fisheries development of any country should have a close link with the domestic consumption. The infrastructure needed for domestic fish marketing in India is inadequate. The successive five-year-plans did not give emphasis on this aspect. Instead, importance was given only to export, and that too only one item i.e., shrimp. This has resulted in the lopsided development of Indian fisheries and the capital invested in the mechanisation, research and development did not bring the desired result. This paper deals with this aspect of giving importance to the domestic fish marketing for the real development of fisheries. A strong domestic market is a guarantee for a healthy export trade.

2223. **Sathiavani Muthu** 1973. Tamil Nadu Fisheries at a glance. *Seafood Export J.,* 5(1): 71-73.

Abstract : This article mentions the setting up of boat building yards at Mandapam and Nagapattinam.

2224. **Sathivel, A., H. Balaji Raghavendra Rao and T. Devaki** 2003. Hepatoprotective nature of seaweeds (*Ulva lactuca, Gracilaria edulis*) against liver injury induced by D-Galactosamine/endotoxin in rats. *Seaweed Res. Utiln.,* 25(1&2): 109-114.

Address : Department of Biochemistry and Molecular Biology, University of Madras, Guindy campus, Chennai-600 025, Tamilnadu, India.

Abstract : Two species of seaweeds *Ulva lactuca* and *Gracilaria edulis* collected from Gulf of Mannar were investigated for their antihepatotoxic nature using D-Galactosamine and endotoxin (LPS extracted by phenol water method from *E. coli* serotype 0111 B4) 300mg and 30µg/kg body wt/day respectively intraperitoneal (i.p) 18hrs before the assay to induce liver injury in the rats as model of acute hepatitis. Induction dose was able to produce significant decrease in the levels of marker enzymes and free radical scavenging enzymes with increase in the levels of lipid peroxides. Administration (pre-treatment) of 200 and 300 mg/kg methanolic extracts from *Ulva lactuca* and *Gracilaria edulis* significantly reduced the D-Galactosamine and endotoxin induced oxidative stress in rats by improving the status of liver markers and free radical scavenging enzymes. The same results were observed in the histopathological studies of liver. These results indicate that pretreatment with seaweed extracts of *Ulva lactuca* and *Gracilaria edulis* in rats is effective in reducing oxidative stress suggesting hepatoprotective nature.

2225. **Satyamurthi, S.T.** 1946. A new pleurobranch from Pamban, South India. *Proc. Malac. Soc. Lond.,* 27:137-140.

Address : Zoological Section, Madras Government Museum, India.

2226. **Satyamurthi, S.T.** 1952. The molluscs of Krusadai Island in the Gulf of Mannar. I. Amphineura and Gastropoda. *Bull. Madras Govt. Mus., N.S., Nat. Hist. Sec.,* 1(2) Pt 6: 1-265.

Address : Zoological Section, Madras Government Museum, India.

Abstract : The classification followed in this paper is in the main that of Thiele's "Handbuch der systematischen Weichtierkunde" (Jena, 1931) as this is the latest and most complete classification of the Mollusca at present available. But this classification is itself largely based on that adopted by Dr. Paul Pelseneer in his volume on Mollusca in "Lankester's Treatise on Zoology" which still remains one of the best standard descriptive works on Mollusca in English. The Mollusca are broadly divided into five classes, namely, Amphineura, Gastropoda, Scaphopoda, Pelecypoda and Cephalopoda. It may be helpful to point out at the outset the distinguishing features of these classes.

2227. **Satyamurthi, S.T.** 1956. The mollusca of Krusadai Island II. Scaphopoda, Pelecypoda and cephalopoda. *Bull. Madras. Govt. Mus. New Ser. Nat. Hist. Sec.,* 1(2) Pt. 7 : 202.

Address : Zoological Section, Madras Government Museum, India.

Abstract : The present work, is based upon a detailed study of the material of Scaphopoda, Pelecypoda and Cephalopoda from Krusadai Island and its vicinity, comprising both spirit-preserved, and dry specimens, contained in the molluscan collections of the Madras Museum, which have been considerably enriched in recent years by repeated collections made in this area by the staff of the zoological section of the Museum and by the addition of an extensive collection of shells donated by the late Mr. M.D. Crichton. This volume is a sequel to the previous one on the mollusca of Krusadai Island, published as a Bulletin of the Madras Government Museum *(Natural History Section, I,* No.2, Pt. 6, 1952)

2228. **Satyanarayana Rao, K.** 1966. Reproductive and nutritional cycles of *Oreaster hedemanii*. *J. Mar. Biol. Assoc. India,* 8(2): 254-272.

Address : Zoological Research Laboratory, University of Madras, Madras-5.

Abstract : The nutritive cycles of the starfish *Oreaster hedemanni* have been studied by examination of the storage organs in the course of a year. The hepatic indices of the starfish show high values in the spent and immature stages and low values during maturation of the gonads. In the pyloric caecae lipids and protein are in larger amounts compared to glycogen. The total contents of lipids and protein are higher in the immature stages due to accumulation. A depletion of lipids, protein and glycogen in the pyloric caecae appear to be correlated with the gonadial activity preparatory to spawning. The changes in gonadial activity have been estimated by determining gonad indices, which show an inverse relationship to hepatic indices. The reproductive cycle extends from June to May. The gonads attain maturity by October and spawning occurs in December. Correlated with these changes the lipid content in percentage dry weight of testes and ovaries shows an increase between the immature and maturing stages and a fall in values on attaining maturity. The total protein content of the gonads shows fluctuations, which are inversely correlated with changes in the pyloric caecae. Although the total protein content shows marked fluctuations the changes in the content per unit weight are not marked. Glycogen is present in small quantities at the commencement of gonadial activity. Its percentage decreases during maturation but the total content increases during the period. The extent of accumulation of the organic materials in storage organs and gonads in *O. hedemanni* is compared with that in members of other groups.

2229. **Satyanarayana Rao, K and K.S. Sundaram** 1972. Ecology of intertidal mollusca of Gulf of Mannar and Palk Bay. *Proc. Ind. Natn. Sci. Acad.,* 38B (5&6): 462-474.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The distribution of Fauna in the intertidal zone in the Gulf of Mannar and Palk Bay in the vicinity of Mandapam Camp has been studied. Distinct zonation has been observed in the occurrence of the fauna and three sub-zones the supralittoral fringe, midittoral zone and infralittoral fringe were recognized in the intertidal region. In the Gulf of Manar, *Littorina scabra,* L. *Undulata,* Tecarius spp, *Crassostrea cucullata* and *Chthamalus stellatus stellatus* have been recorded in the supralittoral fringe. In the midlittoral zone, *C. stellatus stellatus* is usually abundant along with some *Cellana radiata, Modiolus striatula, Tectarius* spp, *Donax* spp and *Prianospio* sp. In the Infralittoral fringe, tubiculous Vermetid Gastropods, prosobranches like, sponges and sea anemones have been recorded. In Palk Bay the supralittoral fringe is mostly sandy and on some dead coral stones a few *Littorina scabra* and *Tectarius* spp are found. The midittoral zone fauna includes *Planaxis sulcatus, Nerita maura, Crassostrea cucullata,* a few *Littorina* spp. And *Tectarius* spp on coral stones. In the infralittoral fringe prosobranches like *Cerithium* spp, *Rissoina bertholleti* and *Pyrene diminuta*, bivalves (*Arca* spp, *Isognomon*

spp, etc.), sponges, hydroids, polyzoans, polychaetes, isopods, amphipods and crabs occur. The probable factors influencing the variations in abundance of the fauna, particularly the molluscs in different stations and the habits of the molluscs in relation to low and high tides, temperature, etc., have been discussed.

2230. **Satyanarayana Rao, K.** 1974. Edible Bivalves: Mussels and oysters. *CMFRI Bulletin,* 25: 4-39.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Edible sea mussels belonging to the genus *Mytilus* are fished in quantities on some parts of the Indian coasts and are commercially important. They are bivalves approximately triangular in shape, with a shell pointed at the anterior end, a firm, horny periostracum, and anchoring byssus threads secreted by byssus glands present in the foot. The mussels attach themselves to rocks or other hard substratum by these threads. The mussel resources are rich on the southwestern coast. When occurring in abundance they form thick carpet-like growths on rocks and concrete constructions like piers and wharves. Large beds of *Mytilus* colonise concrete and timber structures in ports and harbours. Two species of mussels are represented along our coasts, the Green Mussel, *Mytilus viridis* Linnaeus and the brown mussel, *Mytilus* sp. *Mytilus viridis* enjoys a wide distribution, occurring on both the east and west coasts and is fairly abundant at Cochin, Malabar and southern coast of Mysore. On the other hand, the Brown Mussel has a very restricted distribution extending from South of Quilon to Tirunelveli coast.

2231. **Satyanarayana Rao, K.** 1974. Other commercial molluscs. *CMFRI Bulletin,* 25: 141-151.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : In addition to the molluscan species dealt with in the preceding chapters, there are several others, which are also of commercial value but have not so far received much attention from biologists in our country. In this chapter an account is given of what is known about the identity, habits, biology, distribution and utilization of these shell-fish.

2232. **Satyanarayana Rao, K., K. Dorairaj and K.A. Unnithan** 1976. New Records of Five Species of Marine Molluscs From Mandapam Area. *J. Mar. Biol. Assoc. India,* 18(3): 669-672.

Address : Central Marine Fisheries Research Institute, Cochin-682018, India.

Abstract : Five species of marine molluscs, two Prosobranch Gastropods, Strombus (Euprotomus) *aurisdianae aurisdianae* (Linne) and *Distorsio reticulata* (Roeding) and three species of pelecypods *Cardium coronatum* Spengler, *Chione squamosa* (Linne) and *Cultellus maximus* (Gmelin) have been recorded for the first time from Mandapam area. The diagnostic features of the species have been given.

2233. **Satyanarayana Rao, K.** 1982. Studies on the populations of *Saurida tumbil* (Bloch) from Indian waters. *Indian J. Fish.,* 29(1&2): 8-19.

Address : Waltair Research Centre of Central Marine Fisheries Research Institute, Waltair, Andhrapradesh, India.

Abstract : A comparison of and meristic characters of *Saurida tumbil* respectively by mean of analysis of covariance and analysis of variance indicated that there may be three populations of *S. tumbil* in Indian waters, confined to (1) Visakhapatnam-Kakinada, (2) Bombay-Mangalore, and (3) Tuticorin India.

2234. **Satyanarayana Rao, K., D. Sivalingam and K.A. Unnithan** 1983. Observations on the setting of Spat and growth of *Crassostrea madrasensis* in Vaigai Estuary at Athankarai. *Proc. Symp. on Coastal Aquaculture*, held at Cochin from January 12 to 18, 1980. *Part-2: Molluscan culture*. MBAI, Cochin, India, 6: 436-443.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The settling of spat of the edible oyster *Crassostrea madrasensis* on different kinds of spat collectors like oyster shells, wooden pieces, concrete pieces, concrete slabs, tiles, bamboo frames and coconut shells kept in Vaigai Estuary at Athankarai was studied. It was observed that there was spat fall on concrete pieces with irregular surfaces given lime coating, on oyster shells given a coating of cement or lime and lime-coated curved tiles. Oyster spat settled in stray numbers on bamboo frames. On Mangalore tiles and coconut shells, spat fall took place between January and April and generally only small numbers of spat were seen to settle on spat collectors in the other periods of the year.

2235. **Satyanarayana Rao, K.** 1985. Migration of seer fish in relation to the circulation pattern in the Bay of Bengal. ***In****: The oceans: realities and prospects.* (*ed*.) Sharma, R.C. pp. 133-144.

Address : Department of Zoology, Andhra University, Waltair, Andhrapradesh, India.

Abstract : The common seer fish in the coastal waters along the east and west coasts of India is *Scomberomorus guttatus*. This species constitutes about three quarters of the seer fish landings at Lawson's Bay, Visakhapatnam. The dominant species at Tuticorin (Gulf of Mannar) was *S. commerson* constituting about 80% of the seer fish catch by weight, during October 1966 to May 1967. It shows that *S. commerson* is relatively more abundant at Tuticorin than at other places along the east coast. The truly oceanic *S. commerson* enters in large numbers, Gulf of Mannar, which is proximal to oceanic waters, while *S. guttatus*, which inhabits the coastal waters, moves along the coast in large shoals and in all likelihood it is subjected to the influence of coastal currents. This aspect is examined in detail.

2236. **Satyanarayana Rao, K.** 1987. Taxonomy of Indian oysters. *CMFRI Bulletin*, 38: 1-6.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : An examination is made of various specimens of oysters collected from different areas off the Indian coast. Based on structural features, 6 species were identified: *Crassostrea madrasensis, C. gryphoides, C. rivularis, C. cristagalli, C. folium and Saccostrea cucullata*. The diagnostic features of these 2 genera are discussed, describing the taxonomic affinities and distributions of the 6 species.

2237. **Satyanarayana Rao, K., D. Sivalingam, P.N. Radhakrishnan Nair and K.A. Unnithan** 1987. Oyster resources of Athankarai Estuary, southeast coast of India. *CMFRI Bulletin*, 38: 17-29.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The findings are presented of survey of oyster resources of Athankarai Estuary, India. An account of the general feature of the estuary, its hydrological conditions, and ecologically associated fauna and flora, the distribution and magnitude of the standing stocks of the oysters are discussed. Seasonal variations in the meat of the oysters are also examined.

2238. **Satyanarayana Rao, K., P. Muthiah, M.E. Rajapandian, R. Sarvesan, P.V. Sreenivasan and R. Thangavelu** 1988. Oyster resources of India: Strategies for exploitation. *CMFRI Spec. Publ.*, 40: 38.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Whilst several oyster species have been recorded, three, *Crassostrea madrasensis*, *C. gryphoides* and *Saccostrea cucullata* are of definite economic significance and substantial research has been carried out on the bionomics of these species. Resource studies have been carried out only in a few areas. Major developments made recently are the evolving of culture methods for *C. madrasensis* and hatchery techniques for mass production of oyster seed. The present status of the resources and their exploitation are reviewed and the need for adoption of culture practices is emphasized.

2239. **Satyanarayana Rao, K., C.T. Rajan and K. Ramadoss** 1988. Molluscan shell deposits along Punnakkayal-Valinokkam coast and their exploitation. *CMFRI Bulletin*, 42(1): 40-41.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Marine molluscan shell deposits are distributed at different places between Punnakayal and Valinokkom on the southwest coast of India and support a good shell lime industry. The different areas where the lime shell deposits occur have been surveyed and the nature and extent of the deposits, the species composition, the methods of exploitation, magnitude of production utilization and annual turnover are dealt with.

2240. **Satyanarayana Rao, K.** 1988. Marketing of Molluscs: Indigenous marketing. *CMFRI Bulletin*, 42(2):436-437.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Marketing is the most important aspect of exploitation of shellfish resources as it involves selling of the harvested shellfish which determines the income which they can fetch. Marketing of molluscs has received the attention of the Government of India and Central Marine Fisheries Research Institute since the forties of this century. One of the early publications of the Government of India on fisheries is on the marketing of fish in India, which also deals with marketing of molluscan shellfish in the country.

2241. **Satyanarayana Rao, K., P.V. Sreenivasan, P. Muthiah, R. Sarvesan, P. Natarajan, M.E. Rajapandian, C.T. Rajan, R. Thangavelu, D. Sundararajan and P. Poovannan** 1996. Distribution and exploitation of Oyster resources of the southeast and southwest coasts of India. *Mar. Fish. Infor. Serv. T & E Ser.*, 145: 1-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

2242. **Satyanarayana Rao, K.** 2003. Sustained Pearl Oyster Seed and Adult Oyster Production for Commercial Marine Pearl Culture in India. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. p. 42.

Address : 8-4-60, Prasanthi Nagar, Peddha Waltair, Visakhapatnam-530 017, Andhrapradesh, India.

Abstract : For the establishment of commercial marine pearl culture in India, sustained mass production of seed and fully grown pearl oysters are essential. We have technologies for hatchery production of seed and further rearing of the Indian pearl oyster, *Pinctada fucata* to operable size. Pearl oyster hatcheries and grow out systems have to be set up in selected sites conducive for production on a sustained basis. Calm, sheltered coastal waters with stable hydrographic conditions, good phytoplankton production rich in diatoms and without problems of currents, pollution, fouling organisms and predators are ideal for the location of pearl oyster farms. The use of healthy, fast growing superior quality oysters with bright, thick nacre of preferred colour, produced by selective breeding is an important requirement for pearl oyster production. Proper maintenance of brood stock, utmost care in regard to water quality and environment conditions, strict adoption of techniques of induced breeding, artificial fertilization, larval and spat rearing, live feed production and feeding, nursery rearing of spat and later phases of growth and good farm management determine the survival of pearl oysters and sustained production. The Pearl Oysters Grow to a size of 50 mm (DVM) at the end of one year of culture, when they can be used for nucleus implantation. If the oysters are grown to a larger size of 70-80 mm, multiple implantations can be done. Pearl oysters should not be cultured in enormous numbers in an area, as it will lead to eutrophication, which will affect the quality of pearl oysters and pearls. Maritime State Governments have to give to entrepreneurs incentives like lease of land in coastal areas at subsidized rates for some years, provision of electricity connection etc., to attract those who are interested in taking up marine pearl oyster farming. Small-scale entrepreneurs should be especially encouraged as they can be expected to work with zeal and investment could be restricted to the minimum. The entrepreneurs should have the benefit of expert advice and guidance of scientists of C.M.F.R. Institute.

2243. **Scheer, G.** 1984. The distribution of reef-corals in the Indian Ocean with a historical review of its investigation. *Deep Sea Res.,* 31: 885-900.

2244. **Sebastin, M.J.** 1964. *Taeniacanthus dentatus* sp. Nov. a copepod parasite of the fish *Bembrops caudimaculata* Staindachner. *J. Mar. Biol. Assoc. India,* 6(1): 94-97.

2245. **Seema, C., R. Jayasankari and G. Mathew** 2005. Influence of physicochemical parameters on the removal of nitrogenous compounds during treatment of fish effluent with seaweeds. *Seaweed Res. Utiln.*, 27(1&2): 99-104.

Address : Central Marine Fisheries Research Institute, Kochi - 682 018, Kerala, India.

Abstract : Fish effluent was treated with *Gracilaria corticata* and *Ulva lactuca* in separate tanks. Effluent without seaweeds was kept as control. Physico-chemical parameters such as pH, Biological Oxygen Demand, Dissolved Oxygen on nitrogenous compounds such as ammonia, nitrite and nitrate were monitored. The DO content was found to be 15% more in the treatment tanks of *G. corticata* (5.44 ml/l) when compared to the control (4.05 ml/l) during same period, may account for the high photosynthetic activity and efficient utilization of dissolved carbon in the effluent. The BOD value was observed to be more in the treated tank of *G. corticata* compared to control on 20 days of treatment, could be due to the growth of associated bacteria in the system, which favoured the oxidation of ammonia to nitrite and then to nitrate. The pH was found to have significant positive correlation with nitrate content in all the treatments, whereas BOD exhibited a negative correlation with nitrate. The removal of nitrogenous compounds was found to be more in the effluent treated with *U. lactuca* followed by *G. corticata* than the control.

2246. **Sekar, N.C., V.J. Loveson and G. Victor Rajamanickam** 1996. Distribution of organic matter and calcium carbonate content in the sediments of salt marsh area, Tuticorin, Gulf of Mannar, *J. Indian Assoc. Sedimentol.*, 15(1): 59-66.

2247. **Sekhar, V.C., Ch.B. Rao, D.V. Rao, B. Sarvani, D.K.M. Lakshmi** 2004. Isolation of polyhydroxysterols from a species of Sarcophyton of the Indian Ocean. *Asian J. Chem.*, 1-16.

Address : Department of Pharmaceutical Sciences, Andhra University, Visakhapatnam-530 003, India; Department of Organic Chemistry, School of Chemistry, Andhra University, Visakhapatnam-530 003, India.

Abstract : A new trihydroxysterol, (24S)-4á,24-dimethylcholestane-3â, 6á, 25-triol (1) was isolated from a soft coral Sarcophyton sp. collected from the coast of Gulf of Mannar, Indian Ocean together with four known polyhydroxy sterols 3, 4, 5 and 6, that was earlier reported as its penta acetate. The structures were derived by spectral data.

2248. **Sekharan, K.V.** 1955. Observation on the Choodai fishery of Mandapam area. *Indian J. Fish.*, 2(1): 113-131.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The choodai fishery of Mandapam area is essentially a fishery for small sardines, confined mainly to the inshore waters of Palk Bay. Shore-seines, hand-nets (along with torches) and gill-nets are the main type of gear employed in the fishery. The methods of fishing are briefly described. *Sardinella albella* and *S. gibbosa* constitute the bulk of the catches. Studies on length-frequency distribution show that the fishery operates mainly on the 0-year class; the proportion of older fishes in the catches is small. Both *S. albella* and *S. gibbosa* spawn at about the end of the first year of their life.

2249. **Sekharan, K.V.** 1959. Size-groups of "Choodai" taken by different nets and in different localities. *Indian J. Fish.*, 6(1&2): 1-29.

Address : Central Marine Fisheries Research Institute, Kozhikode, Kerala, India.

Abstract : At present, the boats fishing choodai do not normally venture out to more than 6-8 miles off the shore. Within this zone, there are separate fishing grounds for various types of nets, which differ, among other things, in mesh size. But an analysis of the size-groups taken by them shows that the catches as a whole are supported mostly by the 0-year-class. This indicates that given the indices of abundance and the corresponding rate of growth of an year-class, it should be theoretically possible, from a study of mesh-selection, to determine in advance the period at which it (the year-class) would enter the catches of a net; perhaps the approximate amount of total catches that could be expected during a particular season could also be estimated. The data collected should further be important from the point of view of evolving a proper exploitation policy. Investigation of selection has also to some extent become urgent in view of a controversy that has recently arisen in the fishery. The men who use shore-seines fish choodai within the coastal belt, 1-1½, miles from the shore, and they feel that the operation of gill-nets both within and outside this range is detrimental to their trade. As there are indications that the use of gill nets is likely to increase rather than diminish in the coming years, this dispute is likely to become more serious in the future. Obviously, an important point to be clarified in this connection is whether both gill nets and shore-seines operate on the same size-group or age group at any time of the year.

2250. **Sekharan, K.V.** 1962. On the Mackerel fishery of the Mandapam area. *Indian J. Fish.*, 9(1&2): 714-727.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Mackerel supports a minor fishery in the Mandapam area, especially along the Gulf of Mannar coast, during the December – March period. The catches on the Palk Bay side are generally negligible, but in October 1956, there were unusually large catches here also. Shore-seine is the main gear employed. Monthly catch-per-man-hour based on observed landings is given. As on the West coast, so also in the Mandapam area, mackerel approach the nearshore waters at a time when salinity and temperature show an upward trend after attaining their minimum values. On the Gulf of Mannar side net-plankton volume also has a maximum during the January-March period. The fishery appears to be supported mainly by a single age group. The modal size varied from 227 to 242 mm, during the December-March periods of 1952-56. These modal sizes are larger than those occurring at Malpe and Karwar during the December-March period. Catch-per-man-hour (in numbers) for night-hauls was considerably greater than that for daytime-hauls. On the other hand, the average length of mackerel in night catches was slightly smaller. During 1952-53 the length-weight relations of mackerel in day-and night catches were estimated separately. The difference between the two regression coefficients was not significant at the 5% level. During 1952-53, an average cube of length of mackerel for each haul was calculated and plotted against the catch in numbers. A tendency for the catches to drop in relation to average L3 was noticed.

2251. **Sekharan, K.V.** 1966. On the food of the sardines, *Sardinella albella* and *S. gibbosa* of the Mandapam area. *Indian J. Fish.*, 13(1&2): 96-141.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam-623 520, India.

Abstract : A study was made of the food of *Sardinella albella* and *S. gibbosa* in relation to plankton in 1953-54 and 1954-55. Emphasis was laid on the food of the fishes of the 20 –79 mm groups, immature and commercially important on the Palk Bay coast. For a year-round study, larger fishes were also collected from Gulf of Mannar, where the fishery is poor. The sample values of food varied with the catches for sampling days, lunar months and seasons. Plankton was collected from the Palk Bay; 5-6 hours after the fish samples were collected in 1953, and at the time of fishing in 1954.

2252. **Sekharan, K.V.** 1967. The 'Choodai'. *Souvenir 20th Anniversary CMFRI.* pp. 67-69.

Addresses : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The sardines, other than the oil sardine, though not so important as the latter nor as abundant, are of considerable local importance in that they are popular food fishes contributing to a seasonal fishery at some places along the east coast, especially the south eastern region. Due to their thin bodies and non-oily nature, they are conveniently and rapidly beach dried in large quantities and exported to interior places, in excess of local consumption in the fresh and cured states. *Sardinella albella* and *S. jussieu* are the two important species forming the fishery, others contributing only in a small measure to the fishery being *S. sirm* and *H. clupeoides.* In recent years (1960-1965) on an all India basis, these sardines which are together called 'Choodai' in Tamil along the coast of Madras State, have contributed from 1.89 to 5.23 per cent of the total marine fish catch.

2253. **Sekharan, K.V.** 1968. Growth rates of the sardines, *Sardinella albella* (Val) and *S. gibbosa* (Bleek), in the Mandapam area. *Indian J. Fish*., 15 (1&2): 68-80.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Mandapam, India.

Abstract : The monthly mean lengths of the O-year-classes of *S. albella* and *S. gibbosa* were estimated for the Palk Bay seasons of 1952-56. They indicated that, for the greater part of the Palk Bay season, the length of each species increased at a decreasing rate. But towards the end of the season it appeared to increase at an increasing rate. The von Bertalanffy equation was fitted to the former part, the growth curve so obtained was extrapolated to the latter part of the season also, and the observed and expected mean lengths were compared. It was seen that the differences in the rate of change of the monthly mean lengths between years were statistically non-significant. The asymptotic maximum lengths of the two sardines, estimated on the basis of the growth data of the first 6-7 months of life are considerably less than the modal sizes attained by them at the end of the first year of life, indicating that a change in growth rate has to take place if these modal sizes are to be attained. This expectation is supported by the observation that the mean lengths towards the end of the Palk Bay season are larger than those expected on the basis of the growth data of the earlier months and indicate the start of an exponential phase of growth. Hence there appears to be a periodicity in the growth of these young fishes, comparable to what is observed in temperate water fishes. The environmental data also indicate that a change in the growth rate towards the end of the Palk Bay season is possible. The estimated monthly growth coefficients of the two species compare very well with each other and also with that of the Japanese sardine.

2254. **Sekharan, K.V.** 1968. Length weight relationship in *Sardinella albella* (Val) and *S. gibbosa* (Bleek). *Indian J. Fish*., 15(1&2): 166-174.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India.

Abstract : The length-weight relationships in *S. albelIa* and *S. gibbosa* were estimated. In *S. albella,* the regression coefficients of the 20-39 mm group, the larger indeterminates of the 40-95 mm group and the sexes were found to be significantly different from one another. In *S. gibbosa,* the regression coefficients of the 20-39 mm group and the larger fish (indeterminates of the 40-95 mm group and the sexes) were significantly different from one another. In both species, the regression coefficients of the fishes of the 20-39 mm group were significantly higher than those of the fishes of the larger size-groups.

2255. **Sekharan, K.V.** 1976. Culture of marine fishes in India. The problems and the promise. *Seafood Export J.*, 8(1): 61-65.

2256. **Selvakumar, R.A.** 1974. A note on the early development of the marine insect *Halobates* sp. (Hem., Gerridea) from the Gulf of Mannar near Mandapam (India). *J. Bomb. Nat. Hist. Soc.*, 71(2): 335-336.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Notes on the development of *Halobetes* eggs on a cuttle bone collected from the Gulf of Mannar in Sept 1965 are presented.

2257. **Selvamani, J.** 2000. Likely impact of sea urchin removal as by-catch on lobster resources in Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E. Ser.*, 166: 15-17.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract: The impact of garbage with seaurchins which were discarded in the marine environment at Tharuvaikulam is reported.

2258. **Selvan, K and K. Venkatanarasimha** 1988. A study on the bacterial quality of brown mussel *Perna indica* and

its purification. *CMFRI Bulletin,* 42(2): 431-435.

Address : Fisheries Technological Station, Tuticorin-628 001, Tamilnadu, India.

Abstract: Brown mussel *(Perna indica)* samples were collected periodically during 1983-1985 from Vizhinjam (Central Marine Fisheries Research Institute) farm and also from the natural beds and were studied for their bacterial quality, The seawater samples surrounding the mussels were also collected along with the mussel samples and analysed for physical, chemical and bacteriological qualities. The mussel samples were subjected to purification by employing different purification methods. The total bacterial count of cultured brown mussels and natural bed brown mussels ranged between 102 to 103 organisms per ml of mussel fluid. The T.B.C. of the seawater around cultured brown mussels and natural bed brown mussels ranged between 102 to 103 organisms per ml of seawater. The faecal coliforms were found to be very low and they were in permissible limits. The pathogenic bacteria *Salmonella, Streptococci* and *Staphylococci* were absent. The variations in pH, temperature, salinity and dissolved oxygen of the seawater samples were insignificant. The mussels were subjected to purification by employing different purification methods and chlorination was found to be better.

2259. **Selvaraj, G.S.D.** 1973. Molluscan fishery resources in India and their scope for exploitation. *Seafood Export J.*, 5(5): 29-33.

2260. **Selvaraj, G.S.D.** 1973. Mariculture in India, its potentialities and practical applications. *Seafood Export J.*, 5(11): 29-37.

2261. **Selvaraj, M.** 2000. Seaweeds and their uses (in Tamil). *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI.* pp. 43-49.

2262. **Selvaraj, P., V. Sundararaj and J. Vasanthakumar** 1988. Training of fisherfolk and coastal area development. *CMFRI Spec. Publ.,* 40: 77.

Address : Fisheries College and Research Centre, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Research in social sciences has revealed the need for diversification of income sources of rural households to cope with risk and uncertainty inherent in rural occupations like fishing and agriculture. Experience has shown that the labour force of the fishing households possesses skills in fishing-related and non-fishing activities and such skills can be improved upon by conducting training programmes. An analysis is made of 2 such training programmes-one conducted by MPEDA and the other by TNAU.

2263. **Selvaraj, P., G. Indra Jasmine and P. Jeyachandran** 1991. Effect of ascorbic acid dip treatment on frozen storage of squid (*Loligo duvaucelii*, Orbigny). *Fish. Technol.,* 28(2): 117-121.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Squid (*Loligo duvaucelii*) was treated with 0.5% ascorbic acid solution for 10 min and both treated and control samples were frozen at -40 ºC and stored at -20 ºC. The quality changes during frozen storage and shelf life were evaluated by following the physical, chemical, bacteriological and sensory characteristics. Ascorbic acid treatment was found to improve the quality and shelf life compared to control.

2264. **Selvaraj, R and R. Selvaraj** 1997. Distribution and diversity of seaweeds in Tiruchendur and Idinthakarai. *Seaweed Res. Utiln.,* 19(1&2): 115-123.

Address : Department of Botany, Annamalai University, Annamalai Nagar-608 002, Tamilnadu, India.

Abstract: A study on the distribution and diversity of seaweeds in Tiruchendur and Idinthakarai was carried out to record macroalgal communities on the littoral and sublittoral zone. A total of 46 species from 37 genera and 22 families in station-1 (Idinthakarai) and 33 species from 33 genera and 18 families in Station -II (Tiruchendur). At Station-1, there were 19 species, of Rhodophyta (41.3% of the total), 16 species of Chlorophyta and 11 species of Phaeophyta (23.9% of the total).

2265. **Selvaraj, R., M. Ayyappan, R. Sidva and S. Kabilan** 2006. Screening for antifungal activity of macro algae. *Seaweed Res. Utiln.,* 28(1): 89-98.

Address : Department of Botany, Annamalai University, Annamalainagar - 608 002, Tamilnadu, India.

Abstract : Antifungal activity of 20 species of marine macro algae was evaluated against *Candida albicans, C. krusei, C. tropicalis, C. parapsilosis, Trichophyton mentagrophytes, Aspergillus niger, A. javus* and *A. jumigatus*. Of the 20 algae, aqueous extracts showed trace activity; toluene and methanol extracts have moderate activity.

Among the six single solvent extracts, the chloroform extract had better inhibitory activity against the fungal pathogens. New seaweeds were chosen for further study. These seaweeds were subjected to extraction by using single solvents. The lipid fraction of *E. compressa* had maximum inhibitory activity over *Candida tropicalis* and *C. albieans.* The chloroform extract and lipophilic fraction of same algae had better activity against *C. tropicalis* and *A. niger* respectively. The lipophilic fraction of *Ulva fasciata* had maximum inhibitory activity against *C. albicans, T. mentagrophytes* and *A. jumigatus.* Among the single solvent extract, the chloroform extract showed better activity against *C. albieans* and *A. jumigatus.* The lipid fraction of *Caulerpa sealpelliformis* had maximum inhibitory activity against *C. krusei* and *T. mentagrophytes.* The lipid fraction of *Stoichospermum marginatum* had more inhibitory effect on *Candida albicans.* The lipid fraction of *Hypnea valentiae* showed maximum inhibitory activity against *A. flavus and C. albicans.* The ethanolic extract of *H. valentiae* has no inhibitory activity over any of the eight fungal pathogens. From this investigation, it is concluded that brown seaweed is more effective than the green and red seaweeds.

2266. **Selvaraj, S., M. Feroze Khan, R. Baskaran and K. Anbarasu** 2004. A study on the water pollution of Kayalpattinam area, Tuticorin, Tamilnadu. *J. Ind. Poll. Con.,* 20(1): 25-30.

Address : Department of Geology, National College, Tiruchirapalli - 620 001, Tamilnadu, India.

Abstract : Industries without a concern for the environment deteriorate the land, water and air in an area. When the industrial activity is located in the coastal zone the harm it causes to the various components of the environment becomes irreparable. Unless the nature and consequences of pollution are understood properly and preventive measures are adopted the area not only the land but also the adjoining sea would witness the effects of physical, chemical and organic pollutants released from the industry. A case study of pollution of the surface and subsurface water nearer to coast is presented to highlight the need for remedial measures.

2267. **Selvavinayagam, K.** 2003. Application of remote sensing and GIS for Tuticorin coastal and harbour environment management. *Ph.D Thesis*, Anna University, Chennai.

Address : Institute of Ocean Management, Anna University, Chennai – 600 025, Tamilnadu, India.

Abstract : In order to study the environmental quality of the Tuticorin Harbour area recent scientific tools such as satellite remote sensing and GIS are used. The environmental parameters such as water quality, landuse, coastal processes etc were studied using remote sensing and GIS. To assess the present water quality status of Tuticorin coastal and harbour environment, surface water samples were collected and chemically analyzed. The water quality status for the two years 1999 and 2000 is as follows. pH, 7.5 to 8.6; water temperature, 28.0 to 31.0°C; salinity, 34.05 to 35.94 ppt; dissolved oxygen, 3.6 to 5.3 mg/l; nitrite, 0.10 to 0.54 mg/l; nitrate, 25 to 50 mg/l; phosphate, 0.89 to 5.22 mg/l and ammonia, 3.1 to 5.9 mg/l. As per the water quality data of summer 1999 and 2000 and monsoon 1999 and 2000, the harbour coastal water comes under SW-I class (all the water quality parameters such as salinity, temperature, pH, dissolved oxygen, nitrite, nitrate, phosphate and ammonia are within the acceptable level). To estimate the suspended sediment concentration directly by using radiometric data, a series of equations were developed with the use of multiple regression models. In the present study regression analyses were carried out between dependent variables (suspended sediment concentration) and independent variables (radiometric bands). The study confirms that multiple linear regression models were the best suited for deriving SSC from IRS lA and lC/lD digital data and have a better accuracy. The algorithm developed by *in situ* sampling and the universal algorithm developed by SAC (OCM DAS) applied over the study area has also got a better accuracy. Mapping of chlorophyll distribution using satellite sensors, especially the OCM (Ocean Colour Monitor) sensor combined with 'sea truth' measurements will facilitate better understanding of the ocean productivity and also the management of the fishery resources. The present study provides a regional distribution of Chlorophyll - *a* along the coast of Tuticorin, Tamil Nadu using Indian Remote Sensing Satellite (IRS - P4) OCM data. The landuse/landcover of the area in the present study has changed considerably over a period of 29 years i.e., between 1969 and 1998. Results of landuse/landcover change studies from 1969 to 1998 reveal that there is 188 % (1.88 times) increase in urban area, 749 % (7.49 times) increase in settlement, 174 % (1.74 times) increase in cropland, 110 % increase in industrial area, 42 % increase in mangrove, 106 % increase in salt affected land, 135 %(1.35 times) increase in marshy/swampy, 102 % increase in industrial wasteland, 123 % increase in fly ash site, 153 % (1.53 times) increase in saltpans and 121 % increase in harbour area. This increase has taken place at the expense of the following land use categories; land with/without scrub, sandy area, open scrub, tank, mudflat, and sand spit. It is also observed that there is 15 % decrease in mudflat, 46% decrease in land with/without scrub, 60 % decrease in sandy area, 74 % decrease in tank, 60 % decrease in open scrub and 34 % decrease in sand spit. All the developmental activities such as urban sprawl, industrial development, harbour development and increased salt pan activity are the major classes of change. The coastal

erosion and accretion activity of the study area were identified using Survey of India toposheet (1969), IRS 1A 1990, Landsat TM 1994 and IRS 1C/1D 1998 data. Changes in erosion and accretion areas during the period of 1969 to 1990, 1990 to 1994 and 1994 to 1998 were estimated. Erosion was observed in 121.48 hectares, 121.62 hectares and 119.18 hectares respectively. Accretion was observed in 523.53 hectares, 137.03 hectares and278.80 hectares respectively. Erosion and Accretion were observed in specific sites. These are south of harbour breakwater, north of harbour breakwater, sand spit and urban coast. In all these areas the accretion activity predominates. So this coastal area could be considered as the coast of progradation. To substantiate the coastal configuration change, wave pattern and its dynamics were studied using IRS P2 May 1996 and IRS 1C/1D May 1998 data. Image enhancement techniques as well as spectral merging techniques for infrared band of IRS P2 and IRS 1C/ 1D were carried out using Erdas imagine image processing software for better visualization of coastal wave pattern. Coastal processes such as wave diffraction, wave refraction and shadow zone formation were identified. It was noticed that because of wave action there is erosion at tip of Hare Island and Vann Island during 1969 to 1990 and 1990 to 1994. But from 1994 to 1998 there is no erosion noticed in Hare Island. This may be due to the bund constructed recently for the storage of fly ash. Analysis of suspended sediment concentration and its transport through IRS lA, IRS 1C/1D and IRS P4 OCM showed that there is increased suspended sediment concentration in nearshore. Sediment transport identified through the IRS P4 OCM data and the slope variations inferred from urban coast and harbour environmental area clearly show that the chance of sediments entering into harbour breakwater are very low and hence the Tuticorin harbour is free from sedimentation problem. In this study the aspatial data were linked with spatial database with Open Database Connectivity (ODBC) driver. Both the database are linked with common id. So whenever querrying is put up to the visual display (spatial data), accordingly the attribute (aspatial) information is displayed. Harbour Information System has been developed as a scientific database, which can be used as a baseline information system for all future long term monitoring programs. All the environmental parameters such as water quality, landuse, coastal processes etc were organized as Harbour Information System. It consists of past data collected from port authorities and present data collected during the study. This gives an idea about the changes taking place in the study area. Regular updating of this information system will be very useful and helpful to the port authorities for its further development and management.

2268. **Selvavinayagam, K., A. Surendran and S. Ramachandran** 2003. Land use change detection using remote sensing and GIS – A case study in Tuticorin, Tamil nadu, India. *Proc. International Conference on Coastal and Fresh water issues*, December 8-10, 2003 Chennai, India. 143 pp.

Address : Institute of Ocean Management, Anna University, Chennai – 600 025, Tamilnadu, India.

Abstract : Information on existing Land use/land cover, its spatial distribution and changes are essential prerequisites for any kind of planning activities. One of the constraints which planners are faced with is the unavailability of reliable data. Remote sensing, because of its capability of synoptic viewing and repetitive coverage, provides full information on Land use/land cover dynamics on a very large scale. In this study, Land use maps were prepared using IRS 1 A 1990, LANDSAT 5 TM 1994 and IRS 1C 1998 data. The Survey of India toposheet (SOl) 1969 was used as a base map. The Land use maps prepared from remote sensing data were interpreted, digitized and analysed. Accuracy check and accuracy matrix is developed for land use/land cover and for land use change. It is found that the accuracy is more than 95%. Land use change maps were prepared by adopting Arc-Overlay techniques using Arc Info software. The major land use changes that have occurred in Tuticorin area during a 30 year period (1969-1998) are described. The urban area has increased from 943.53 ha to 1776.21 ha, Settlement has increased from 103.33 ha to 774.30 ha, Industrial area has increased from 93.90 ha to 109.82, Salt pan has increased from 2198.08 ha to 3354.99 ha, Harbour area has increased from 101.73 ha to 121.32 ha, Fallow land has increased from 27.03 ha to 99.80 ha, Mangrove has increased from 38.09 ha. to 42.34 ha, Marshy/Swampy land has increased from 70.74 ha to 95.18 .ha and Fly ash has increased from 193.02 ha to 273.35 ha. Increase in Urban area, Settlement, Industries, Saltpan and Harbor area are attributed to increase in population and development activities. During the same time the following land use have decreased in Tuticorin area. Land with/without scrub has decreased from 4943.56 ha to 2261.20, Cropland has decreased from 1176.79 ha to 978.49 ha, Open scrub has -decreased from 1142.58 ha to 684.39 ha, Wasteland has decreased from 302.59 ha to 105.99 ha, Mud flat has decreased from 142.75 ha to 21.26 ha, Sandy area has decreased from 92.88 ha to 55.41 ha, Water body has decreased from 242.87 ha to 179.47 ha and Sand spit has decreased from 21.52 ha to 7.22 ha. Decrease in land with/without scrub, Open scrub Cropland, etc were attributed to the conversion of the above land use categories into urban area, settlement, industries and saltpans. Land use change analysis reveals that there is a predominant increase in urban area, settlement, industrial area, fly ash and saltpans. These changes cause large increase in pollution load, increase in suspended sediment concentration, degradation in water quality and degradation in coastal marine resources.

2269. **Selvavinayagam, K., A. Surendran and S. Ramachandran** 2003. Quantitative study on Chlorophyll using IRS P4 OCM data of Tuticorin coastal waters. *J. Indian Soc. Remote Sensing*, 31(3): 228-235.

Address : Institute of Ocean Management, Anna University, Chennai-600 025, Tamilnadu, India.

Abstract : Quantification of Chlorophyll using IRS-P4 OCM data was attempted. OCMDAS software developed by Space Applications Centre, Ahmedabad was used in data analysis. The results showed considerable variations in nearshore (case 2) waters due to interference from yellow substance and suspended sediments. However, in offshore areas (case 1) the measurements showed good correlations. The r values are 0.663 for nearshore waters and 0.892 for offshore waters.

2270. **Senthilathiban, R., P. Selvaraj and N.V. Sujathkumar** 1989. Constraints to marine fisheries productivity in Chidambaranar District of Tamil Nadu. *Seafood Export J.*, 21(8): 23-30.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The findings are presented of an investigation conducted in order to analyze the constraints to the development of marine fisheries in Chidambaranar District of Tamil Nadu, India. The constraints were classified into 5 groups: fishing constraints, input constraints, socioeconomic constraints, infrastructural constraints and institutional constraints. Recommendations are given for overcoming existing constraints; it is concluded that the fishery extension system should be strengthened in order to enable information regarding the latest technologies and various welfare and development programmes to reach the fishermen in time.

2271. **Senthilathiban, R and P. Selvaraj** 1990. Consumption expenditure of fishing households in Tirunelveli district of Tamil Nadu. *Seafood Export J.*, 22(5): 23-25.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Marine fisherfolk constitute a considerable proportion of the rural population but living conditions of fishing households are deplorable because of the incidence of poverty. This study presents a picture of the levels and pattern of consumption of fishing households in selected coastal villages of undivided Tirunelveli district of Tamil Nadu. Sampling was confined to households owning and operating fishing crafts. For data collection, an interview method was designed and used in direct personal investigation.

2272. **Senthilathiban, R and P. Selvaraj** 1990. Demand for and supply of marine fisheries finance in Chidambaranar district of Tamil Nadu. *Seafood Export J.*, 22(4): 21-26.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Cheap credit facilities are essential for rural development and agricultural growth. Formation of strategies of fisheries development, and institutional credit are required. A study pertaining to these aspects was carried out in Tamil Nadu, India. The main objectives were to: (1) estimate credit requirements, availability, repayments; and (2) to study problems involved in availing finance. The credit facility is described in relation to its methodology and credit sources, after interviewing the fishermen, and discussing encountered difficulties. It is recommended that awareness of repayment, leadership training, and training programs on financial management would be of great help in using this facility properly.

2273. **Senthilathiban, R., P. Selvaraj and R.K. Ramkumar** 1991. Aspirations of youth in fishing families in Chidambaranar District of Tamil Nadu. *Seafood Export J.*, 23(2): 14-23.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Social, economic and psychological aspects of fishing youth in Chidambaranar District of Tamil Nadu, India was studied including (1) the size of fishing family and proportion of youths to the family size; (2) extent and pattern of employment of fishing youth; (3) occupational aspirations of youths in fishing families; (4) role of youths in family decision making; and (5) problems of fishing youth. It is suggested that training in fishing be extended, level of literacy be improved, fishing oriented employment opportunities be given and co-operative unions be formed, in addition to the development of suitable fisheries policies.

2274. **Senthilathiban, R and P. Selvaraj** 1992. Price spread analysis of important marine fish varieties in the selected landing centres of Chidambaranar District. *Seafood Export J.*, 24(4): 22-31.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A comprehensive study on price spread of important varieties of marine fish landed at selected fish

landing centres, their marketing costs, margins and the share of producers in consumer's rupee was carried out at four landing centres in Chidambaranar District of Tamilnadu, India. The data on important species-wise landings, auction price, marketing costs and margins were collected at weekly intervals. A healthy trend of 60% shares for the fishermen in consumer retail price is noticed, whereas the share of marketing margins accruing to retailers vary from 14 to 23%. A positive correlation between the retail price and the net amount realized by the fishermen at 1% level for almost all the fish varieties is noticed.

2275. **Senthilathiban, R and P. Selvaraj** 1995. Economics of production of prawn/fish pickles. *Fish Chimes*,15(6): 35.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The paper focuses on the role of these byproducts on rural employment and their production process and cost structure.

2276. **Senthilathiban, R., K. Venkataramanujam, P. Selvaraj and G. Sanjeeviraj** 1999. Economics of Mechanized fishing in Tuticorin, Tamil Nadu. *Proc. on the 4th Indian Fish. Forum*, 24th to 28th Nov'1996. pp. 499-500.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The profitability and economic efficiency of mechanised fishing vessels at Tuticorin Fishing Harbour in Tamilnadu were studied for mechanised boats fixed with 106 HP and 98 HP marine diesel engines in two more categories of mechanised boats. The size of sample of fisherman respondents was fixed as 15,10 representing the first category and 5 representing the second category. A modified cost accounting methods was followed to collect data at weekly intervals. Data collection was carried out every Wednesday stretching for a period of 53 weeks from the first week of July '92 to the last week of June '93. In all 530 and 265 fishing trips were considered for first and second categories, respectively. The mean fixed cost per trip was Rs. 320.24 for first category against Rs. 214.06 for second category boats. The corresponding mean variable costs were Rs. 4016.20 and Rs. 3004.42. The mean gross returns per trip for first category boats was estimated as Rs. 6,378.57 that was higher than Rs. 4,598.94 for 98 HP boats.

2277. **Senthil Kumar, S.** 2001. Occurrence of coliphages in Tuticorin and Punnakayal mangrove areas. *National seminar on Marine and Coastal Ecosystems: Coral and Mangrove- Problems and Management Strategies*, 26-27, Sept. 2001, Tuticorin, p. 50.

2278. **Senthil Kumar, S and J.K. Patterson Edward** 2002. A preliminary study on the occurrence of coliphages in Tuticorin and Punnakayal mangrove areas. *SDMRI Res. Publ.*, 2: 194-197.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin, 628001, Tamilnadu, India; E-mail: skkumar_76@hotmail.com

Abstract : Viruses are ubiquitous components of microbial communities in surface waters and play an active role in the marine ecosystem. One type of coliphages specifically infecting *Escherichia coli* is considered as an indicator of sewage contamination of coastal waters. The virological qualities of the water in the mangrove areas of Tuticorin and Punnakayal, Tamilnadu, India were analysed. Based on the results, it is concluded that the Punnakayal mangrove area is more contaminated than Tuticorin.

2279. **Senthil Kumar, S., T. Prem Anand and J.K. Patterson Edward** 2003. Dye decolourization ability of two fungi from Tuticorin coastal waters, southeast coast of India. *SDMRI Res. Publ.*, 3: 122-128.

Address : Suganthi Devadason Marine Research Institute, 44-Beach Road, Tuticorin 628 001, Tamil Nadu India; E-mail: skkumar_76@hotmail.com

Abstract : Dye decolourizing ability of a marine derived fungus Mucor sp. and a facultative marine *Cladosporium* sp. were assessed. Synthetic indicator dyes such as Congo red, Methyl Violet, Malachite Green, Erichrome Black, Methyl Red and Brilliant Green were used for the experiment. The decolorizing ability of Cladosporium sp. was comparatively more than *Mucor* sp. The ability of *Mucor* sp. was more than 95% for Methyl violet and Malachite green, while *Cladosporium* sp., exhibited 99-100 % of decolourization of these two dyes.

2280. **Senthil Kumar, S., A. Nithyanandam and J.K. Patterson Edward** 2003. Antibacterial activity of the epidermal layer extracts of four coral associated fishes. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 43.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : The epidermal layer of coral fishes such as *Sufflamen chrysopterus, Coris frerei, Sargocentron rubrum* and *Plectorhinchus gibbosus* were assayed for antibacterial activity against 10 pathogenic bacteria using standard disc diffusion method. The epidermal layer extract of *Sufflamen chrysopterus* exhibited the highest activity against *Streptococcus pyogenes* with an inhibition zone of 5 mm and the lowest activity against *Klebsiella pneumoniae* with an inhibition zone of 2 mm. The ethyl acetate phase of the partitioned crude extract showed broad spectral activity. The crude extracts which exhibited potential activity were partially purified by column chromatography and again tested for antibacterial activity. This showed the highest activity against *Shigella flexneri* than the other pathogens.

2281. **Senthilnathan, S., T. Balasubramanian and V.K. Venugopalan** 1998. Metal concentration in mussel *Perna viridis* and oyster *Crassostrea madrasensis* from some parts in southeast coast of India. *Indian J. Mar. Sci.*, 27: 206-210.

Address : CAS in Marine Biology, Annamalai University, Porto Novo - 608 502, Tamilnadu, India.

Abstract : The concept of mussel watch has been applied to monitor the levels of heavy metals in the southeast coast of India covering a distance of 250 km. The data reflected a definite seasonal variation with an increased metal load during the monsoon period and decreased level during the summer period. The order of metal accumulation was found to be Zn>Cu>Pb>Cd>Hg. Salinity of the media was found to play an important role in the accumulation of metals in tissue. A linear relationship was found between the meta1 level in the tissues and that in the dissolved fractions. Oyster showed maximum concentration factor (CF) when compared to mussels. Both animals showed high adsorption and absorption capacity for heavy metals as revealed by the CF, suggesting that they can be used as indicator for water quality and heavy metal pollution on a long-term basis.

2282. **Seralathan, P.** 2006. Disposal of dredge spoil from Sethusamudram Ship Channel Project. *Curr. Sci.*, 90(1): 146-147. 2006.

Address : Department of Marine Geology and Geophysics, Cochin University of Science and Technology, Cochin - 682 016, Kerala, India, E-mail: pseran@yahoo.com

Abstract : The Sethusamudram Ship Channel Project (SSCP), Tamil Nadu, India involves dredging for a length of about 35 km in the Adam's Bridge sector and about 54 km across the Palk Strait and will generate respectively 48 and 34.5 million cubic meters of sediments. The materials dredged from Adam's Bridge area will be dumped in the Gulf of Mannar region at 20-30m water depths with in the Indian territorial waters about 30 km away from Adam's Bridge. The sediments dredged from Palk Bay will be dumped in the Indian Ocean at about 25-30m water depths. Dumping of sediments in open sea will cause turbidity in the water column and submergence of large bottom community by the sand contained in the dredged sediments. Such environmental effect over vast areas for considerably long time span will have long-term impact. Instead, the dredge spoil can be dumped at one place in the sallow western Palk Bay at water depths of about 10 or 12m (30-35 km off Thondi) so that an island with land area of about 6-8 km^2 can be created. Alternatively the dredge spoil can also be used to enhance the size and relief of a section of the narrow spit of the northeastern Rameswaram Island, as it is vulnerable for erosion. The land area that can be reclaimed between Rameswaram town and Dhanuskodi using the sediments dredged from Adam's Bridge area alone is about 10 km^2. As the proposed dumpsites are considerably away from the coral islands of the Gulf Mannar, suspended sediments may not be able to reach the coral island areas.

2283. **Sethuraman, V.** 1998. Major and Minor Fisheries Harbour of India: 4 Jetty for fishing boats at Mandapam along Gulf of Mannar coast. *Mar. Fish. Infor. Serv. T & E. Serv.*, 153: 15-17.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The catch trends of Mandapam fisheries harbour was compared with other maritime fishing harbours of India.

2284. **Sethuraman, V.** 1998. On a whale shark landed at Pamban. *Mar. Fish. Infor. Serv. T & E Ser.*, 157: 23.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A whale shark of total length of 9.2 m, *Rhincodon typus* landed at Pamban on 17-04-98 is described.

2285. **Sewell, R.B.S.** 1914. Notes on the surface Copepoda of the Gulf of Mannar. *Spolia Zylan.*, 9: 191-263.

2286. **Sewell, R.B.S.** 1929. Geographic and oceanographic research in Indian water. V. The temperature and salinity of the surface waters of the Bay of Bengal and Andaman Sea with reference to the Laccadive Sea. *Mem. Asiat. Soc. Bengal.*, 9: 133-205.

2287. **Sewell, R.B.S.** 1932. Geographic and Oceanographic research in Indian water. VI. The temperature and salinity of the deeper waters of the Bay of Bengal and Andaman Sea. *Mem. Asiat. Soc. Bengal,* 357-423.

2288. **Sewell, R.B.S.** 1932. The coral coasts of India. *Geogr. J.,* 79: 449-465.

2289. **Sewell, R.B.S.** 1935. Geographic and oceanographic research in Indian waters. Part VIII. Studies on coral and coral formations in Indian waters. *Mem. Asiatic. Soc. Beng.,* 9: 461-540.

2290. **Shah, C.K and B.S.Vaidya.** 1967. Studies on *Turbinaria ornata* (Turn.) *Proc. Seminar on Sea, Salt and plants*. Dec. 20-23, 1965. pp. 155-157.

2291. **Shahul Hameed, M and M. Mukundan** 1987. Strategies for the development and management of purse seine fishing in India. *CMFRI Spec. Publ.,* 40: 96.

Address : Department of Industrial Fishery, Cochin University of Science and Technology, Cochin - 682 016, Kerala, India.

Abstract : Purse seine, an important bulk catching method was first evolved in the Atlantic Coast during the last quarter of the 19th century and in India the developmental efforts were initiated by the Indo-Norwegian Project in 1954 and the operations on commercial lines were taken up from 1976 onwards. Competition and conflict arose between traditional fishermen and purse seine operators as their gears are operated in the inshore region and for the same pelagic species of fishes. Regulations were formulated delimiting the activity of purse seiners to avoid conflict resulting in the reduction of catch. A strategy is recommended for management of resources and development of purse seine fishery in India.

2292. **Shanbhogue, S.L.** 1978. The embryonic and early larval development of *Gonodactylus falcatus* (Crustaceae: Stomatopoda) from India. *J. Mar. Biol. Assoc. India,* 20(1&2): 86-97.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The embryology and early larval development of *Gonodactylus falcatus* (Forsskal) were studied, based on eggs reared and hatched in the laboratory. The larval development was followed up to the fourth larval stage when all the larvae died. Observations on the behaviour of larvae, their feeding habits and moulting periodicity were also made. Differences in the larval characters between the present series and the ones described earlier have been discussed.

2293. **Shanbhogue, S.L.** 1979. Demersal fishery resources of India. *Seafood Export J.,* 11(8): 9-16.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The author states that some similarity in the catch composition of trawlers at Tuticorin and Madras regions has been found. Elasmobranch constitute about 20%, perches 14% and sciaenids 8% of trawler landings at Tuticorin.

2294. **Shanbhogue, S.L.** 1986. Studies on stomatopod crustacea from the seas around India. pp. 515-567. ***In.*** *Recent advances in Marine Biology,* (ed.) P.S.B.R. James, Today and Tomorrow, New Delhi, 1986: 591 pp.

2295. **Shanker, K.** 2003**.** Safeguarding Olive ridley along Tamil Nadu coast. *The Hindu* 16th *May* 2003.

Address: Centre for Herpetology and Madras Crocodile Bank Trust, Chennai, Tamilnadu, India.

Abstract: While all attention on the need for preservation of rare Olive Ridley turtle is hogged by Orissa, which is a major nesting ground for seaturtles, the sporadic nesting beaches of these turtles in Chennai have gone unnoticed. The region has shown a drastic decline in the nesting population due to urbanization, predation of eggs and snatching by dogs, crows and poaching by man.

2296. **Shanmugam, P., Yu-Hwan Ahn and S. Sanjeevi** 2006. A comparison of the classification of wetland characteristics by linear spectral mixture modelling and traditional hard classifiers on multispectral remotely sensed imagery in southern India. *Ecological Modelling,* 194(4): 379-394.

Address : Ocean Satellite Research Group, Korea Ocean Research and Development Institute, Ansan P.O. Box 29, Seoul 425 600, South Korea; Centre for Geoscience and Engineering, Anna University, Chennai 600025, India.

Abstract : An attempt has been made to compare the recently evolved soft classification method based on linear spectral mixture modelling (LSMM) with the traditional hard classification methods based on iterative self-organizing data analysis (ISODATA) and maximum likelihood classification (MLC) algorithms, in order to map and monitor the coastal wetland ecosystems of southern India, using Indian Remote Sensing Satellite (IRS) 1C/1D LISS-III and Landsat-5 Thematic Mapper (TM) image data. ISODATA and MLC methods were attempted to produce maps of 5, 10, 15 and 20 wetland classes for each of Pitchavaram, Vedaranniyam and Rameswaram sites. The accuracy of the derived classes was assessed with the simplest descriptive statistic technique called overall accuracy and the discrete multivariate technique called KAPPA accuracy. We found that MLC classification method produced maps with higher accuracy than ISODATA classification method. However, there was a systematic decrease in overall accuracy and KAPPA accuracy, when more number of classes were aimed to be derived from IRS-1C/1D and Landsat-5 TM imagery by ISODATA and MLC, caused by the limited spectral separability and instantaneous field of view (IFOV) of the sensor. The later one inevitably caused occurrence of number of mixture pixels (mixels) in the image and its effect on the classification process was a major problem to derive accurate wetland cover types, in spite of the increasing spatial resolution of new generation Earth Observation Sensors (EOS). To achieve higher accuracy of deriving wetland cover information from these data, a soft classification method based on linear spectral mixture modelling was presented. This method considered number of reflectance end-members that form the scene spectra and determined their nature and finally decomposed the spectra into their end-members. Because of the limited number of spectral bands, we collected only three spectral end-members (vegetation, soil and moisture) ideal to the accurate estimation of their sub-pixel fractions from the image data. The resulted fractions from LSMM were compared with normalised difference vegetation index (NDVI), ground truth data, as well as those estimates derived from the traditional hard classifier. NDVI values exhibited a positive correlation with vegetation fractions and negative correlation with soil fraction. Comparison with field data demonstrated higher reliability of the LSMM than the traditional approach of using predefined classification schemes with discrete numbers of cover types. The LSMM would seem to be well suited to locate the small wetland habitats that occurred as sub-pixel inclusions, and to represent continuous gradations between different habitat types in the study sites.

2297. **Shanmugam, S and P. Bensam** 1982. Experimental culture of prawns and fishes in coastal pens at Tuticorin during 1976-78. *Proc. Symposium on coastal aquaculture*, held at Cochin from January 12 to 18, 1980. *Part-1: Prawn culture.* MBAI, Cochin, India, 6: 266-272.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The paper gives an account of experimental culture of prawns *Penaeus semisulcatus*, *P. indicus* and fishes *Chanos chanos* and Mugil in split bamboo screen pens, constructed in the shallow bay at Tuticorin during 1976-78. The problems encountered in the maintenance of the pens in the locality in the context of tidal conditions, winds and waves, as well as the growth of the culture stocks in relation to the hydro-biological conditions prevailing in the area in the course of the work are recounted. Suggestions for a more effective approach of pen culture in the light of the practical experiences gained in the work are given.

2298. **Shanmugapriya, E., M. Mariaselvam, T. Prem Anand and S. Ravikumar** 2001. Screening for insecticidal activity of seaweeds and seagrass from Tuticorin coastal waters. *National Seminar on marine and coastal ecosystems: Coral and mangrove - problems and management strategies, 26-27 Sept 2001, Tuticorin,* p. 69.

2299. **Shanmugaraj, T.** 1998. Impact of Sethu Samudram Ship Canal Project on the Scyllaridae: Decapoda Gulf of Mannar Marine Biosphere Reserve, Tuticorin southeast coast of India – An environmental issue. *Seshaiyana*, 6(2): 6-7.

Abstract : The marine ecosystem of the Gulf of Mannar is endowed with four specialized ecosystems namely Island ecosystem mangrove ecosystem, seagrass ecosystem and coral reef ecosystem. The 21 Islands in the Gulf of Mannar on the southeastern coast of India extending from Rameswaram Island on the north and Tuticorin on the south, along with their marine environment between latitude 8°47.9'15' N and longitude 7°81.2'-79° 14'E, have been notified as India's first Marine Biosphere Reserve (MBR). The sea bottom of the inshore area around the Islands is carpeted with seagrass beds which not only serve as feeding grounds for sea cows (*Dugong dugon*), but also harbors most of the other animal community. Highly productive fringing and patchy coral reef that surrounds the Islands is the most complex and delicate ecosystem. This unique marine ecosystem of the Gulf of Mannar is one of the richest for biodiversity resources in Indian subcontinent. About 3,600 species of flora and fauna are known to occur in the Gulf of Mannar. The total area is 10,500 sq. km. And commercial fishing is done in about 5,500 sq. km. within 50 m depth. Nearly 50,000 human population is dwelling in 47

villages along the 180 km coastline bordering the Gulf of Mannar side and depends on the biodiversity resources of this Marine Biosphere Reserve for livelihood.

2300. **Shanmugavelu, C.R.** 1973. On the largest specimen of Big-Jawed jumper, *Lactarius lactarius* (Sehneider). *Indian J. Fish.*, 20(1): 244-245.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A specimen of *Lactarius lactarius* 330 mm total length was recorded from a drift net catch at Pamban (Gulf of Mannar). The largest specimen of this species recorded so far had only 23 rays in the anal fin as against 22-28 rays in the normal specimens.

2301. **Shanmugavelu, C.R., R. Sathiadas and S. Haja Najeemudeen** 1979. Impact of the cyclone of November 1978 on fishing activities at Rameswaram. *Mar. Fish. Inf. Serv. Tech. Ext. Ser.*, 11: 9-11.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A major cyclone hit the Island on 24.11.78. A brief account of the cyclone and its impact is presented.

2302. **Sharmila, D.** 1996. Accumulation of heavy metals in some marine algae of the Mandapam coast. *M.Sc., Dissertation* submitted to Madurai Kamaraj University, Madurai 625021, India.

Address : School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai – 625021, Tamilnadu, India.

Abstract : The present study revealed that there was greater accumulation of heavy metals in the seaweeds than in previous years. The concentration of Fe, Zn, Pb has increased considerably. This showed that the Mandapam coastal waters are getting polluted day by day. Other metals like Ni, Cu, and Cd were found in lesser amount. The increases in the heavy metal concentration in this area could be due to increased tourism and rapid development of human settlement and increasing industrial development. The easy way to get rid of this marine pollution is proper treatment and management in discharging the effluents and municipal sewage water into the ocean waters. Regular monitoring program should be carried out to indicate the levels of metals in marine water and to save marine life.

2303. **Shenoy, A.S.** 1977. Holothurians and its commercial utility. *Seafood Export J.* 9(12): 17-20.

Abstract : The author states that sea cucumber is usually collected by diving to a depth of 1.5 to 6 meters in the shallow seas of Gulf of Mannar and Palk Bay. During low tide they are either picked up by hand or small scoop nets tied to the end of the bamboo pole. During trawling also at Gulf of Mannar and Palk Bay, a small quantity of *Beche de mer* is collected along with shrimps.

2304. **Shere, S.P and P.V. Ramachandran Nair** 1993. Studies on sporulation and propagation in selected agarophytes. *CMFRI Spec. Publ.*, 56: 35-36.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Studies on sporulation of 4 commercially important red algae (Agarophytes) namely *Gelidiella acerosa, Gracilaria corticata, G. edulis* and *Hypnea musciformis* growing in the vicinity of Mandapam Coast, were carried out from October 1981 to September 1983. During this period fruiting behaviour in the natural population of these species was investigated. Laboratory experiments were carried out with the four algae to collect information on seasonal aspects of spore production and diurnal variation of spore shedding. Studies were also carried out to understand the effect of some selected environmental factors such as desiccation, salinity, temperature, light intensity and photoperiod on spore output in the above four species.

2305. **Shiell, G.** 2005. Information on juvenile holothurians: A contribution by Dr. D.B. James. *Beche-de-mer Inf. Bull.,* 21: 26-27.

Address : School of Animal Biology (M092), The University of Western Australia, 35 Stirling Hwy, Nederlands, WA 6009 Australia; E-mail: cucumber@cyllene.uwa.edu.au

Abstract : Following a request for anecdotal information on the habitat preferences of juvenile holothurians in *Beche-de-mer* information bulletin (19: 2004), observations made by Dr. D.B. James of India were submitted to the author. Twenty-one holothurian species were observed, in seventeen of which juveniles were in the same habitat as adults, and in four observations no adults were present. These observations corroborate the patterns

noted in a short article entitled, Field observations of juvenile sea cucumbers published in *Beche-de-mer* information bulletin (20: 2004). However, Dr James also provides evidence to suggest that juveniles of selected species may occupy different habitats to that of the adult form. This trend, which is now reported in a number of species such as *Holothuria fuscolgilva*; *Holothuria whitmaei* (previously *Holothuria nobilis*); *Cucumaria frondosa*; and *Stichopus hermanni* requires more research.

2306. **Shipley, A.E and J. Hornell** 1904. The parasites of the Pearl Oysters. *Rep. Govt. Ceylon Pearl Oyster Fish Gulf of Mannar,* 2: 77-106.

2307. **Shipley, A.E and J. Hornell** 1905. Further report on the parasites of the pearl oyster. *Rep. Govt. Ceylon Pearl Oyster Fish Gulf of Mannar,* 3: 49-56.

2308. **Shipley, A.E and J. Hornell** 1906. Report on the cestode and nematode parasites from the marine fishes of Ceylon. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar,* 5: 43-96.

2309. **Silas, E.G and Dawson Egbert** 1959. On the concealing behaviour of the tiger fish *Therapon jarbua*. *J. Mar. Biol. Assoc. India,* 1(2): 252-253.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : In October 1959 while collecting fish from shallow waters in the lagoon near Pullamadam, about two miles from the Central Marine Fisheries Research Station, Mandapam Camp, one of us (E.G.S.) noticed sprouts of 'mud clouds' rising from the bottom at certain points. This phenomenon was repeatedly seen at certain spots five to ten meters ahead while slowly wading through the water and eventually their origins were traced to the openings of the burrows of the ocypodid crab *Macrophthalmus depressus* Riippell. Observing for about three minutes, one such burrow, form the entrance of which the 'mud cloud' was seen drifting, a fish was suddenly seen to dart out and speed away. The next time a 'mud cloud' was noticed one of us closed the opening of the burrow with the hands and the other helped in scooping up the mud around the entrance from which the 'mud cloud' was originally seen emitting. A fish was found to strike against the palm of the hand cupped over the entrance of the burrow in its bid to escape and when brought up it was found to be the tiger fish *Therapon jarbua.*

2310. **Silas, E.G.** 1960. On a little known Indian cobitid fish *Enobarbichthys maculatus*. *J. Mar. Biol. Assoc. India,* 2(1): 89-94.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Tamilnadu, India.

Abstract : In 1867 Dr. Francis Day described a small loach from Madras as *Platacanthus maculatus,* with a characteristic long dorsal fin composed of 30 rays. However, the type of the genus *Platacanthus* Day (1865), namely, *P. agrensis* Day is a synonym of *Lepidocephalus thermalis* (Valenciennes), which is characterized by a very short dorsal fin with only 9 rays. This naturally restricted *Platacanthus* Day to the synonymy of *Lepidocephalus* Bleeker and hence Day (1870) proposed the generic name *Jerdonia* to accommodate the second species *Platacanthus maculatus,* defining the genus as Body elongated. Barbels eight, one rostral, two maxillary and one mandibular pairs. A free bifurcated suborbital spine. Dorsal fin elongated (thirty rays). Internal pectoral rays osseous. Origin of anal slightly posterior to the termination of the dorsal. Unfortunately, the name *Jerdonia* is preoccupied in Malacology (Blandford, 1861), and in Ornithology (Hume, 1870), a situation of which Day himself was probably aware of, as in his monographic series on Indian Cyprinidae (Day, 1872: 179) in a foot-note under the genus Jerdonia there appears an editorial comment that this name has been also applied in concology and Ornithology. Hence, in accordance with the Rules of Zoological Nomenclature, Whitley (1931) proposed the name *Enobarbichthys* to replace *Jerdonia* Day, with *Platacanthus maculatus* Day as the type, and thus far the genus is monotypic.

2311. **Silas, E.G and Kumara Pillai** 1960. The stranding of two false killer whales (*Pseudorca crassidens* (Owens) at Pozhikara, north of Cape comorin. *J. Mar. Biol. Assoc. India,* 2(2): 268-271.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : On 27 November 1960 the fishermen at Pozhikara, a fishing village between Cape Comorin and Colachel on the west coast were surprised to find two small whales in shallow water within a few meters from the shore. Some of the enterprising young men entered the water and tried to hold on to the tail of one of them, which excitement caused both animals to run ashore and get stranded. They were hauled to a small pool at the mouth of a narrow backwater canal near the shore. The event of the capture of such strange creatures which no

one could recollect seeing along that coastal stretch at least during the past three decades, received wide publicity in the local newspapers resulting in several hundreds of people visiting Pozhikara to view the animals. The larger of the two measuring 375 cms died one day later, most probably because the water was apparently not of sufficient depth to allow for its free movement.

2312. **Silas, E.G.** 1962. Parasites of Scombroids fishes, Part I. Monogenetic trematodes digenetic trematodes and cestodes. *Proc. Symp. Scombroid fishes*, 3&4: 799-875.

2313. **Silas, E.G and A.N.P. Ummerkutty** 1962. Parasites of scombroid fishes Part II: Parasitic copepoda. *Proc. Symp. Scombroid fishes*, 3&4: 876-993.

2314. **Silas, E.G.** 1962. Tuna fishery of the Tirunelveli coast, Gulf of Mannar. *Proc. Symp. Scombroid fishes*, MBAI, 3&4: 1083-1118.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The present investigations show that there has been little change in the fishery from the time it was completely taken over by the Tuticorin fishermen nearly fifty years ago. A shift in the main fishing season from November-January to June-August is seen at present, and this reflects party on the skill of the fishermen to brave the unpredictable weather in the Gulf during the South West Monsoon. While the quantity of tunas and related fishes landed by multiple trawling at present is not great. It is hoped that this account will help in drawing attention to an area where improvements in the methods of fishing could be effected for the development and utilization of the available resources.

2315. **Silas, E.G and M.S. Rajagopalan** 1962. On the sailfish and marlins of the Tuticorin coast. *Proc. Symp. Scombroid fishes*, MBAI, 3&4: 1119-1131.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Billfishes (Istiophoridae and Xiphiidae) form part of the marine fishery resource commercially exploited by some nations, notably Japan, from parts of the Indo-Pacific. Most of the fishery for billfishes from various parts of the Indian Ocean is carried out by the Japanese and Catch statistics published from Japan (Ann. 1959) indicate the occurrence of rich fishing grounds for billfishes even within a few miles off the Indian coasts during certain seasons. However, little attention has been paid by Indian workers towards the study of the billfishes occurring in the Indian seas, and as such hardly any data is available about their seasonal occurrence, species composition, method of capture etc., along our coast.

2316. **Silas, E.G.** 1964. *Cybium croockewitii* and *C. koreanum* considered synonyms of *Scomberomorus guttatus* with a redescription and annotated bibliography of *S. guttatus*. *Proc. Symp. Scombroid fishes, MBAI*, 1: 309-342.

2317. **Silas, E.G.** 1965. Pogonophora from the Indian Seas. *Curr. Sci.*, 34(12): 367-370.

2318. **Silas, E.G and C. Sankarankutty.** 1965. Field investigations on the shore crabs of the Gulf of Mannar and Palk bay, with special reference to the ecology and behaviour of the pellet crab *Scopimera proxima* Kemp. *Proc. Symp. on Crustacea, MBAI*, 3: 1008-1025.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : In the course of carrying out observations on the ecology and behaviour of shore crabs of Palk Bay and Gulf of Mannar in 1959-60, special attention was given by us for studying the burrowing habits, sexual dimorphism, mating behaviour, etc., of the pellet crab *Scopimera proxima* Kemp details of which are embodied in this paper.

2319. **Silas, E.G and G.S.D. Selvaraj** 1972. Descriptions of the adult and embryo of the bramble shark *Echinorhinus brucus* (Bonnaterre) obtained from the continental slope of India. *J. Mar. Biol. Assoc. India*, 14(1): 395-401.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract: A description of the bramble shark *E. brucus* is given, based on specimens collected during exploratory surveys from the continental slope from 200 to 400 m along the west coast of India and the Gulf of Mannar. A description of a 300 mm embryo of this species is also included. A biochemical analysis of the meat and liver showed that the moisture content of the meat is high (78.66%), and the percentage of oil in the liver is as high as 78.07%. The vitamin A content of the oil is negligible, being only 360 USP/gm of oil.

2320. **Silas, E.G and P.P. Pillai** 1973. The Calanoid copepod family Pontellidae from the Indian Ocean. *J. Mar. Biol.*

Assoc. India, 15(2): 771-858.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : Some species of calanoid copepods, chiefly the members of the family Pontellidae inhabiting the surface waters of the oceanic and neritic regions, have been studied in recent years as possible biological indicators of hydrological properties. Very few studies pertaining to the taxonomy and biogeography of the members of the family Pontellidae from the Indian Ocean have previously been carried out. The present communication gives relevant information on descriptions and illustrations of some species from the Indian Ocean belonging to this family. A catalogue of all the nominal species (both valid species and synonyms) hitherto described from the world oceans has also been included.

2321. **Silas, E.G., S.K. Dharmaraja and K. Rengarajan** 1976. Exploited marine fishery resources of India- a synoptic survey with comments on potential resources. *CMFRI Bulletin*, 27: 1-25.

Address : Central Marine Fisheries Research Station, Cochin - 682 018, India.

Abstract: The present status of the exploited marine fishery resources of India, based on available data, is reviewed here. Details of the estimates of catch by mechanised and non-mechanised boats as well as effort and catch per unit effort have been analyzed year-wise (1962-1974) for the maritime States. Attention is also drawn to some of our potential marine fishery resources and to the new fishing grounds, which have been investigated in the recent past. There is an urgent need for planned exploration of new grounds; identification of new resources; exploitation of non-conventional resources; diversification of fishing, particularly fishing by mechanised crafts which are now almost exclusively engaged in trawling for prawns; the introduction of new and better techniques for capture fisheries; utilization of diverse resources; and the development of proper infrastructure facilities in the Marine Fisheries Sector. The needs and possibilities are discussed here.

2322. **Silas, E.G.** 1978. Research and development programmes in culture and propagation of marine penaeid prawns. *CMFRI Spec. Publ.*, 3: 17-25.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The Research and Development programmes on marine fisheries of the country have been greatly weighted towards the development of the capture fisheries involving the traditional small-scale fisheries as well as the rapidly developing industrial fisheries. However, the trend of growth in marine capture fisheries has not kept the anticipated annual increment on account of large-scale fluctuations in some of our major fisheries. This picture is not very different from that of the world marine fish production, which has been stagnating around 69 million tonnes during the last two-three years. In this context the present global effort in finding ways and means to augment world fish production through coastal aquaculture including mariculture is very pertinent. This has given a boost to marine finfish and shellfish culture in the coastal and contiguous brackish waters in many parts of the world. In India, coastal aquaculture carried out by traditional methods in the brackish waters accounts for hardly 1% of the annual fish production. But it offers considerable scope for improvement through planned scientific methods.

2323. **Silas, E.G., M.S. Rajaogpalan and P.P. Pillai** 1979. Tuna Fisheries in India: Recent trends. *Mar. Fish. Infor. Serv. T & E. Ser.*, 13: 1-10.

2324. **Silas, E.G., T. Jacob, K.C. George and M.J. George** 1980. Status paper on coastal fishery resources along the east coast. ***In***: Report of the consultation on Stock assessment for small-scale fisheries in the Bay of Bengal. *BOBP/REP/10.2.* 20 pp.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, India.

Abstract : The percentage contribution of important varieties of fish to the total catch of the east coast and the estimated marine fish landings on the east coast of India during the years 1975 to 79 are discussed.

2325. **Silas, E.G and P.P. Pillai** 1982. Resources of Tunas and related species and their fisheries in the Indian Ocean. *CMFRI Bulletin*, 32: 1-171.

2326. **Silas, E.G., K. Sathyanarayana Rao, R. Sarvesan, K. Prabhakaran Nair and M.M. Meiyappan** 1982. The exploited squid and cuttlefish resources of India. *Mar. Fish. Infor. Serv. T & E. Ser.*, 34: 1-16.

Address : Central Marine Fisheries Research Institute, Cochin, India.

Abstract : The biological data and catch trends of *Loligo duvaucelii* off various Indian coasts were discussed.

2327. **Silas, E.G and A. Bastin Fernando** 1984. Turtle poisoning. *CMFRI Bulletin,* 35: 62-70.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Turtle poisoning or chelonitoxication have been reported from the tropical and subtropical Atlantic, Pacific and Indian Oceans and the species of turtles responsible for the same are also known. While the clinical characteristics of the disease have been reported from time to time, nothing much is known about the pharmacology or chemistry of the toxins. To date there are no known antidotes to combat chelonitoxin. By far the largest number of instance of turtle poisoning are from the Indian Ocean and Western Pacific. Some observations on instances of turtle poisoning in India involving fatalities is reported here with a brief review.

2328. **Silas, E.G and A. Bastin Fernando** 1985. The Dugong in India - Is it going the way of the Dodo? *Proc. Symp. Endangered Marine Animals and Marine Parks,* Cochin, 1985. pp. 167-176.

2329. **Silas, E.G.** 1985. Tuna fisheries of the EEZ of India - An introductory statement. *CMFRI Bulletin,* 36: 1-5.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The tuna fishery in India is still predominantly an artisanal activity with marginal inputs from the commercial sector. As part of the National Policy for the judicious exploitation of the fishery resources of the Exclusive Economic Zone (EEZ) of India, further emphasis is to be given to the development of tuna fisheries, both in the coastal waters and in the high seas. Despite the fact that there has been a noticeable increase in the landings of coastal tunas during the last two decades, the tuna stocks remain to be one of the least exploited pelagic resources from the EEZ of India. The impact of modern technology was mainly by way of introduction of synthetic fibres for the gear and mechanisation of the crafts which enabled the traditional fishermen to develop their fishing practices in a steady state condition, but the developments in the post harvest technology, especially in the processing of products for internal markets and for exports are still lagging behind (Silas *et al.,* 1979; Silas and Pillai, 1982; 1983; 1984). The present state of affairs of the tuna fishery in the Indian Ocean are indicative that a major international effort is needed for the development of tuna fisheries for the coastal and island states and to effectively manage the tuna resources of the Indian Ocean, without generating conflicts/developing protective interests and exclusive attitudes. Except for the longlines tuna fishery by Japan, Taiwan and the Republic of Korea, and purse seine fishery for tuna by Seychelles there is no organised high seas tuna fisheries in the Indian Ocean. There is the possibility of unlimited entry into the tuna fishery, and added to this, estimates of catch and effort expended and information for biological follow up studies are not always available. The major factors to contend with this fishery are the complex nature of the tuna fishery itself, which employs different techniques for harvesting the resources at surface and sub-surface combined with the need for greater mobility of the fishing fleets.

2330. **Silas, E.G and P.P. Pillai** 1985. Methodology and brief review of the oceanological features of the Indian waters. *CMFRI Bulletin,* 36: 6-7.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

2331. **Silas, E.G and P.P. Pillai** 1985. A critique on national tuna fishery. *CMFRI Bulletin,* 36: 8-19.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

2332. **Silas, E.G.** 1985. Cephalopod Fisheries of India - An introduction to the subject with methodologies adopted for this study. *CMFRI Bulletin,* 37: 1-4.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The world production of cephalopods is briefly reviewed with observations on the situation in India. The methodologies adopted for the present studies on the taxonomy, aspects of biology and stock assessment of the resources of squids and cuttlefishes in some of our fishing grounds are outlined. For fully utilizing the resources the need for a close link up of product development and marketing with resource surveys and commercial harvesting is stressed.

2333. **Silas, E.G., K. Prabhakaran Nair, M.M. Meiyappan and R. Sarvesan** 1985. Resume of the work on cephalopods of the Indian ocean. *CMFRI Bulletin,* 37: 5-12.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The available literature on the cephalopods of the Indian Ocean with particular reference to those of

the Indian Seas has been reviewed under five sections: systematics and distribution, biology, ecology, fishery and resources, and utilization.

2334. **Silas E.G., R. Sarvesan, K. Satyanarayana Rao, K. Prabharan Nair and M.M. Meiyappan** 1985. Identity of common species of cephalopods of India. *CMFRI Bulletin,* 37: 13-37.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A key to the identification of the common cephalopods of Indian Seas which are of commercial importance is given with brief descriptions of nine species of cuttlefishes, six species of neritic squids, four species of oceanic squids, seven species of octopods and *Nautilus pompilius*. A Glossary of technical terms used in the descriptions of cephalopods is included.

2335. **Silas, E.G., M.M. Meiyappan, K. Prabhakaran Nair, R. Sarvesan, K. Sathyanarayana Rao, Y. Appana Sastri, K. Vidyasagar, P.V. Sreenivasan, D. Sivalingam, K. Balan and B.N. Rao** 1985. Area wise and gear wise production of cephalopods. *CMFRI Bulletin,* 37: 88-115.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The coasts of the maritime states of India have been divided into sub areas and the annual and seasonal trends of the area wise and gear wise landings of cephalopods and CPUE have been studied in detail.

2336. **Silas, E.G., R. Sarvesan, M.M. Meiyappan, K.P. Nair, K. Sathyanarayana Rao, K. Vidyasagar, Y. Appana Sastri, P.V. Srinivasan and B.N. Rao** 1985. Cephalopod fisheries at selected centres in India. *CMFRI Bulletin,* 37: 116-128.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The cephalopod fisheries at eleven selected centres, Waltair, Kakinada, Madras, Portonovo, Mandapam, Rameswaram and Kilakarai on the east coast and Vizhinjam, Cochin, Mangalore and Bombay on the west coast have been studied and the annual and seasonal trends of the total cephalopod catches, species composition and CPUE investigated. Cephalopods were obtained in appreciable quantities in trawl nets in most of the areas studied. There is an organized fishery with hooks and lines for cuttlefish and squids at Vizhinjam (Trivandrum).

2337. **Silas, E.G., K. Vidyasagar, R. Sarvesan, K. Prabhakaran Nair and B.N. Rao** 1985. Cephalopod resources revealed by exploratory surveys in Indian seas. *CMFRI Bulletin,* 37: 129-136.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The areawise and depthwise cephalopod catches of fishing vessels of Government of India and some Agencies which conducted exploratory fishing in offshore areas have been presented and discussed. The exploratory fishing by Government of India vessels in Bombay-Gujarat region during 1977-80 yielded a maximum of 7,609 kg of cephalopods a year at a catch rate of 6.8 kg/h. The highest catch rates were recorded from the area 19-70 and the depth zone 80-89 m. In Visakhapatnam region the cephalopod catch was poor during 1968-75 but during 1977-80 the annual catch increased to 3,283 kg. The most intensively fished area was 17-83 m. The catch was composed of four species of cuttlefishes and three species of squids. The results of trawl surveys in other parts of Indian waters are also dealt with.

2338. **Silas, E.G., R. Sarvesan and M.M. Meiyappan** 1985. Oceanic squids. *CMFRI Bulletin,* 37: 140-145.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The various species of oceanic squids distributed in the Indian Ocean especially in the Exclusive Economic Zone of India and adjacent waters and their importance form the point of view of exploitation are discussed. The need for conducting experimental fishing and use of suitable fishing and drift net fishing for developing a fishery for oceanic squids is emphasized.

2339. **Silas, E.G., K. Prabhakaran Nair, M.M. Meiyappan, K. Sathyanarayana Rao, R. Sarvesan and P.V.Srinivasan** 1985. Utilisation and export of cephalopods. *CMFRI Bulletin,* 37: 165-171.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : A major portion of the cephalopod catch in India is used as food in the coastal areas and a small portion as bait in the long line fishing. Other uses such as poultry feed, manure, abrasives etc. are also indicated. About one-third of the catch is exported as frozen cuttlefish, frozen cuttlefish fillets, frozen squids and cuttlebone.

The trends in the export of cephalopod products in recent years are indicated.

2340. **Silas, E.G.** 1985. Cephalopod resources: Perspectives, priorities and targets Cephalopod for 2000 A.D. *CMFRI Bulletin,* 37: 172-183.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Estimates of cephalopod resources of the Indian Ocean and the EEZ of India are discussed. Attention is drawn to major lacunae in resource assessment. The importance of Cephalopods also as forage, as bait, for neuro-physiological studies, behavior studies and so on are discussed. The cephalopod potential and the perspectives and production targets for 2000 A.D. along with modalities of achieving the same are outlined.

2341. **Silas, E.G., G. Mohanraj, V. Gandhi and A.R. Thirunavukkarasu** 1985. Spawning grounds of the milk fish and seasonal abundance of the fry along the east and south west coasts of India. *Proc. Symp. Coastal Aquaculture,* 3: 916-932.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The fish seed resources surveys conducted along the east and southwest coasts of India have shown the occurrence of fry and fingerlings of *Chanos chanos* in appreciable qualities during different months. An attempt is made to present a quantitative distribution of fry of the milkfish in space and time in the study area. The occurrence of spawners and fry along some stretches of the coast indicate the proximity of spawning grounds of the milkfish and these are delineated. The research programmes on controlled breeding of *Chanos* and its culture aspects underway at the Central Marine Fisheries Research Institute, are also discussed.

2342. **Silas, E.G., S. Mahadevan and K. Nagappan Nayar** 1985. Existing and proposed marine parks and reserves in India - A Review. *Proc. Symp. Endangered Marine Animals and Marine Park, MBAI,* 1: 414-428.

2343. **Silas, E.G., V.S.K. Chennubhotla and N. Kaliaperumal** 1986. Seaweed resources products, and utilisation. *Seaweed Res. Utiln.* 9(1&2): 11-24.
Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : India has extensive seaweed resources and these have been surveyed by several workers. In India, more attention is being bestowed on increasing the production of economically important seaweeds by different culture techniques. The growth rate and production of *Gelidiella acerosa, Gracilaria edulis, Hypnea musciformis, Acanthophora spicifera and Sargassum* spp., in different culture methods have been studied. Considerable data are also available on the commercial exploitation of Indian seaweeds. The important commercial products from seaweeds are agar-agar, algin, mannitol and proteins. The algae are also found to bear bioactive substances such as toxins and antibiotics. Attempts have been made to develop antiviral, antifungal and antimicrobial substances from seaweeds. The use of seaweeds as human food, cattle, poultry and other farm animal feed, manure for land plants, source of energy and in pharmaceuticals are reviewed.

2344. **Silas, E.G and S. Kalimuthu** 1987. Commercial exploitation of seaweeds in India. *CMFRI Bulletin,* 41: 55-59.

Address : Central Marine Fisheries Research Station, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The commercial exploitation of seaweeds in India has started in 1966. At present the seaweeds are exploited in Gujarat coast and many localities in Tamil Nadu. The seaweeds harvested from these areas are *Gelidiella acerosa, Gracilaria edulis, G. crassa* and species of *Sargassum* and *Turbinaria.*

2345. **Silas, E.G.** 1989. The prawn, fish and molluscan seed resources along the Kerala and Tamilnadu coasts. *Mar. Fish. Infor. Serv. T & E. Ser.,* 94: 1-16.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : In connection with the prawn, fish and molluscan seed resources, the hydrological conditions from various zones are discussed.

2346. **Silas, E.G.** 2003. Pearl Culture - A new hope for Aquaculture in the 21st century. *1st Indian Pearl Congress & Exposition,* 5th to 8th February, 2003. pp. 5-9.

Address : Kerala Agricultural University, Cochin-682 020, Kerala, India.

Abstract : Mankind has always been attracted to pearls, the most mesmerizing and noble of gems. The history of the cultured pearl has been traced from the time of its invention. The famous fisheries for Indian oriental

pearls in the Palk Bay, Gulf of Mannar and the Gulf of Kutch have been described. The pioneering work of James Hornell on pearl fisheries and culture and the subsequent advances made in pearl culture in Indian marine pearl oysters and freshwater mussels by CMFRI and CIBA are outlined. The future course of action for producing value added, internationally competitive pearls are provided.

2347. **Silas Ebanezar, A and P. Parameswaran Pillai** 1993. Studies on the ecology and productivity of saline lagoon. *CMFRI Spec. Publ.,* 56: 1-8.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Considerable attention has been paid in recent years to study the ecology and productivity of the estuarine and connected inshore waters around India in order to ascertain the productivity of these areas for the utility of aquaculture practises. Very little information is available on these aspects in the coastal lagoons which are characterised by high salinity. In order to understand the suitability of such derelict saline lagoons for aquaculture practises, it is necessary to investigate their environment, nature of their fluctuations and the rate of productivity. The investigations on the ecology and productivity of the coastal lagoon at Mandapam Peninsula along the southeast coast of India was taken up.

2348. **Sindhu, P and M.V.N. Panikkar** 1995. On the occurrence of a new species of *Pterocladia* J.G. Agardh from Kanyakumari, India. *Seaweed Res. Utiln.,* 17(1&2): 23-29.

Address : Department of Botony, S.N. College, Quilon- 691 001, Kerala, India.

Abstract : *Pterocladia kanyakumariensis* sp. novo is described from the intertidal zone on the shores of Kanyakumari, South India. The new species is distinguished from other species of *Pterocladia* in its smaller size, arrangement of sporangia and the structure of the cystocarp. The tetrasporic, cystocarpic and antheridial plants of the new species are described in detail.

2349. **Sinear, V.** 1942. On the cytology of the egg of a Balanoglossid. *Proc. 29th Indian Sci. Cong.,* 3: 162.

2350. **Siraimeetan, P.** 1985. Fishery and bionomics of Tunas at Tuticorin. *CMFRI Bulletin,* 36: 86-103.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The tuna fishery at Tuticorin has earlier been documented by Silas (1967). Since then there has been shift in the pattern of fishery from a predominantly trawl line fishery to gill net fishery (both 'paruvalai' and 'podivalai' of synthetic nylon). Trawl line operations are conducted only when the use of gill nets are temporarily suspended and when the fishermen sail to deeper grounds.

2351. **Siraimeetan, P.** 1985. On the occurrence, size distribution, morphometry and feeding habits of the juveniles of *Euthynnus affinis* (Cantor), *Auxis thazard* (Lacepede), and *Sarda orientalis* (Temminck and Schlegel), along the Tuticorin coast, Gulf of Mannar. *CMFRI Bulletin,* 36: 104-114.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results are presented of studies on the fishery and bionomics of juvenile tuna species *Euthynnus affinis, Auxis thazard* and *Sarda orientalis* at Tuticorin, India. Size distribution, length-weight relationship and meristic counts are examined.

2352. **Siraimeetan, P., K. Sathyanarayana Rao and K.M.S. Ameer Hamsa** 1988. Chanks caught by the Research vessel Cadalmin IV from trawling grounds in Gulf of Mannar. *CMFRI Bulletin,* 42(1): 89-93.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The Sacred Chank, *Xancus pyrum* was caught in bottom trawl net operated by the Research vessel CADALMIN IV in different areas in Gulf of Mannar. The area wise, depth wise and month wise catches of the chanks, the ecological conditions from where they were obtained, size composition of the chanks and length weight relationship have been studied. Maximum number of chanks were caught from trawling grounds off Tiruchendur coast. The highest numbers were recorded in the period December-March. The chanks ranged from 25mm to 117 mm in maximum shall diameter and 54 mm to 202 mm in length. In the trawling grounds from where the chanks were netted the bottom was muddy sand with rocky patches here and there and the other fauna found were polychaetes, Crabs, gastropods, starfishes, sea lilies, cephalopods etc.

2353. **Siraimeetan, P., K.M.S. Ameer Hamsa and K. Sathyanarayana Rao** 1988. On the habitat and food of *Lambis*

lambis and *Hemifuscus cochlidium*. *CMFRI Bulletin,* 42(1): 111-116.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : *Lambis lambis* and *Hemifusus cochlidium* are two important marine gastropods of commercial value in India, which occur at several places along the southeast coast and are exploited for their shells. The habitat and food of these gastropods occurring in Gulf of Mannar off Kayalpatnam, 30 km south of Tuticorin have been studied. The two species occur at depths of 2-12 fathoms in sandy mud habitat with rocky outgrowths and are netted in bottom set gill nets (singi valai) laid for lobsters. Direct observations have been made on their habits by SCUBA diving. The gastropods burrow in the sandy mud bottom and sometimes climb over rocks and coral stones found in the area. The food of the two gastropods is similar and consists of ploychaetes, small crustaceans and bivalve molluscs. The nature of sediments, the faun and flora occurring along with the gastropods in their habitat and the behavior of the two species in laboratory have been studied.

2354. **Siraimeetan, P and R. Marichamy** 1988. Seasonal abundance of bivalve and gastropod larvae in the plankton off Tuticorin coast. *CMFRI Bulletin,* 42(1): 225-231.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Estimation and identification of the commercially important molluscan larvae occurring in the plankton collected from inshore waters off Tuticorin coast during 1975-1985 indicated their abundance in space and time. It is of practical significance to determine the fluctuations in the larval population and settlement of many of the bivalves like the pearl oyster. The occurrence of bivalve and gastropod larvae exhibit two distinct modes during February-April and September-December indicating the peak spawning seasons of these groups. In certain years another prominent occurrence of molluscan larvae was noticed during June-July. A maximum of 98.5% of bivalve larvae were recorded in February 1976 and 91.6% of gastropod larvae during June 1976. The distribution pattern of molluscan larvae and that of other planktonic organisms and the relationship with hydrological factors are discussed. Several larval forms have been identified from the collections indicating the significance of Tuticorin as an important molluscan resources zone.

2355. **Siraimeetan, P and R. Marichamy** 1988. Observations on pelagic fish eggs and larvae in the coastal waters of Tuticorin. *CMFRI Spec. Publ.,* 40: 37-38.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Quantitative estimation of pelagic fish eggs and larvae which occurred in the plankton collections of Tuticorin coast during 1976-85 indicated their abundance in space and time. A trimodal cycle in the distribution of fish eggs and larvae with peaks in February-March, June-July and September-October was observed, indicating the spawning seasons. A maximum occurrence of 7,584 eggs, contributing to 80.5% in the composition of total zooplankton, was recorded in October 1978 coinciding with the pre-monsoon season. Abundance of fish eggs and fish larvae exhibiting definite spawning season was identified and tabulated. Hydrological and meteorological features of the area in relation to the distribution of fish eggs and larvae are briefly discussed.

2356. **Siraimeetan, P and R. Marichamy** 1989. Observations on pelagic fish eggs and larvae in the coastal waters of Tuticorin. *CMFRI Bulletin*, 44(1): 245-250.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract: Quantitative estimation of pelagic fish Eggs and larvae which occurred in the plankton collections of Tuticorin coast during 1976-85 indicated their abundance in space and time. A trimodal cycle in the distribution of fish eggs and larvae with peaks in February-March, June-July and September-October was observed, indicating the spawning seasons. A maximum occurrence of 7,584 Eggs contributing to 80.5% in the composition of total zooplankton was recorded in October 1978 coinciding the pre-monsoon season. Hydrological and meteorological features of the area in relation to the distribution of fish eggs and larvae are briefly discussed. A variety of types of eggs and larvae sorted in the collections indicated the area as an important resourceful ground in the fishery map of Southeast Coast of India.

2357. **Siraimeetan, P.** 1998. On a whale shark, *Rhincodon typus* (Smith) caught off Manapad, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E Ser.*, 154: 17.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : This paper deals with the stray whale shark *Rhincodon typus* caught accidentally from the Periyathalai off Gulf of Mannar.

2358. **Siraimeetan, P and M. Selvaraj** 1999. Experimental cultivation of *Gracilaria edulis* (Gmelin) Silva in Gulf of Mannar at Tuticorin. *Seaweed Res. Utiln.*, 21(1&2): 121-124.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Experiments have been conducted to cultivate *Gracilaria edulis* in the Gulf of Mannar at Hare Island of Tuticorin during 1996-97. This agarophyte has been successfully cultured by vegetative propagation method using the fibreglass tank, cement tank, coir net frame and long line coir rope. In these experiments 3.5, 3.7, 16.1 and 13.2 fold increase in biomass after 80, 60, 74 and 86 days respectively have been obtained. The culture techniques of this species, favourable period for culture and influence of environmental parameters are discussed.

2359. **Sivadas, M.** 1986. Occurrence of juvenile mackerel at Mandapam, Gulf of Mannar coast. *Indian J. Fish.*, 33(4): 479-480.

Address : Central Marine Fisheries Research Institute, Mandampam Camp- 623 520, Tamilnadu, India.

Abstract : The occurrence of juveniles of the Indian mackerel, *Rastrelliger kanagurta* (TL 80-110 mm) at Mandapam, Tamil Nadu, India is reported for the first time.

2360. **Sivadas, M., S. Krishna Pillai and M.R. Arputharaj** 1987. Report on a *Physter macrocephalus* stranded along the Gulf of Mannar coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 71: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of a sperm whale *Physter macrocephalus* stranded along the Gulf of Mannar coast is discussed.

2361. **Sivaji, N., P.J. Joseph and N. Jaganathan** 1993. Results of demersal resources along the southwest coast, wedge bank and Gulf of Mannar between latitudes 7° N and 11° N. *Seafood Export J.*, 25(8): 29-52.

2362. **Sivakami, S.** 1990. Observations on the demersal fishery resources of the coastal and deep sea areas of the exclusive economic zone of India. *Proc.First workshop Scientific Results, FORV Sagar Sampada,5-7 June,*1989. pp. 215-231.

2363. **Sivakami, S., P. Marichamy, P. Livingston, G. Gopakumar, R. Thiagarajan, E. Vivekanandan, K. Vidyasagar, G.S.D. Selvaraj, S. Muthusamy, N. Gopala Krishna Pillai and M. Zaffar Khan** 1996. Distribution of finfish resources along south east coast of India in relation to certain environmental parameters. *Proc. 2nd workshop on scientific results of FORV Sagar Sampada*, pp. 315-330.

2364. **Sivakumar, K.** 2004. Plastid development and floridean starch grain formation during carposporogenesis in *Hypnea valentiae* (Turner) Montagne. *Seaweed Res. Utiln.*, 26(1&2): 225-229.

Address : Division of Algology, Department of Botany (DDE), Annamalai University, Annamalainagar 608 002, Tamilnadu India.

Abstract : Development of the plastids and the formation of starch grains during carposporogenesis in the red alga *Hypnea valentiae* was studied by Transmission Electron microscopy. Proplastids show a homogenous stroma, a central region of DNA like fibrils (genophore), an envelope and a peripheral thylakoid. Proplastids without internal lamellar structure are found scattered in the auxiliary cell and the gonimoblast. After the development of the peripheral thylakoid in the proplastid, internal thylakoid develops from it and lies in close contact with the peripheral thylakoid. In the auxiliary cell, gonimoblast cells and developing carpospores, the proplastids often show one or more constrictions and distinct DNA areas. In developing carpospores starch grain formation begins near the thylakoids, which are arranged into parallel groups. DNA in the developing plastid is found divided into a number of smaller DNA fibrils distributed throughout the plastid. In the mature carpospores plastids are well developed. Dividing starch grains are found in the cytoplasm of the carpospores in intimate association with the Endoplasmic Reticulum.

2365. **Sivakumar, R and V. Ramaiyan** 1988. Morphology of the alimentary tract in relation to food of Platycephalids. *CMFRI Spec. Publ.*, 40: 41.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608502, Tamilnadu, India.

Abstract : The interrelationships between the morphology of the alimentary tract and the food and feeding habits in 5 species of flatheads (Order: Scorpaeniformes) in the family Platycephalidae were studied. The nature

of teeth, gill rakers and the number or absence of pyloric appendices were noted. Based on the shape and relative lengths of the different parts of the alimentary tract and the types of food taken, the fishes were grouped into fish feeders and crustacean feeders. Qualitative analysis of the food of five species of flatheads was also made and the results are discussed.

2366. **Sivakumaran, K.P., M. Manickasundaram and V. Ramaiyan** 1988. Problems of identification in *Sardinella* spp. *CMFRI Spec. Publ.,* 40: 33.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608502, Tamilnadu, India.

Abstract : In spite of several recent studies, confusion still surrounds the identification of a few Indian clupeoids such as Sardinella, Ilisha and Thryssa because of the morphological similarity between species, with has severely restricted useful biological studies. Of all clupeoids, the identification of the species of Sardinella based on meristic and morphometric characters is often confusing. The identity of *S. longiceps, S. clupeoids, S. leiogaster* and *S. sirm* based on a few meristic and morphometric characters is relatively easy. However, the same characters are not satisfactory for *S. albella, S. brachysoma, S. dayi, S. fimbriata, S. gibbosa, S. melanura* and *S. sindensis*.

2367. **Sivakumari, N and M. Sundararaman** 2006. Effect of different seaweeds as a dietary supplement on growth and survival of *Penaeus monodon. Seaweed Res. Utiln.,* 28(1): 175-182.

Address : Department of Microbiology, Srimad Andavan Arts and Science College, T.V. Kovil, Tiruchirappalli - 620 005, Tamilnadu, India.

Abstract : Dry powder of four seaweeds viz, *Chondrococcus hornemanii* (SW-l), *Padina tetrastromatica* (SW-2), *Lobophora variegata* (SW-3) and *Dictyota alternaria* (SW4) were used as dietary supplement separately for shrimp feed formulations and data on shrimp growth and survival rate, proteins and lipid levels were calculated. From the results, 5% supplementation of *Chondrococcus hornemanii* showed higher growth followed by *Dictyota alternaria,* compared to control. The mortality rate was higher in animal fed with control feed (33.33%), interestingly 90.33% of shrimp survival was accounted only in the animal fed with SW-l feed. Higher body protein was recorded in animal fed with SW4 feed. This preliminary study gave useful information on nutritive shrimp feed production.

2368. **Sivalingam, D and S. Krishna Pillai** 1983. Preliminary experiments of breeding of cephalopods. *Proc. Symp. Coastal Aquaculture,* 2: 633-635.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The results of preliminary experiments on hatching and rearing of a squid *Sepioteuthis lessoniana* and a cuttlefish *Sepia aclllleata* are described. The hatchling survived for a maximum of 10 days.

2369. **Sivalingam, D and P. Thillairajan** 1987. Feeding and spawning behaviour of cephalopods reared in the laboratory. *Nat. Symp. Environ. Biol.* 2nd to 4th April, 1987, St. Xavier's College, Palayamkottai-627 002, India. p. 9.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The cuttlefish, *Sepia pharaonis*, was reared from eggs to sexually mature adults for the first time in India. In laboratory conditions the hatchlings took 6 to 7 months for deposition of first batch of eggs. The squid, *Sepioteuthis lessoniana,* was reared from eggs as well as hatchlings collected from wild. The feeding behaviour of the cephalopods during various phases of their life cycles has been observed. Cephalopods feed only on live organisms and the hatchlings thrive well on mysids. Several batches of cuttlefish and one squid attained sexual maturity and they spawned in the laboratory. The mating behaviour and the deposition of eggs of *Sepia pharaonis* and *Sepioteuthis lessonniana* have been observed.

2370. **Sivalingam, D., K. Ramadoss, A.D. Gandhi and M. Enose** 1993. Hatchery rearing of the squid, *Sepioteuthis lessoniana* and the cuttlefish, *Sepia pharaonis*. *Mar. Fish. Infor. Serv. T & E Ser.,* 122: 12-14.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : This article mainly deals with the hatching and the growth of various squids such as *Sepioteuthis lessoniana* and *Sepia pharaonis* and their food ration.

2371. **Sivalingam, D.** 1999. Successful breeding and hatchery experiments of the spineless cuttle fish *Sepiella inermis* at Tuticorin shell fish hatchery. *Mar. Fish. Infor. Serv. T & E Ser.,* 161: 11-13.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The egg masses of the spineless cuttlefish *Sepiella inermis* were collected from Manapad near Tuticorin. The hatching started in the very next day and it took 10 days for the entire egg mass to hatch out and release the young ones. The mantle length and mortality were further discussed.

2372. **Sivalingam, D.** 2000. Culture of cephalopods. *Souvenir, Golden Jubilee, Staff Recreation Club of Tuticorin R.C. of CMFRI,* pp.33-35.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Cuttlefish, squids and octopus come under class cephalopoda which form a major resource. The commercial exploitation of cephalopods records a phenomenal increase leading to increase in cephalopod export.

2373. **Sivalingam, S.** 1958. Survey of pearl Banks of Gulf of Mannar, 1955. *Indian J. Fish.*, 5(1&2): 308-325.

Address : Department of Fisheries, Ceylon.

Abstract : The Pearl Banks of the Gulf of Mannar have been productive for centuries. They are noted, however, for the wide fluctuations in the amount of oysters they produce: many barren years occur between productive years. The biology of the pearl oyster (*Pinctada vulgaris*) as well as the history and other features of the fishery were thoroughly investigated by Herdman and his associates (Herdman, 1903; 1904; 1905 a, b; 1906). The last Pearl Fishery was held in 1925 (Pearson *et al.*, 1929). Since then, intermittent surveys were carried out in order to ascertain the presence of oysters and investigate the possibility of a fishery.

2374. **Sivalingam, S.** 1961. The 1958 pearl oyster fishery, Gulf of Mannar. *Bull. Fish. Res. Station. Ceylon,* 11: 1-28.

2375. **Sivaprakasam, T.E.** 1966. Amphipoda from the east coast of India. Part 1, Gammaridea. *J. Mar. Biol. Assoc. India,* 8(1): 82-122.

Address : Zoological Survey of India, Southern Regional Station, Madras-4.

Abstract : Our knowledge on the taxonomy of the amphipod Crustacea is based on a large number of works done since the beginning of the 19th century by Montagu (1808), Milne-Edwards (1840, 1868), Kroyer (1845), Costa (1853), Dana (1853-55), Bate (1862), Haswell (1880, 1885), Mayer (1881-1904), Della Valle (1893), Sars (1895), Stebbing (1888-1910), Chevreux (1900-1911), Stephensen (1912-1942), Chilton (19121923), Tattersall (1912-1929), Barnard, K. H. (1916-1955), Pirlot (1930-1939), Shoemaker (1920-1956), Schellenberg (1925-1955), Gurjanova (1951), Reid (1951), Barnard, J. L. (1955) and several other authors. A compilation of all the species of gammaridean Amphipoda was first made by Stebbing in 1906. This work was continued by Barnard, J.L. (1958) who published an index to the families, genera and species of the gammaridean Amphipoda, providing a source of valid names and nomenclatural additions and changes since Stebbing's monograph. The study of Indian amphipods has received considerable interest since Giles first published a series of papers from 1885 to 1890 on the amphipods collected by H.M.S. Investigator from the Bay of Bengal. There are several papers by Stebbing (1904, 1907, 1908), Walker (1904, 1905), Tattersall (1912, 1914, 1925), Chilton (1920, 1921, 1923), Gravely (1927), Raj (1927), Stephens en (1931), Carl (1934), Barnard, K. H. (1935), Nayar (1950, 1956, 1959), Pillai (1954, 1957, 1961) and John (1955) dealing with amphipods collected from the coastal areas of Bengal, Chilka lake, Visakhapatnam, Madras, Kerala and the Islands of Laccadives, Maldives, Ceylon and Andaman and from the high ranges of the Himalayas and Nilgiris. In spite of the vast literature, our knowledge of Indian amphipods is far from complete since the studies already made are incomplete and the amphipods of the rest of the Indian subcontinent have not been studied at all. The author was therefore interested in this study and made an exhaustive collection of amphipods from the east coast of India. The collection includes 61 species of which 33 species are recorded for the first time from India. The present paper, which is the first part of this study, gives data on the collection and a systematic account of 29 species belonging to nine gammaridean families. Part 2 to be published in due course (Sivaprakasam, in press) will deal with the rest of the collection together with a discussion on the ecology and geographical distribution.

2376. **Sivaprakasam, T.E.** 1966. Two new Amphipod records from the Gulf of Mannar, India. *Sci. Cult.,* 35: 71-72. .

2377. **Sivaprakasam, T.E.** 1967. Notes on some amphipods from the south east coast of India. *J. Mar. Biol. Assoc. India,* 9(2): 372-383.

Address : Zoological Survey of India, Southern Station, Madras-4, India.

Abstract : The paper contains notes on eleven species of amphipods, of which eight are newly recorded from India.

2378. **Sivaprakasam, T.E.** 1968. A new species and a new record of Amphipoda (Crustacea) from the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 10(2): 274-282.

2379. **Sivaprakasam, T.E.** 1970. Description of *Atylus processicer* (Amphipoda: Dexaminidae) from the Gulf of Mannar. *J. Mar. Biol. Ass. India,* 12(1&2): 93-96.

Address : Zoological Survey of India, Southern Regional Station, Madras-4, India.

Abstract : The genus *Atylus* Leach, which was revised by Barnard (1956, 1970b) comprises 22 species under its nominate subgenus (Barnard, 1969) and 1 species under the subgenus *Kamehatylus* Barnard (1970a). The genus is now placed under the family Dexaminidae with the merger of the family Atylidae with it (Barnard, 1970b). While studying the amphipod collections from the coral reefs of Appa Island in the Gulf of Mannar, the author came across an interesting species belonging to the subgenus *Kamehatylus.* As it differs in several important characters from the only other species known under the subgenus, it is being described as a new species.

2380. **Sivaprakasam, T.E.** 1977. The skeleton shrimps (Amphipoda: Caprellidea) of the Tamil Nadu and Kerala Coasts. *J. Mar. Biol. Assoc. India,* 19(1): 78-96.

Address : Zoological Survey of India, Southern Regional Station, Madras-4, India.

Abstract : The paper deals with the Caprellid Amphipoda collected from the Tamilnadu and Kerala coasts. Description and figures of nine species and keys to the families and Indian species of given. Note on the ecology, distribution and evolution of Indian Caprellidea are also given.

2381. **Sivaprakasam, T.E.** 1986. A study of the demersal fisheries resources of the wadge bank and the Gulf of Mannar. *Bull. Fish. Surv. India,* 15: 1-37.

Address : Fishery Survey of India, Bombay (India).

Abstract : Results of the fishery survey during October 1983 to March 1985 in Wadge Bank and Gulf of Mannar on southeast coast of India are presented. Comparison of the previous estimates of total biomass and annual potential yield for these two areas with present survey estimates is made. Though the estimates vary to a high degree, the results of survey give an idea of the size of resources available for exploitation.

2382. **Sivaprakasam, T.E.** 1986. What is in store in the deep sea? Results of explorations into the demersal resources of the Indian Exclusive Economic Zone. *Occas. Pap. Fish. Surv. India,* 4: 24 pp.

Address : Fishery Survey of India, Bombay, India.

Abstract : A synoptic picture of the coastal and deep sea demersal resources up to a depth of 500 m as surveyed by the larger vessels of Fishery Survey of India has been given. The northern latitudes of Gujarat, Orissa, West Bengal and Andhra Pradesh coasts the states having widest continental shelf are most productive. The Coromandel coast of Tamil Nadu, which has the narrowest shelf, is the least productive. In the coastal waters up to a depth of 70 m, elasmobranchs and dhoma are dominant resources in Gujarat; ribbonfish in Maharashtra; catfish in Goa, Karnataka and Kerala; perches in Wadge Bank and Gulf of Mannar; rays, clupeids, perch and catfish in Andhra Pradesh; catfish and carangids in Orissa-West Bengal coasts dominate.

2383. **Sivaprakasam, T.E., P.S. Parasuraman, S.A.P. Rajakumar and G. Nagarajan** 1991. Marine fishery resources off the lower east coast of India. *Bull. Fish. Surv. India,* 21, 30 pp.

Address : Fishery Survey of India, Bombay, India.

Abstract : The Fishery Survey of India conducted exploratory/experimental fishing to explore fishery resources in the Gulf of Mannar and the Wadge Bank, South East Coast of India until 1987. Another base established at Madras in 1972 initiated an exploratory survey of the resources along the Coromandel Coast, which is still continuing. The results of the surveys carried out by these bases are presented with an assessment on the fishery potential of the southeast Coast of India.

2384. **Sivaram, V. M.M. Babu, G. Immanuel, S. Murugadass, T. Citarasu and M. Peter Marian** 2004. Growth and immune response of juvenile greasy groupers (*Epinephelus tauvina*) fed with herbal antibacterial active principle supplemented diets against *Vibrio harveyi* infections. *Aquaculture,* 237: 9-20.

Address : Department of Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam - 629 502, Kanyakumari, Tamilnadu, India.

2385. **Sivasankari, S., M. Chandrasekaran, K. Kannathasan and V. Venkatesalu** 2006. Effect of seaweed extract on growth and yield of cowpea. *Seaweed Res. Utiln.,* 28(1): 145-150.

Address : Department of Botany, Annamalai University, Annamalainagar - 608 002, Tamilnadu, India.

Abstract : Seaweeds become popular in agricultural practices due to their manurial value. In India, seaweeds are found more abundantly in the southeastern and northwestern coasts. Seaweeds contain all known trace elements and are present in acceptable form to plants. The present study deals with the effect of seaweed extract prepared from *Turbinaria decurrens* Bory de Saint-Vincent on seed germination, seedling growth and yield of *Vigna sinensis* L. (cowpea). Hundred percent germination and enhanced growth-parameters like shoot and root length, total leaf area, seedling fresh and dry weight, number of lateral roots, number of root nodules, number of pods, pod length, dry weight of pod and yield have been recorded at 20% concentration of the seaweed extract of *Turbinaria decurrens.* The other higher concentrations showed declining trend.

2386. **Sivasankari, S., M. Chandrasekaran, K. Kannathasan and V. Venkatesalu** 2006. Studies on the biochemical constituents of *Vigna radiata* Linn. treated with Seaweed Liquid Fertilizer. *Seaweed Res.Utiln.,* 28(1): 151-158.

Address : Department of Botany, Annamalai University, Annamalainagar-608 002, Tamilnadu, India.

Abstract : Marine algae are one of the renewable and economically valuable seawealths. Different forms of seaweed preparations such as Seaweed Liquid Fertilizer (SLF) also known as liquid seaweed fertilizer (LSF) and either whole or finely chopped, powdered algal manure have been used as biofertilizer or biostimulants and all of them have been reported to produce beneficial effects on pulses, cereals and flowering plants. SLF was extracted from the brown algae *Sargassum wightii* collected from Rameshwaram coast. The effect of SLF prepared at different concentrations (5, 10,20, 30, 50, 100%) on biochemical constituents of *Vigna radiata* has been studied. SLF at 10 per cent concentration increased the pigment content, protein, amino acid, total sugar content, catalase, peroxidase and polyphenol oxidase activities. Whereas, the other higher concentrations showed decreasing trend. SLF at 10 per cent might be preferential concentration to be used as a potential seaweed biofertilizer to boost the growth and productivity of *Vigna radiata*

2387. **Sivasubramaniam, K.** 1985. Marine fishery resources of the Bay of Bengal. BOBP/WP/36 (RAS/81/051), BOBP/WP/36. 66 p.

Address : Fishery Biology Division, Bay of Bengal Division, Madras, India.

Abstract : This paper attempts to summarize available knowledge, and identify the gaps in that knowledge, on marine fisheries and fishery resources in the Bay of Bengal region. It provides information on Bangladesh, Burma, India, Indonesia, Maldives, Malaysia, Sri Lanka and Thailand-their marine fisheries, fishery resources, status of important stocks, etc. The Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal, Chittagong, Bangladesh in June 1980, was the first major attempt to collect the knowledge available on marine fishery resources in the Bay of Bengal (see BOBP/REP/10.1, BOBP/REP/10.2 and BOBP/WP/7). That attempt did not cover Maldives and Indonesia. This paper updates the three earlier papers, besides providing information on Maldives and Indonesia. The data covered is largely for the period 1974-82. It is hoped that this document will serve as a handy reference to those interested in the subject and also provide pointers to activities that are required in the area of marine fishery resource management. The preparation of this paper is an activity of the 'Marine Fishery Resources Management' component of the Bay of Bengal Programme (BOBP). The project commenced in January 1983 and has duration of four years. It is funded by the UNDP (United Nations Development Programme) and executed by the FAO (Food and Agriculture Organization of the United Nations) its immediate objective is to improve the practice of fishery resources assessment among participating countries and to stimulate and assist in joint management activities between countries sharing fish stocks.

2388. **SLF.** 1977. General description of marine small-scale fisheries, Tamilnadu, India. (SLF=SriLankan fisheries). *RAS/74/031 Working paper No.12* (Rev.1). pp. 45.

Address : Small scale Fisheries, Colombo.

Abstract : This report deals with the Tamilnadu coastline region's fishery resource and the most abundant species are discussed.

2389. **Sluka, R.D and S. Lazarus** 2005. Humphead wrasse (*Cheilinus undulatus*) rare on the west coast of India. *J.*

Mar. Biol. Assoc. UK., 85(5): 1293-1294.

Abstract : Humphead wrasse (*Cheilinus undulatus*) are widely distributed throughout the Indo-Pacific region, but usually at low densities. This species distribution in India includes Lakshadweep, Gulf of Mannar, the east coast and the Andaman and Nicobar Islands. The abundance and distribution of this species on the west coast of India was unknown prior to this study.

2390. **Smith, H.M.** 1912. The pearl fisheries of Ceylon. *Nat. Geogr. Mag.*, 23(1): 173-194.

2391. **Sobha, V., M. Surendar and T. Vasudevan Nair** 1992. Heavy metal and biochemical studies of different groups of algae from Cape Comorin and Kovalam. *Seaweed Res. Utiln.*, 15(1&2): 77-90.

2392. **Soetersdal, G.S and G.H.P. de Bruin** 1978. Report on the survey of the coastal fish resources of Sri Lanka August-September 1978. *Dr. Fridtj of - Nansen Survey Reports,* 37 pp.

Abstract : The Survey report includes the survey of trawling grounds of lobster and shrimp located in 1972 in the Gulf of Mannar.

2393. **Somasekharan Nair, K.V and R. Raghu** 1990. Studies on the threadfin bream and the lizard fish resources in the exclusive economic zone of India based on the demersal trawling operations of FORV Sagar Sampada. *Proc. First workshop Scientific Results, FORV Sagar Sampada, 5-7 June*, 1989: 239-255.

2394. **Somasundaram, S.S.N., B. Amanullah, K. Shaheed and P. Sahul Hameed** 1996. Environmental radioactivity in the ecosytem of Gulf of Mannar, India. *Proc. V Nat. Symp. Env.*, pp 52-58.

Address : P.G. Department of Zoology, Jamal Mohamed College, Trichy - 620 020, Tamilnadu, India.

Abstract: The paper presents results of a preliminary study of background radiation and the distribution of natural radionuclides (Po-2l0, Pb-210 and Ra-228) in the ecosystem of Gulf of Mannar, which maintains a rich biological diversity of flora and fauna. Five sampling stations were fixed along the coast. The ambient gamma levels were measured and they revealed a non-uniform radiation profile ranging from 10 to 450 μR/hr. The biological samples were subjected to analyses of Po-210, Pb-210 and Ra-228. The general trend was that Po-210 was concentrated to a higher degree than Pb-210 and Ra-228. The soft tissues of organisms accumulated higher Po-210 content while the shells and bones contained more of Pb-210 and Ra-228. The results of the present study are indicative of a high natural background radiation in the coastal area of Gulf of Mannar and the need of an intensive study of the gulf.

2395. **Somasundaram, S.S.N., K. Shaheed and P. Shahul Hameed** 1999. Polonium-210 in seaweeds of the Krusadai Island, Gulf of Mannar. *Proc. Sixth National Symposium on Environment, Coimbatore,* pp. 165-169.

Address ; Post Graduate Department of Zoology, Jamal Mohammed College, Trichy-620020, Tamilnadu, India.

Abstract : The concentration of Po-210, an alpha emitter of the natural uranium series was measured in some commercial seaweeds collected from Krusadai Island, the south east coast of Tamil Nadu. The concentration of Po-210 in water and sediment samples was found to be 2.80 mBq/L and 36.2 Bq/Kg respectively. The Po-210 was observed to be non-uniformly distributed among the seaweeds, which maintained the following descending order: *Viva reticulata* (30.0 Bq/kg) > *Cystophyllum murictum* (24.9 Bq/Kg) > *Sargassum wightti* (22.1 Bq/Kg) > *Sargassum ilicifolium* (19.6 Bq/kg) > Hypnea valentiae (15.09 Bq/kg) >*Gracilaria follifera* (14.87 Bq/Kg) > *Gracilaria edulis* (10.12 Bq/Kg) > *Turbinaria conoides* (8.5 Bq/kg) > *Gelidiella acerosa* (5.80 Bq/kg). The general range of CF for the macro algae varies between 10^3 and 10^4. The distribution of Po-210 in the seaweeds and its relation to the protein content is discussed.

2396. **Somasundaram, S.S.N., S. Ravi Kumar, V. Masilamani and P. Shahul Hameed** 1999. Differential distribution of natural radionuclides in the ecosystem of Gulf of Mannar, India. p.15.

Address : P.G. Department of Zoology, Jamal Mohammed College, Trichy-620 020, Tamilnadu, India.

2397. **Somasundaram, S.S.N and P. Shahul Hameed** 2000. Polonium-210 in bivalve mollusks of Gulf of Mannar, Southeast coast of India. *Indian J. Mar. Sci.*, 29: 263-267.

Address : P.G. Department of Zoology, Jamal Mohammed College, Trichy-620 020, Tamilnadu, India.

Abstract : This paper presents the concentration of ^{21O}Po in five species of bivalve molluscs (*Donax faba, Donax cuneatus, Scapharca illaequivalvis, Pinctada vulgaris and Perna indica*) from Gulf of Mannar, southeast

coast of India. The levels of ^{21O}Po among the tested species ranged from 65.8 to 2,668.9 Bq kg^{-1}. Analyses indicated that the soft tissues of the bivalves registered a higher level of ^{21O}Po than the shells. Further, analyses also showed non-uniformity in the distribution of ^{21O}Po in the various internal organs. The concentration recorded in them maintained the following descending order: digestive glands> viscera> gills> foot> mantle> shell. It is evident that *P. indica* could be used as a sentinel organism for ^{210}Po in the ambient waters.

2398. **Somvanshi, V.S.** 1989. Stock assessment of barracuda (*Sphyraena obtusata*) in the Gulf of Mannar off India. 1989. *Contributions to Tropical fish stock assessment in India. Papers prepared by the participants at the FAO Danida ICAR National follow up training course on fish stock assessment*. Cochin, India, 2-28 November, 1987. (eds) S.C. Venema, N.P. Zalinge and Van. pp. 87-101.

Address : Fisheries Survey of India, Botawala Chambers, Sir P.M. Rd., Bombay 400 001, India.

Abstract : Fish resources in the Gulf of Mannar are unexploited beyond 50 m depth. Exploratory fishing surveys conducted in 1983-85 reveal that barracuda (*Sphyraena obtusata*) could be a commercially exploitable resource from 50 to 200 m depth. The biomass of specimens over 25 cm was estimated at 3384 t, and the MSY at 1000 t per year. Growth parameters were estimated as L_u = 39.7 cm, K = 0.54/year, while a total mortality Z = 2.24/year was found. These calculations are based on the assumption that the survey area holds a unit stock. However, the level of the total mortality estimate (Z = 2.24) compared to a likely natural mortality M of 1 per year suggests migration out of the area of the larger sized barracuda, possibly to Sri Lankan waters.

2399. **Southwell, T.** 1910. A note on endogenous reproduction discovered in the larvae of *Tetrarhynchus unionifactor* inhabiting the tissues of the pearl oyster. *Rep. Ceylon Mar. Biol. Lab.,* 1.

2400. **Southwell, T and J.C. Kirkham** 1912. Currents on the Ceylon pearl banks. *Ceylon Mar. Biol. Rep.,* 6: 231-248.

2401. **Southwell, T.** 1914. A short account of and present knowledge of the cestode fauna of British India and Ceylon. *J. Asiat. Soc. Beng.,* 10: 139-145.

2402. **Southwell, T.** 1927. On a collection of cestodes from the marine fishes of ceylon and India. *Ann. Trop. Med. Parosit.,* 19: 315-317.

2403. **Southwell, T.** 1929. A monograph on cestodes of the order Trypanor hyncha from Ceylon and India I. *Ceylon J. Sci.,* (*Sec. B. Zool. Geol.*) 15: 169-312.

2404. **Southwell, T.** 1929. Cestodes of the order pseudophyllidae recorded from India and Ceylon. *Ann. Trop. Med. Parasitol.,* 22: 419-448.

2405. **Southwell, T.** 1930. The fauna of British India including Ceylon and Burma. *Cestoda I & II.* 1-391 and 1-262. London.

2406. **Sreedharan, C.K and V.K. Melkani** 2006. Enhanced and effective protection and conservation of coastal ecology, biodiversity and communities through active and meaningful support of multi-sectoral stakeholders - A current initiative in the Gulf of Mannar. *Nat. Symp. Marine Biodiversity Conservation and Community. GEER FOUNDATION, Gujrat. June 2006.*

Address: PCCF & CWLW, Tamilnadu, Chennai and Trust Director, GOMBRT, Ramanathapuram.

Abstract : Conflicts between conservation efforts and livelihood needs of communities that depend on these natural resources for sustenance and the developmental needs of societies around vulnerable and fragile eco-systems are on the increase. Adding fuel to the situation there is lack of required levels of mutual coordination and recognition of the need and values of conservation among various departments and agencies who work in and around these areas. Marine Protected Areas are no exceptions. The challenges to marine biodiversity conservation and sustainable use of marine resources are manifold and mammoth. The Gulf of Mannar National Park (GOMNP, 1986) and the Gulf of Mannar Biosphere Reserve (GOMBR, 1989) are the first marine National Parks and Biosphere Reserves not only in India, but also in the South and South East Asia and has long been a national and regional priority. The Gulf of Mannar located in the southeastern tip of India in the State of Tamilnadu is unique and rich in biodiversity (about 4000 marine species) of global significance and falls in Indo-Malayan realm, the world's richest region from marine biodiversity perspective. As elsewhere, the GOMNP and GOMBR face increasing threats to biodiversity and resource use by way of habitat destruction, overharvest of marine

resources, localized land based marine pollution, insufficient law enforcement, lack of community support for conservation, insufficient public awareness and lack of alternative livelihoods etc. Whether acknowledged or not with growing population, fishing gears and crafts and depleting stocks of fish and other harvestable resource which is the grim reality today, developing logical fisheries regimes, enhanced and strict regulation have to be seriously pursued and tackled on priority by all concerned to ensure sustainable future for coastal communities, biodiversity and ecology. In order to improve the current situation and to address the imposing threats a new initiative with collaborative support of GEF–UNDP–GOI-GOTN in a project mode is now under implementation in the area. A special purpose vehicle in the form of a statutory body the Gulf of Mannar Biosphere Reserve Trust (GOMBRT) has been established to co-ordinate the implementation of project initiatives. The project "Conservation and Sustainable use of the Gulf of Mannar Biosphere Reserve's Coastal Biodiversity" aims to conserve GOMBR's globally significant assemblage of coastal biodiversity and to demonstrate in a large biosphere reserve with various multiple uses, as to how to integrate biodiversity conservation and sustainable coastal zone management and livelihood development of coastal people. The focus of project initiative will be on empowering local communities to manage the coastal eco-system and wild resources in partnership with government and other stakeholders and making all accountable for the quality of the resulting stewardship. The project has adopted the eco-development approach to elicit people's support for conservation. Eco-development as a tool for conservation of Protected Area (PA) management has been in practice in many terrestrial PA's since 1980s. Eco-development is a viable strategy for protecting ecologically valuable areas from unsustainable or otherwise unacceptable pressures resulting from the needs and activities of people living in and around such areas. The process of eco-development is site specific and is driven with participation of people in planning and implementation of agreed programmes. The inputs of eco-development at one side aim to increase resource productivity in the areas used by the people who are peripheral to the PA and at the other to bring reduction in dependence levels on PA resources through alternative development for livelihoods and other basic needs and enhanced awareness on the need and values of conservation.

2407. **Sree Kala Devi, R., J. Edwin James and S. Saravana Babu** 2004. Distribution of marine macroalgae in Idinthakarai and Vizhinjam coasts - A comparative study. *Seaweed Res. Utiln.,* 26(1&2): 29-32.

Address : Department of Botany, Scott Christian College, Nagercoil-629 003, Tamilnadu, India.

Abstract : A comparative study on the distribution of marine macroalgae was carried out during the northeast monsoon season (October, 2003 to December, 2003) at two stations, Idinthakarai on the southeast and Vizhinjam on the southwest coast of India. Abundant vegetation of algae was seen in the Idinthakarai than in the Vizhinjam coast. A total of 38 species was recorded from Idinthakarai of which 16 belong to Chlorophyceae, 10 to Phaeophyceae and 12 to Rhodophyceae. Among the Chlorophyceae, *Caulerpa* showed greater species diversity with 7 species. A total of 22 species was recorded from Vizhinjam constituting 10 Chlorophyceae, 5 Phaeophyceae and 7 Rhodophyceae members. Two seagrasses namely *Syringodium isoetifolium* and *Cymodocea serrulata* were recorded from Idinthakarai.

2408. **Sreekrishna, Y and L. Shenoy** 1988. Role of fishing technology in research and development of marine fisheries of India. *CMFRI Spec. Publ.,* 40: 66-67.

Address : Central Institute of Fishery Education, Bombay, India.

Abstract: Consequent to the declaration of Exclusive Economic Zone (EEZ) to 200 nautical miles, India has acquired right to explore, exploit, manage and conserve the resources of her seas. Fishing technology, which deals with the study, development and improvement of the techniques used to catch the fish, has a greater role to play in the exploitation of all potential fishery resources in the EEZ. This discipline concerned with fishing gear, fishing vessels and operations represent major share of investment. This paper deals with fishing methods in marine waters, types of vessels in operation, prospective developments in fishing technology and recommendation regarding vessel and gear suitability for exploitation of deep-sea resources.

2409. **Sreekrishna, Y and R.S. Biradar** 1988. Human resources development in fisheries. *CMFRI Spec.Publ.,* 40: 75.

Address : Central Institute of Fisheries Education, (ICAR), Versova, Bombay - 400 061, India.

Abstract : Human resources development is an important part of fisheries development. The Central Institute of Fisheries Education (CIFE) at Bombay has provided the requisite trained manpower at different levels from fisheries development, industry, research, education, training and extension. In addition to regular courses, a large number of short term training programmes on selected topics have also been conducted at national and international levels to meet specific demands. The Institute is today recognized as the centre of excellence in

higher education in fisheries. Besides the CIFE traditional and agricultural universities and Indian institutes of technology are also engaged in imparting fisheries education. There is a need for standardisation and inter-collaboration of these courses. Establishment of a central fisheries university will go a long way in achieving these objectives.

2410. **Sreekrishna, Y and L. Shenoy** 1990. Role of fishing technology in the research and development of marine fisheries in India. *CMFRI Bulletin,* 44(2): 447-452.

Address : Central Institute of Fisheries Education, Versova, Bombay - 400 061, India.

Abstract : Consequent to the declaration of Exclusive Economic Zone (EEZ) to 200 nautical miles, India has acquired right to explore, exploit, manage and conserve the resources of her seas. This provides greater challenge by way of financial investment, provision of infrastructural facilities introduction of different types of large deep sea vessels, modern fishing gear and use of modern technologies in fish handling, processing, storage and marketing. Great strides have been made in increasing marine fish production of India from 0.53 million tonnes in 1951 to 1.81 million tonnes in 1984. This has been possible by application of various technologies including fishing technology. The introduction of bottom trawls, purse seines, high opening trawls in selected areas, double rig shrimp trawls from deep sea fleet, etc., has made significant impact on the marine fish production. Introduction of synthetic twines contributed to the increase of efficiency of gear like gill nets and trawls. Mechanisation of fishing vessels resulted in economical operations, expansion of fishing range and duration of fishing. Other aspects of fishing which helped the overall fisheries development include exploratory surveys for resources assessment, deck equipment to handle the gear, electronic instruments for finding fish and to navigate the vessels safely. This paper deals with fishing methods in marine waters, types of vessels in operation, prospective development in fishing technology and recommendation regarding vessel and gear suitability for exploitation of deep sea resources.

2411. **Sreekumaran Nair, S.R., A.H. Parulekar and B.N. Desai** 1988. Research in the assessment of capture and culture fisheries along the Indian coast. *CMFRI Spec. Publ.,* 40: 42.

Address : National Institute of Oceanography, Dona Paula, 403004, Goa, India.

Abstract : A review of the research conducted at National Institute of Oceanography, Goa, to assess the capture and culture fishery potential of India is presented. The productivity of the coastal and oceanic waters around India is discussed. The expected fishery yield and present level of exploitation are assessed and further course of action discussed. In culture fisheries the contribution of NIO in the fields of mussel culture, shrimp culture, brine shrimp culture, seaweed culture, horseshoe crab culture and fish culture are reviewed and discussed.

2412. **Sreenivasan, A.** 1980. Small-scale marine fisheries of Tamil Nadu. *CMFRI Bulletin,* 30-B: 34-38.

Address : Department of Fisheries, Madras, Tamilnadu, India.

Abstract : There is no precise definition of "smallscale fisheries", In the cast of small-scale industries, Rs, 10.0 lakhs investment is the ceiling. 'Traditional Fisheries'- will certainly be deemed to be part of small-scale fisheries, possibly fishing with boats of size up to 43 ft. will also belong to small-scale fisheries. But the F.A.O. reports on small-scale fisheries refer only to improvements in traditional craft and their "motorization" but not mechanization.

2413. **Sreenivasan, P.V., A. Chellam, P. Poovannan and A.D. Gandhi** 2003. Experimental Onshore Marine Pearl Culture at Chennai. *1st Indian Pearl Congress & Exposition,* 5th to 8th February, 2003. pp. 61-64.

Address : Central Marine Fisheries Research Institute, Chennai - 600 006, Tamilnadu, India.

Abstract : Work on the onshore pearl culture was initiated at the Gem Hatchery, Chennai in the month of December 1995, by bringing 1,000 pearl oysters of the species, *Pinctada fucata* (Gould) from Tuticorin Research Centre of Central Marine Fisheries Research Institute. The work continued till July 1997 (when the hatchery was shut down permanently). Six batches of pearl oysters totaling 4,000 oysters and 30,000 spat were brought during the period, the mode of transportation being train or bus. On reaching the Gem Hatchery, the oysters were first kept in 400 litre FRP tanks for acclimation, the period of which varied from one week to 2 months (specifically in the case of spat, the acclimation period was longer). Thereafter, they were distributed in box type netted iron cages (40 cm x 40 cm x 10 cm size), which was suspended in large RCC tanks. Mortality among the oysters was more in the period, immediately after transport due to the stress caused by transportation. The season, time, mode and duration of transport greatly affected the survival of the oysters. Atmospheric temperature prevailing during the time of transport was a major factor, which induced stress on the oysters. Comparatively

lower percentage of mortality (3 to 5%) was recorded in the last three batches, while it was as high as 23 to 35% in the earlier batches. This was possible due to improvised method of transporting the oysters in polythene bags with oxygenated seawater. Moreover, average size of the oysters of these batches was much smaller at less than 20mm, while in the earlier batches it was 30mm and above. Transporting them by train with seawater change at least once in three hours on the way was found to reduce the mortality among the oysters considerably. Stocking was done at the rate of 2,000 oysters per cage for the size below 20 mm, up to 600 for the size below 30mm and 100 to 150 for the size above 30mm. Whenever overcrowding was observed, thinning was done. Apart from keeping the oysters in suspended cages, planting them on the bottom of the tank was also done. However, for effective management, keeping the oysters in the suspended cages was found to be the best option.

2414. **Sridhar, P., C. Namasivayam and G. Prabhakaran** 1988. Algae flocculation in reservoir water. *Biotechnol. Bioeng.*, 32(3): 345-347.

Address : R&D Centre, Southern Petrochemical Industries Corp., Ltd., SPIC Nagar, Tuticorin-628 005, Tamilnadu, India.

Abstract : Removal of algae in reservoir water was studied by electroflocculation using a bipolar cell with aluminum electrodes and flocculation by treatment with commercial alum. Comparison of both the methods is discussed.

2415. **Srikrishnadhas, B and V. Sundararaj.** 1989. Status and scope for lobster culture.*Seafood Export J.*, 21(3):19-24.

Address : Fisheries College and Research Institute, Tuticorin-628 008, Tamilnadu, India.

Abstract : A discussion is presented on the potential for spiny lobster culture in India; some 6 species of *Panulirus* are common in both east and west coasts. These lobsters may be easily cultured in control conditions and confined marine environments, provided the water quality is good and necessary food and hiding places are provided sufficiently. Applications of eyestalk ablation techniques in lobster culture systems are examined briefly.

2416. **Srikrishnadhas, B., M.K. Rahman and A.S.M. Anandasekaran** 1991. A new species of Scyllarid lobster, *Scyllarus tutiensis* (Scyllaridae: Decapoda) from the Tuticorin Bay in the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 33(1&2): 418-421.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A new lobster *Scyllarus tutiensis* from Tuticorin Bay, Gulf of Mannar is described. The salient characters of the new species are absence of median tubercles on last thoracic sternum; anterior tooth of inner margin of orbit small and straight; median carina of abdomen not raised; a conspicuous colour spot on mid dorsal line of first abdominal segment partially hidden under carapace.

2417. **Srikrishnadhas, B and Md. Kaleemur Rahman** 1993. A growth system for spiny lobsters. *Seafood Export J.*, 25(5): 11-14.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Three species of spiny lobsters, i.e., *Panulirus polyphagus*, *P. homurus* and *P. ornatus*, have been identified for culture in the coastal zone of India. A lobster culture unit for these has been developed. This has been briefly described. Water exchange and continuous aeration of the water are considered to be vital to the system. The designs of culture tanks have been outlined.

2418. **Srikrishnadhas, B and V. Sundararaj** 1993. Studies on the growth of marine shrimps in floating cages and pen. *Proc. on Aquaculture Development in India- Problems and Prospects, Trivandrum (India), 27-29 Nov, 1990. (eds) P. Natarajan and V. Jayaprakas.* pp. 53-58.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Studies made on the growth of marine shrimps in floating cages and pen in the coastal waters of Tuticorin are presented. A floating raft was made using casuarina and bamboo poles and empty oil drums. Cages of 4 m^2 and 1 m^2 size with 1 cm nylon mesh nettings were suspended from the raft. A floating pen of 12 m^2 was also anchored. The shrimps *Penaeus indicus, P. monodon, P. semisulcatus* and *Metapenaeus dobsoni* were stocked in the culture system in high densities of 50/m^2, 80/m^2 and 100/m^2 unlike in pond systems to utilize the dynamic nature of the coastal water. The experiments conducted showed different growth rates varying from 4.490 g (*M. dobsoni*) to 10.195 g/month (*P. semisulcatus*) in 2 to 4 months of growth periods. The problems and prospects of

shrimp culture in floating cages and pen in the coastal waters are presented. The merits and demerits of this farming system are also compared with other shrimp farming practices in Tuticorin Region in India.

2419. **Srinath, M.** 1988. Trend of major exploited marine fishery resources of India during 1961-85. *CMFRI Spec. Publ.,* 40: 103.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The annual estimated total marine fish landings in India during 1961-85 are given. The contributions of the four regions namely Northeast, Southeast, Southwest and Northwest to the total landings are presented. The trends in the landings of some of the major exploited resources are depicted. Estimates of the potential yields of the major fishery resources are given. Strategies for monitoring and rational exploitation of the fishery resources are also indicated along with the future perspective.

2420. **Srinath, M.** 1989. Trend of the major exploited marine fishery resources of India during 1961-1985. *CMFRI Bulletin,* 44(1): 272-283.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The annual estimated total marine fish landings in India during 1961-'85 are given. The contributions of the four regions namely Northeast, Southeast, Southwest and Northwest to the total landings are presented. The trends in the landings of some of the major exploited resources are depicted. Estimates of the potential yields of the major fishery resources are also indicated. Strategies for monitoring and rational exploitation of the fishery resources are also indicated along with the future perspective.

2421. **Srinath, M., S. Kuriakose and K.G. Mini** 2005. Methodology for the estimation of Marine fish landings in India. *CMFRI Spec. Publ.,* 86 : 1-57.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The marine fisheries sector in India has witnessed a phenomenal growth during the last five decades both quantitatively and qualitatively. The subsistence fisheries during the early 50's which produced about 0.5 million tonnes annually has presently grown into a full grown industry producing currently about 2.7 million tonnes annually with a landing site value of about Rs. 13,000 crores. This increase is not only as a result of improvements in the harvesting methods, increase in the fishing effort and extension of fishing into relatively deeper regions but also increased demand resulting from trade in export of marine products as well as the ever growing domestic market demand. Monitoring and assessment of the exploited marine fishery resources of India is one of the important mandates of the Central Marine Fisheries Research Institute (CMFRI). The effect, extent and scope of the management measures are assessed by precise and reliable fishery statistics. In order to make stock assessments relevant to site-specific fisheries management, it is essential to know what is actually being fished from the population, as this affects the ability of stocks to survive and most importantly, to reproduce and repopulate. Thus, catch and effort statistics along with biological data on fish caught by various gears form the key and essential basis for effective fisheries management. Marine fish landings in India are estimated from the sampling of commercial landings. Statistics on marine fish production are available from 1950 onwards when the Institute started nation wide sample survey for estimating the marine fish landings in the country. Keeping in pace with the changing marine fisheries scenario, the sampling procedure has been modified over the periods. The resource monitoring system is represented in the following diagram.

2422. **Srinivas, K., V.K. Das and P.K.D. Kumar** 2005. Statistical modelling of monthly mean sea level at coastal tide gauge stations along the Indian subcontinent. *Indian J. Mar. Sci.,* 34(2) 212-224.

Abstract : This study investigates the suitability of statistical models for their predictive potential for the monthly mean sea level at different stations along the west and east coasts of the Indian subcontinent. Statistical modelling of the monthly mean sea level at 15 selected tide gauge stations (8 stations on the west and 7 stations on the east coast) along the coastline of the Indian subcontinent was attempted using autoregressive, sinusoidal and exponentially weighted moving average (EWMA) techniques. Statistics pertaining to the mean seasonal cycle as well as interannual variability are also presented. A strong domination of the annual cycle over the semi-annual cycle was seen at ten stations. The maximum seasonal sea level ranges were observed along the west coast at Bhavnagar (63 cm) and along the east coast at Sagar Island (48 cm). While the autoregressive and sinusoidal models were satisfactory, EWMA technique was found to be the best of all. Tuticorin on the east coast, and Mormugao on the west coast of India have shown minimum RMSEs for the corresponding coasts for all the three models, while Bhavnagar on west coast has shown very high RMSE values. The EWMA technique

(which yields forecast with a lead time of only one month) gave the lowest root mean square errors relative to the verifying observations.

2423. **Srinivasan, A., R. Santhanam and G. Jegatheesan** 1988. Biomass and seasonal distribution of planktonic tintinnids of Pullavazhi Estuary, southeast coast of India. *Indian J. Mar. Sci.*, 17(2): 131-133.

Address : Marine Prodoucts Export and Development Authority, (MPEDA) Machilipatnam, India.

Abstract : Seventeen species of tintinnids were recorded from Pullavazhi Estuary, Gulf of Mannar. While much of the agglomerated species were associated with salinities of < 29.5 x 10^{-3}, all the non-agglomerated species were with salinities of > 31.5 x 10^{-3}. The net tintinnids dominated over nanotintinnids and their percentage contributions by counts and plasma volume were 72 and 75% (st 1) and 71 and 88% (st 2) respectively.

2424. **Srinivasan, A and R. Santhanam** 1991. Tidal and seasonal variations in zooplankton of Pullavazhi brackishwater, southeast coast of India. *Indian J. Mar. Sci.*, 20(3): 182-186.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Distribution and biomass of zooplankton in relation to tides and seasons were studied in 2 stations (mouth of the estuary and backwaters) at Pullavazhi, Tamil Nadu, India. The tidal study revealed that the peak values in density (723,700 and 1,036,500 ind/m^3) and dry weight biomass (667 and 738 mg/m^3) were during night high tides in both the stations. Species diversity values were generally high in both mouth and tidal zone and maxima were 5.3 and 4.5 respectively. In both stations summer season registered higher density values (263,000 and 297,000 ind/m^3) and biomass (498 and 455 mg/m^3) of zooplankton. Compared to other Indian estuaries, this brackishwater showed an abundance of microzooplankton, particularly copepod larvae and molluscan veligers, which contributed a larger share (average 56 and 58%) to the dry weight biomass.

2425. **Srinivasan, R and T. Santhanaraj** 1967. Studies on the extraction and properties of agar-agar from the seaweed *Gracilaria* sp. in Madras State. *Madras J. Fish.*, 3: 146-151.

Address : Fisheries Technological Station, Tuticorin, Tamilnadu, India.

2426. **Srinivasan, R and T. Santhanaraj** 1968. Some studies on the processing and utilisation of seaweeds of Madras State. *Madras J. Fish.*, 4: 92-97.

Address : Fisheries Technological Station, Tuticorin, Tamilnadu, India.

Abstract : Indian resources of seaweeds, though not considerably large, are sufficiently valuable. In Madras State, there are extensive beds of seaweeds along the rocky coasts of Thanjavur, Ramanathapuram and Tirunelveli districts in a distance of about 480 kilometres from Point Calimere to Cape Comorin. As many as 134 species were provisionally listed from the neighbourhood of Krusadai island in the Gulf of Mannar by Chacko, Mahadevan and Ganesan (1955).

2427. **Srinivasarengan, S.** 1979. Occurrence of a large shoal of Javanese cow nose ray, *Rhinoptera javanica* Muller and Henle in the Bay of Bengal off Madras. *Indian J. Fish*., 26(1&2): 239.

Address : Central Marine Fisheries Research Institute, Madras, Tamilnadu, India.

Abstract : The present note records the occurrence of a large shoal of *R. javanica* off Madras in the northerly direction at a depth of 5 fathoms on 3-4-1973. According to fishermen who sighted the shoal the major portion of the shoal escaped the net. Therefore, the exact number comprising the shoal could not be estimated. However, 690 fish were landed by the fishermen at Royapuram. The size range of the fish varied from 102 to 156 cm and the weight from 15 to 25 kg. 85% of the fish landed were female and most of them were gravid and > 128 cm, thus confirming the nature of migration during this period of occurrence in the coastal waters, as recorded earlier by James (1962, 1970). The stomachs of these fishes were empty. Probably they do not feed during their breeding migration into coastal waters. The present study indicates that the shoals of *R. javanica* are not confined to Gulf of Mannar alone, but extend northward into the Bay of Bengal, at least as far as Madras.

2428. **Sriramachandra Murty, V.** 1967. Notes on the hyperostosis in the fish *Drepane punctata* (Linnaeus). *J. Mar. Biol. Assoc. India*, 9(2): 323-326.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Mandapam, India.

Abstract : Hyperostosis of frontals, supraoccipital, lacrymals, ribs, neural and haemal spines and of caudal rays

in *Drepane punctata* is described. Hyperostosis seems to occur only in *D. punctata* and it has so far not been found to occur in specimens of *D. longimana* (maximum size 180 mm).

2429. **Sriramachandra Murty, V.** 1968. On some interesting and new records of marine fishes from India. *J. Mar. Biol. Assoc. India,* 10(1): 126-132.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : While examining the fish landings by shore seines and trawl nets at various fishing centres along the Palk Bay and Gulf of Mannar in the vicinity of Mandapam the author came across several specimens of *Drepane longimana* (Bloch and Schneider) which is little known and *Drepane punctata* (Linnaeus) which was recognised as the only valid species of the genus *Drepane.* A study of these specimens has shown that these two species are distinct as shown by some authors (vide Text). A brief comparative account of these two species is given in this paper, along with a few remarks and key to distinguish the two species. The author has also been able to collect specimens of *Platycephalus isacanthus* Cuvier from the above catches, and a single specimen of *Stethojulis interrupta* (Bleeker) from the inshore waters of Gulf of Mannar caught in dragnet, whose occurrence, in Indian seas, is so far not known. Brief descriptions of these two species are also given in this paper.

2430. **Sriramachandra Murty, V.** 1972. On a specimen of *Caranx carangus* (Carangidae: Pisces) without a pelvic fin. *J. Mar. Biol. Assoc. India.* 14(2): 884-885.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The present note reports the absence of the pelvic fin of the right side of the fish, *Caranx carangus* Bloch from the Southeast Coast of India. It has been found that, while the pelvic fin on the left side and its girdle are normal, but for slight thickening of the 4th and 5th rays, the absence of the fin on the right side may be congenital.

2431. **Sriramachandra Murty, V., T. Appa Rao, M. Srinath, E. Vivekanandan, K.V. Somasekharan Nair, S.K. Chakraborty, S.G. Raje and P.U. Zachariah** 1992. Stock assessment of threadfin breams (*Nemipterus* spp.) of India. *Indian J. Fish.,* 39(1&2): 9-41.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Asbtract : The annual average estimated landing of threadfin breams in India during 1980-83 was 22,247 tonnes which increased to 48,100 tonnes during 1984-88; a maximum of about 60,000 tonnes landed in 1986. Over 90% of threadfin bream catch in the country was obtained by commercial trawlers. Among the maritime states of India, Kerala contributed maximum (52%) to the nemipterid landings. followed by Maharashtra (13.6%), Tamil Nadu and Pondicherry (l1.2%), Kamataka and Goa (8.8%), Gujarat (7.8%), Andhra Pradesh (5.5%) and Orissa (1.1 %). Though a total of six nemipterid species contributed to the fishery in different states, only two species *viz Nemipterus japonicus* and *N. mesoprion* contributed significantly; the former was most abundant in Tamil Nadu-Pondicherry, Karnataka-Goa, Maharashtra and Gujarat and the latter in Andhra and Kerala. Periods of peak abundance were January-March in Andhra Pradesh, Karnataka-Goa, and Gujarat whereas April-June in Maharashtra and July-September in Tamil Nadu-Pondicherry and Kerala. The parameters of growth and mortality were estimated. The results of stock assessment from each state show that though there is scope to increase the effort by 40%-100% to get MSY from the fishing grounds, the increase in yield will be marginal (1 %-12%). There is need to increase the cod end mesh size of trawl net (or length at first capture L.c) by 10-30% to get MSY. The maximum possible yield of *N. japonicus* and *N. mesoprion* from the fishing grounds along east coast (Andhra Pradesh, Tamil Nadu and Pondicherry) is around 5,000 tonnes and along west coast between 43,000 tonnes and 46,000 tonnes. These are close to the yields in 1984-88. The problems in stock assessment and different options for management of fisheries are discussed.

2432. **Sriramachandra Murty, V., M. Srinath, P. Livingston, Y. Appanna Sastry and S. Srinivasarengan** 1992. Stock assessment of silver bellies of India with particular refernece to Andra Pradesh and Tamil Nadu, *Indian J. Fish.,* 39(1&2): 42-64.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Along Indian coasts, the silverbellies are exploited by trawl and artisanal gears but bulk of the landings are obtained by trawls, which operate up to 50 m depth. During 1979-83, the estimated annual average silverbelly landings were 69,000 tons, whereas during 1984-88 these were 62,000 tons. Maximum silverbelly landings were obtained in Tamilnadu, which contributed 70.5% of total all-India silverbelly landings followed

by Andhra Pradesh (9%), Kerala (8.4%), Karnataka (6%) and other states (6.1%). Out of 20 species of silverbellies, known to occur in the seas around India, *Leiognathus bindus* and *Secutor insidiator* were most dominant along Andhra Pradesh and northern Tamilnadu coasts, together contributing to 64% and 55% respectively of silverbelly landings. Along southern Tamilnadu, *L. jonesi* and *L. dussumieri* were most dominant together forming about 60% of silverbelly catch in the region. The available information on the biology of different species from several localities along Indian coast was reviewed. Parameters of growth and mortality of dominant species were estimated. Stock assessment was made separately for *L. bindus* and *S. insidiator* and then mixed fisheries assessment made for these two species combined from Andhra Pradesh and northern Tamilnadu. From southern Tamilnadu coast, stock assessment was made for *L. jonesi* and *L. dussumieri* separately and combined. Along Andhra Pradesh coast, the effort level was found greater than the one yielding MSY in the existing fishing grounds. In northern Tamilnadu there was scope to increase the fishing effort to get MSY. In southern Tamilnadu yield can be increased by about 1.5% through increasing the effort by 40%. The assessment of yield of *L. bindus* and *S. insidiator* in relation to cod end mesh size of trawl along Andhra Pradesh showed the need to reduce the cod end mesh size by about 40%. In northern Tamilnadu also more or less similar situation existed. In southern Tamilnadu, the MSY corresponded to the existing cod end mesh size and, therefore, did not warrant any change in the latter.

2433. **Sriramachandra Murty, V.** 1996. Marine Ornamental fishes of India. *Proc. Seminar on fisheries: A Multibillion Dollar Industry Madras*, 17-19, Aug. 1995, pp.23-24.

2434. **Sriramachandra Murty, V and P. Vedavyasa Rao** 1996. Marine fishery resources of India - Present status and management concerns, pp. 103-125. ***In.*** *Marine biodiversity : Conservation and management.* (eds.) N.G. Menon and C.S.G. Pillai, CMFRI. 205 p.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The marine capture fishery of India is in the cross roads at the present juncture. It has two options with regard to the coastal fisheries: either to sustain the production by harvesting the resources in a rational manner or to succumb to the economic, ecological and social pressures leading to resource depletion and continued conflicts.

2435. **Sriraman, K and G. Sathiyamoorthy** 1988. Rearing of PL 20 of *P. monodon* in nursery pond - an experimental study. *CMFRI Spec. Publ.,* 40: 54.

Address : Department of Fisheries, Porto Novo - 608 502, Tamilnadu, India.

Abstract : In the present experiment postlarvae 20 (PL-20) of *Penaeus monodon* received from M/s. Hindustan Lever Limited, Hatchery Muthukadu, were reared in a nursery pond at Portonovo. In a span of one month, they were reared to the stockable size of 30 to 48 mm (average size 38 mm.) from an initial size of 8 to 12 mm (average size of 10 mm). Pond was suitably prepared after the application of cow dung. Coconut palm leaves were fixed at the sides of the pond to avoid the direct heat of the sun and evaporation. Clam meat (*Meretrix* sp.) was used as the supplementary feed given at the level of 100% body weight. Conditions of the pond waters in relation to length and weight (growth) are discussed. About 98% recovery was achieved.

2436. **Srivastava, U.K.** 1988. Marine fisheries development - An outlook for 21st century and key policy issues. *CMFRI Spec. Publ.,* 40: 3.

Address : Indian Institute of Management, Ahmedabad 380 015, Gujarat, India.

Abstract : Marine fisheries in India will have to play a crucial role in augmenting supplies both in the domestic as well as export markets. Thrust of the development will be on deep sea and brackish water resources. The exploitation of these resources, particularly deep sea, will require a rapid transition from charter of vessels to joint ventures and owned fleet with modern and sophisticated technology. This thrust for exploitation of deep sea resources can be sustained with concerted attempts to formulate and implement strategies for product development and marketing in both domestic as well as exports markets. This will also require the attention to develop the necessary infrastructure to handle such vessels, onshore processing facilities, better management of fishing harbours, cold chain grid in the domestic markets, development of transit and terminal markets at wholesale and retail levels.

2437. **Sriyudha Murthy, P., D. Magesh Peter, M. Ravindran and R. Venkatesan** 2004. Microfouling on titanium and stainless steel-316L surfaces under static and flow conditions in an oceanic environment. *Proc. Nat. Sem. New Frontiers in Marine Bioscience Research, January 22-23, 2004.* pp. 271-278.

Address : National Institute of Ocean Technology, Velachery-Tambaram Road, Pallikarnai, Chennai - 601302, Tamilnadu, India.

Abstract : Microbial colonization and biofilm development on titanium and stainless steel 316L surfaces under static and flow conditions was studied at the OTEC site 65 km off Tuticorin coast on the east coast of India. Experiments were conducted using a flow through system (modified Pederson device) housing the metallic coupons for a period of 16 days at the offshore site. Velocities across the plates in the flow cells were maintained at 0.5 m/s the operating velocities in an OTEC plant. Coupons for the static tests were suspended from the starboard side of the vessel at 3 m water depth. Total biofilm solids, total viable counts and differential bacterial counts (*Pseudomonas* sp., *Aeromonas* sp., and sulphate reducing bacterial species) were monitored in biofilms. Accumulation of total suspended solids in biofilms did not show any significant difference between flow and static conditions on both titanium and SS surface. In contrast, biofilm solids accumulation on titanium surfaces was low compared to SS-316L surfaces. Total viable counts in biofilms increased with age of biofilm. In comparison no significant difference in bacterial densities between titanium and SS surfaces was observed under static conditions. Bacterial density in biofilms on titanium surfaces under flow conditions showed an increase of 5.9 times compared to SS-316 L surfaces. No significant difference in colonization by *Pseudomonas* sp. counts on titanium and SS-316L surfaces was observed under flow conditions. A reduction of 87% was observed between flow and static conditions on titanium surface and SS-316L (78%). A similar trend was observed with *Aeromonas* sp., and sulphate reducing bacterial counts.

2438. **Sriyudha Murthy, P., D. Magesh Peter, M. Ravindran and R. Venkatesan** 2004. Biofilm development and control in flow chambers and plate heat exchangers - A comparison. *Proc. Nat. Sem. New Frontiers in Marine Bioscience Research, January 22-23, 2004.* pp. 359-368.

Address : National Institute of Ocean Technology, Velachery-Tambaram Road, Pallikarnai, Chennai - 601302, Tamilnadu, India.

Abstract : Efficacy of the chlorination dose and regime was standardized through preliminary experimentation in coastal waters using flow chambers was tested at the oceanic site 65 km off Tuticorin coast on the east coast of India. A once through flow system was rigged onboard the research vessel 'A.A. Sidorenko'. The flow through system comprised of plate heat exchangers connected in series to two flow cells. One set of plates received raw seawater feeding the odd number of plates was chlorinated. The plate heat exchangers were connected in series with Pederson devices housing the flat stainless steel 316 L coupons. Velocity across the plates was maintained at 0.5 m/s. The flat coupons were sampled after 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14 and 16 days. The heat exchangers were sampled after 3, 6, 10, 14 and 16 days of operation. An intermittent chlorination dose of 1.2 ppm residual once in 2 h for 2 hours was maintained. In comparison of biofilm thickness on flat metal coupons were high with 46.5 µm in controls and 16.2 µm in chlorinated sections. A marginal increase in total viable counts was observed between plate heat exchangers and flat coupons however the differences were not significant. 96.8% reduction in total viable counts between control and treated plates was observed. The prescribed dose of 1.2 ppm once in two hours for 2 hours was found to be effective in control microfouling and flow chamber measurement were found to be reliable and comparable to plate heat exchangers.

2439. **Sriyudha Murthy, P., R. Venkatesan, K.V.K. Nair, D. Inbakandan, S.S. Jahan, D. Magesh Peter and M.Ravindran** 2005. Evaluation of sodium hypochlorite for fouling control in plate heat exchangers for seawater application. *Inter. Biodet. Biodegrad*., 55(3): 161-170.

Address : National Institute of Ocean Technology, Department of Ocean Development, Government of India, Velachery-Tambaram main road, Chennai- 601 302, Tamil Nadu, India.

Abstract : Plate heat exchangers are often preferred in Ocean Thermal Energy Conversion (OTEC) plants because of the large area they provide for heat transfer leading to higher efficiencies and also because of the compact size of such heat exchangers. Tight control over heat exchanger cleanliness is required as the gap between successive plates is only 3.7 mm and hence fouling can easily impede flow. Based on preliminary evaluation liquid sodium hypochlorite was selected as a possible biocide for fouling control in OTEC operation based on its effectiveness, easy availability, low cost and ease in mid sea replenishment of stock. Subsequently, experiments were conducted in near-shore waters, at residuals of 0.2, 0.5, 0.8, 1.0, 1.2 and 1.5mg.L^{-1} in simulated flow chambers (Pederson device) and slime control was achieved at a continuous residual level of 1.2mg. L^{-1}. A log reduction 0.8 times in bacterial density between control and chlorinated plates was observed at this regime. Later on experiments were conducted at an OTEC site (65 km offshore off Tuticorin, on the east coast of India) by changing the regime to an intermittent mode, with a view to reducing the amount of chlorine carried on the OTEC barge. These studies showed that an intermittent chlorination regime of 1.2mg. L^{-1} residuals, 2 h on/2 h

off, was effective for slime control. Since the control of fouling is critical for heat transfer efficiency, the dose and frequency evolved in coastal and oceanic waters using flow chambers was validated using a model plate heat exchanger at the oceanic site onboard a research vessel. In these experiments, a significant log reduction (0.6 times) was observed in bacterial density between control and chlorinated plates in an intermittent mode of 1.2mg. L^{-1} once $2h^{-1}$ for 2 h. In addition, experiments were conducted by varying the frequency of chlorination from 0.5 to 2 h at a dose of 1.2mg. L^{-1} to gain a better understanding of biofilm development and the cleanliness efficiencies achievable for plate heat exchangers used for seawater applications.

2440. **Starmuhlner, F.** 1974. Contribution to the knowledge of the molluscan fauna of the littoral zone in Southern India and Ceylon. *Symposium on India Ocean and adjacent seas. Their origin, science and resources*; Cochin, India; 12 Jan 1971. *J. Mar. Biol. Assoc. India*, 16(1): 49-82.

Address : Zoological Institute, University of Vienna (Section of Molluscs), Vienna, Austria.

Abstract : Between January and February 1968 quantitative (1/16 m^2) and qualitative collections of molluscs were carried out from the littoral-zone of the shores of South India (Trivandrum-Kovalam Bay, Mandapam Camp) and Ceylon (Colombo-Mt. Lavinia, Negombo). The paper deals with the association of molluscs found in the different ecological niches of the littoral zone.

2441. **Stebbing, T.R.R.** 1905. Report on the Isopoda collected by Prof. Herdman, at Ceylon, in 1902. *Rep. Govt. Ceylon pearl oyster fish. Gulf of Mannar,* 4: 1-64.

2442. **Stella Roslin, A., P.J. Rosakutty and S. Lazarus** 1997. A study on the flora and fauna of Arockiapuram Coast of Tamil Nadu. *Seaweed Res. Utiln.,* 19(1&2): 55-61.

Address : Department of Botany, Holy Cross College, Nagercoil 629 004, Tamil Nadu, India.

Abstract : A community study of flora of Arockiapuram Coast near Kanyakumari, South Tamil Nadu, India was made for a period of three months from September 1995. Different species of plants and animals occuring in the area were identified and their inter-specific relationship studied.

2443. **Stella Roslin, A and S. Lazarus** 1998. A preliminary study on the plankton of Arockiapuram coast. *Seaweed Res. Utiln.,* 20(1&2): 9-12.

Address : Department of Botany, Holy Cross College, Nagercoil-629 004, Tamilnadu, India.

Abstract : Plankton samples collected from the Arokiapuram coast were utilised for the study of their relative abundance and distribution. Variations in the environmental parameters such as salinity, pH, temperature and dissolved oxygen and phyto and zooplankton distribution were also studied.

2444. **Stella Roslin, A and S. Lazarus** 1999. Seasonal variation of seaweed biomass in Arockiapuram coast. *Seaweed Res. Utiln.,* 21(1&2): 137-148.

2445. **Stella Roslin, A.** 2003. Seasonal variations in the protein content of marine algae in relation to environmental parameters in Arockiapuram coast. *Seaweed Res. Utiln.,* 25(1&2): 77-86.

Address : Department of Botany, Holy Cross College, Nagercoil- 629004, Tamilnadu, India.

Abstract : Nine species of Chlorophyceae, nine species of Phaeophyceae and eleven species of Rhodophyceae of Arockiapuram coast were analysed for their protein content from October 1995 to September 1997. The protein content of different species showed that the values were specific to the individuals and also showed specific monthly and seasonal variations. Protein content varied from 1.5 to 24.8 % with high value in *Caulerpa taxifolia.* The seasonal protein peak amongst species also differed. All the members of Rhodophyceae except *Gracilaria corticata* showed their seasonal protein peak during monsoons. Simple correlation coefficient between environmental parameters and protein content of above algae were also recorded.

2446. **Stella Roslin, A.** 2003. Seasonal variations in the alginic acid content of some marine algae in relation to environmental parameters in Arockiapuram coast. *Seaweed Res. Utiln.,* 25(1&2): 87-93.

Address : Department of Botany, Holy Cross College, Nagercoil- 629 004, Tamilnadu, India.

Abstract : Nine species of Phaeophyceae viz. *Padina boergesenii, P. tetrastromatica, Lobophora variegata, Stoechospermum marginatum, Colpomenia sinuosa, Chnoospora minima, Sargassum ilicifolium, S. wightii* and *S. linearifolium* were collected every month from October 1995 to September 1997 at Arockiapuram coast to

study the yield of alginic acid. The monthly alginic acid yield varied from 1.50 to 27.50% in the brown algae studied, with highest values from *Sargassum ilicifolium* and *S. linearifolium.* The harvestable season for maximum alginic acid yield is north-east monsoon (October to December) for *Padina boergesenii*, *Stoechospermum marginatum* and *Chnoopsora minima*; south-west monsoon (June to September) for *Lobophora variegata;* pre-monsoon (March to May) for *Colpomenia sinuosa*; pre-monsoon (March to May) and post-monsoon (January and February) for *Sargassum wightii* and post-monsoon (January and February) for *Padina tetrastromatica*, *Sargassum ilicifolium* and *S. linearifolium.* Simple correlation coefficient between environmental parameters and alginic acid content of above algae were also recorded.

2447. **Stella, C and K. Ayyakkannu** 1992. Taxonomic status of *Chicoreus ramosus* from the southeast coast of India. *Proc. Second Workshop of the Tropical Marine Mollusc Programme* (TMMP) at Annamalai University, India, 4th to 14th May,1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent.,* 10: 95-99.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : This paper describes the taxonomic status, historical recapitulation, classification and synonymy of *Chicoreus ramosus* collected from the Gulf of Mannar. In Chicoreus as in *Murex* sp., there is a problem of identifying the type species. Montfort (1810) designated *C. ramosus* as synonymous with *Murex ramosus* (Linnaeus, 1758) and his illustration of the shell was based on *M. brevifrons* (Lamarck).

2448. **Stella, C., A. Murugan and K. Ayyakkannu** 1992. Digestive and reproductive systems of *Chicoreus ramosus*. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May,1992. (eds) J. Hylleberg, K. Ayyakkannu,and S. Khokiattiwong. *Phuket Marine Biol. Cent.,* 10: 123-128.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The anatomy of *Chicoreus ramosus* has been studied in long and short spined forms collected from Gulf of Mannar. No anatomical differences were found between the 2 forms. In *C. ramosus*, the alimentary canal begins at the pleuroembolic proboscis with oesophagus. The anterior oesophagus receives ducts from a pair of salivary glands and accessory salivary glands which are yellow in colour. The posterior oesophagus opens into the stomach which is triangular in shape and embedded in the visceral mass. The short intestine is followed by the rectum which opens into the mantle cavity through the anus in *C. ramosus* are separate.

2449. **Stella, C and K. Ayyakkannu** 1992. Morphology of soft body of *Chicoreus ramosus. Proc. Second Workshop of the Tropical Marine Mollusc Programme* (TMMP) at Annamalai University, India, 4th to 14th May,1992. (*Eds*) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent.,* 10 : 132-134.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of a study conducted to determine the morphology of the soft parts of *Chicoreus ramosus* from the Gulf of Mannar. The foot, operculum, mantle, gills, osphradium, hypobranchial gland and visceral complex are given in detail.

2450. **Stella, C., T. Rajakumar and K. Ayyakkannu** 1992. Analysis of size class distributions of *Chicoreus ramosus* collected from the Gulf of Mannar area of southeast coast of India. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Phuket (Thailand), 1st to 4th Nov, 1992. *Publ. Phuket Marine Biol. Cent*., 11: 91-93.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Details are given of a study conducted regarding the size and growth of *Chicoreus ramosus* specimens collected from the Gulf of Mannar area of the coast of Tamil Nadu, India. The age and corresponding length of the molluscs obtained from the probability plot method were used to construct the von Bertalanffy growth curve.

2451. **Stephen Sampathkumar, J., N. Nagarathinam, A. Selvan, M.J. Prince Jayaseelan and V. Sundararaj** 1996. Fairy shrimp: A wonderful live feed. *Seafood Export J.*, 27(12): 23-26.

2452. **Stoddart, D.R and C.S. Gopinadha Pillai** 1972. Raised reefs of Ramanathapuram, India. *Trans. Inst. Brit. Geographers,* 56: 111-125.

2453. **Subbaramaiah, K and Y.A. Goshi** 1965. Growth of blue-green algae in national seawater. *Indian J. Microbiol.,* 5(3): 35-38.

2454. **Subbaramaiah, K.** 1967. Ascorbic acid content and growth in *Ulva fasciata* Delhi. *Phykos,* 6(1&2): 115-117.

2455. **Subbaramaiah, K., K. Rama Rao, P.C. Thomas, M.R.P. Nair, B.V. Gopal and V.R. Nagulan** 1975. Cultivation of *Gelidiella acerosa*. *Salt Res. Ind.,* 11(1): 33-36.

2456. **Subbaramaiah, K.** 1977. Conservation of *Gelidiella acerosa* natural resources. *Seaweed Res.Utiln.,*2(2):62-64.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Gelidiella acerosa* is a small seaweed growing mostly in mixed population on submerged coral reefs. It grows better in surf-exposed areas and open-sea conditions. It is the principal raw material for the agar industry in India. At present it is harvested throughout the year mostly in the Mandapam region from around Rameswaram to Valinokkam. As a result of the indiscriminate harvesting the availability of the seaweed has become scarce. The non-availability of this raw material is the cause of great concern for the opening and expansion, of agar industries in India. The available resources of *Gelidiella acerosa* now will be 150 tons (Subbaramaiah, *et. al*., 1967), Earlier records have put the availability figures from 2 to 300 tons annually in the Gulf of Mannar; 2 tons (Thivy, 1959) 19 tons (wet) (Varma and.Rao 1964) 300 tons (Desai, 1967). Krishnamurthy (1971) stated that the available resources of *Gelidiella* would support the production of 50 tons of agar per year.

2457. **Subbaramaiah, K., M.R.P. Nair and V. Krishnamurthy** 1977. Distribution pattern of marine algae on the shore of Pamban. *Seaweed Res. Utiln.,* 2(2): 74-77.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : The seaweed growth depends on the availability of suitable substratum, depth and season. In the Indian coasts the nature, continuity and physiognamy of the substrata have greatly determined the type and extent of seaweed growth.

2458. **Subbaramaiah, K and P.C. Thomas** 1982. Studies on the regrowth of *Sargassum wightii* at Mandapam. *Seaweed Res. Utiln.,* 5(1): 29-32.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

2459. **Subbaramaiah, K.** 1986. Seaweed culture in India. *Proc. Symp. Coastal Aquaculture, MBAI,* 4: 1460-1462.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Since 3000 B.C. seaweeds have been used by man as food, animal feed, fertilizer, medicines and in chemical industry. More recently they have been used experimentally as a source of fuel and in the recovery of nutrients in recycling aquaculture systems. However, Phycocolloids *viz.,* agar-agar, carrageenan and algin form the basis of their major industrial utilisation.

2460. **Subbaramaiah, K.** 1988. Current status of seaweed cultivation in India. *Seaweed Res. Utiln.,* 11(1): 39-42.
Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

2461. **Subbaramaiah, K and P.C. Thomas** 1989. Effect of seedling density and growth regulators on field grown red alga *Gelidiella acerosa*. *Indian J. Mar. Sci.,* 18(4): 291-292.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Planting of *Gelidiella acerosa* was carried out to study the effect of (1) seeding biomass; and (2) pretreatment with growth regulators (ascorbic acid, kinetin and naphthalene acetic acid at 100 mg/L) on the growth, yield of the alga, and the agar content and physical properties (gel strength, melting and gelling

temperatures). Two plantings and 2 harvests in Dec and Jun were conducted over 3 yr (1980-82). Optimum biomass for growth in large plantations could be 300 g/sq.m. At this planting density, treatment with ascorbic acid and kinetin increased growth rate and crop yield to get an annual yield biomass of 650 g/sq.m.

2462. **Subbaramaiah, K and P.C. Thomas** 1990. Raft cultivation of *Gracilaria edulis* (Gmeln.) Silva. *Proc. Indian Acad. Sci. Plant Sci.,* 100(2): 123-127.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Single-rope floating raft cultivation of *Gracilaria edulis* was tried at Krusadai Island for a year. In 3 harvests mean biomass annual yield of 4 kg (wet) m^{-1} was obtained which is the highest recorded for the alga. The raft cultivation of the alga at different levels has shown that maintaining the cultivation ropes at the top level will give better yield.

2463. **Subbaramaiah, K., P.C. Thomas and P.S.N. Rao** 1990. Effects of ethyl methanesulphonate on growth and agar content in marine alga *Gelidiella acerosa* (Rhodophyta). *Indian J. Mar. Sci.,* 19(4): 288.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Effect of ethyl methanesulphonate (EMS) at 0.2 and 0.1 M conc. on *Gelidiella acerosa* was studied under field conditions. No stable mutants were produced. However, growth of the treated plants gave improvement in algal yield with loss in agar content and quality.

2464. **Subbaramaiah, K and R. Banumathi** 1991. Growth and reproductive biology of red alga *Gelidiella acerosa* (Rhodophyta) in the Mandapam Region, east coast of India. *Indian J. Mar. Sci.,* 20(1): 61-66.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Growth and reproductive biology of *Gelidiella acerosa* (Forsskal) Feldmann et Hamel growing in a protected reef were studied monthly from Mar 1988 to Feb 1990. Growth rate, reproductive effort, number and distribution of stichidia, sporogenous tissue and shedding of 4 types of spores (mono-, bi-, tetra-, and polyspores) were measured. Seasonality in growth and reproduction was noticed without change in the morphology. Analyses of reproductive features gave a measure of fecundity of the alga. Seasonality in the output of spores (type wise) was also observed with a maximum during winter months, when seawater temperature was minimum 26° - 28° C. An estimate of the reproductive effort is given. Greater abundance of stichidia was recorded throughout the year with peak in Jan. High percentage of sporogenous tissue in the stichidium, which showed preferential distribution in the secondary branches, was a special feature in its reproductive phenology.

2465. **Subbaramaiah, K and R. Banumathi** 1992. A preliminary note on the raft cultivation of *Gelidiella acerosa*. *Phykos,* 31(1&2): 1-5.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Single Rope Floating Raft cultivation technique for *Gelidiella acerosa* was developed on the open coast at Erwadi. Growth and harvest data for vertical and horizontal type of planting are given. By this method *G. acerosa* has been found to grow to full maturity giving higher yields. The technique provides an efficient method for cultivating the alga in deeper waters and comments on its economic feasibility.

2466. **Subbaramaiah, K.** 2004. Seaweed resources and distribution in India. *Nat. Symp & Expo.* 22nd to 24th Jan'04, CMFRI, Cochin. pp. 63-65.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam - 623 519, Tamilnadu, India.

Abstract : Seaweeds (the benthic marine algae) have played a significant role in the economy of some nations in Japan, China, Korea, etc. The resources are consumed as human food and also utilized for extraction of phycocolloids. In India, bulk utilization of seaweeds has been for the production of agar and algin. Until 1976 seaweeds were exported to many countries and they banned when they were used for extraction of phycocolloid in domestic market. A detailed account on the flora distribution, drift, harvest from landings, natural growth, resources assessment, and potential harvest is emphasized here.

2467. **Subba Rao, P.V., K. Rama Rao, T.K. Mal, K. Subbaramaiah, N. Kaliaperumal, S. Kalimhuthu, K. Muniyandi, J.R. Ramalingam and V.S.K. Chennubhotla** 1992. Seaweed resources of Tamilnadu coast: Sector II. Alanthalli- Manapad and Vennta-Nallathannithivu. *Seaweed Res. Utiln.,* 15(1&2): 177-184.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The seaweed resources survey in the deepwater of Tamil Nadu coast was done in the area between Alanthali and Manapad and between Vembar and Nallathanni Thivu at 8° 57' - 9° 4'N & 8° 27'N and long. 78° 35'E & 78° 6' - 78° - 14'E) during March - Apri11988. During this survey, in all 76 species of marine algae were recorded of which 11 species belonged to Chlorophyta, 14 to Phaeophyta and 51 to Rhodophyta 3 species of sea grasses namely *Cymedocea rotunda, Halophila evalis* and *H. stipulaco* were also encountered. The estimates for the dominant species (in tons) were, *Codium tomontosum* 8090; *Halimeda macroloba* 3800; *Spatoglossum asperum* 9290; *Dictyota maxima* 750; *Halymeni venusta* 2530; *H. dilata* 3550; *H. florosia 3440;Amphiroa anastromosans* 1130; *Agardhiella robusta* 980; *Solioria robusta* 2430; *Scinaia bongalica* 1250; *Gracilaria textorii* 630; *Hypnea musciformis* 980; *H. esperi* 580; of *these,Gracilaria* spp, and *Hypnea* spp could be exploited for the indigenous production of agar and carrageenan respectively by the seaweed based industries.

2468. **Subrahmanyam, C., S.R. Kumar and G.D. Reddy** 2003. A new pregnane derivative from the Indian Ocean gorgonian *Subergorgia suberosa* (Pallas). *Indian J. Chem. B Org. Med. Chem.,* 42(1): 219-220.

Address : Department of Organic Chemistry, Foods, Drugs and Water, Andhra University, Visakhapatnam - 530003, Andhrapradesh, India.

Abstract : 3, 3-Dimethoxy-5 delta -pregnan-20-one 1, a new compound, has been isolated from the gorgonian *S. suberosa*.

2469. **Subrahmanyam, C., S.R. Kumar, G.D. Reddy** 2005. Bioactive compounds from the Indian Ocean gorgonian *Subergorgia suberosa* (Pallas). *IIndian J. Chem. B Org. Med. Chem..,* 44(10): 2186-2188.

Address : Department of Organic Chemistry, School of Chemistry, Andhra University, Visakhapatnam 530 003.

Abstract : From the gorgonian *S. suberosa* Pallas collected from the Mandapam coast, Tamil Nadu, a monohydroxy sterol mixture subergorgic acid 1, batyl alcohol 2, two pregnane derivative mixtures, and a new ceramide mixture in which N-hexadecanoyl-2-amino-1,3-dihydroxyoctadec-4-ene 6 is the major isomer have been isolated. Compounds 1, 3, 6 and one of the pregnane mixtures exhibit antibacterial and antifungal activities.

2470. **Subrahmanyan, R and R. Sen Gupta** 1963. Studies on the plankton of the east coast of India 1. Seasonal variation in the fat of the plankton and its relationship to phytoplankton and fisheries. *Proc. Indian Acad. Sci.,* 57B(1): 1-14.

2471. **Subrahmanyan, R.** 1967. Phytoplankton. *Souvenir, 20th Anniversiary,* CMFRI pp.89-93.

2472. **Subrahmanyan, R.** 1968. The Dinophyceae of the Indian Seas. Part I. Genus *Ceratium* Schrnk. *Mar. Biol. Assoc. India, Memoir.,* 2: 1-129.

2473. **Subrahmanyan, R.** 1973. Hydrography and plankton as indicators of marine resources. *Proc. Symp. Living Resources of the seas around India, CMFRI*, pp.199-228.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Madapam-623 520, India.

Abstract : Available data on the standing crop of phytoplankton and zooplankton are presented for the Indian region and hydrographical factors such as upwelling, divergence, convergence, currents, nutrients responsible for production of plankton, and distribution of plankton in time and space are dealt with. Role of southwest monsoon and the magnitude of the intense bloom of phytoplankton during this period are pointed out. The significance of the distribution of plankton to other organisms in the food chain including fish is indicated. Attempt is made to correlate the fisheries of the region with the above several factors and point out the potential resources and their location. The possibilities of using some of the factors as indicators of fishery resources are examined. Certain similarities in the hydrological features, production of plankton, its distribution and fisheries occurring here and elsewhere are reviewed. It is also suggested that the high production of plankton which is also rich in oil-a product of the photosynthesis of the diatoms which form the bulk of the synthesizers of the organic matter-is responsible for the rather extensive oil deposits in the past geological ages in the northern Arabian Sea region which we are exploiting now; this is a continuing process. It is also pointed out that the general pattern of circulation of water during the period of heavy bloom of plankton, *viz.*, southwest monsoon in

the Arabian Sea, is clockwise which is likely to lead to anticyclonic eddies on a large scale, particularly around Saurashtra coast which would have the effect of taking plankton to the bottom leading to gradual deposition of matter.

2474. **Subramani, S.** 1987. On an unusual landing of catfish *Arius caelatus* at Rameswaram Verkottil, Tamil Nadu. *Mar. Fish. Infor. Serv. T & E. Ser.,* 73: 15-16.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The unusual catch of 7 tons of catfish was obtained in a single haul by one of the units operated by two STC boats, each with 68 hp diesel engine.

2475. **Subramanian, B.** 1984. The morphology and relationships of *Desikacharyella indica* gen. et sp.nov., Ceramiaceae (Ceramiales, Rhodophyta) from the southern east coast of India. *Phykos,* 23(1&2): 3-14.

Address : Department of Botany, Pachaiyappa's College, Madras-600030, Tamilnadu, India.

Abstract : *Desikacharyella indica* gen. et sp. nov., based on an undescribed alga from Hare Island, Tuticorin, on the Southern east Coast of India, is described. Both asexual and sexual plants (procarpic) bear multinucleate pseudosporangia = monosporangia; sexual plants are dioecious, bearing either spermatangial heads on subapical procarps followed by carposporophytes with an irregular fusion cell and clavate to tear-drop shaped carposporangia produced from only the terminal cells of the sympodially developed gonimoblast. An inner involucrum of 15-18 large, inwardly curved, single celled sterile filaments, developing from the sterile cells associated with the subapical procarp, loosely surrounds the gonimoblast. *Desikacharyella* is placed provisionally in the tribe spermothamnieae of the Ceramiaceae; its relationships with the other pseudosporangia bearing taxa and with those having a subapical procarp, is briefly discussed.

2476. **Subramanian, B.R and S.A.H. Abidi** 1993. Marine pollution and coastal zone management. *Seminar on Environmental Impact on Aquatic and Terrestrial Habitats*, Berhampur, Orissa (India), Dec 1991. (*eds*) V.P. Agrawal, S.A.H. Abidi and G.P. Verma. Muzaffarnagar India Society of Bioscience. pp. 1-8.

Address : Department of Ocean Development, New Delhi, India.

Abstract : The coastal marine environment around India's 7,515-km coastline supports a variety of marine ecosystems including the fragile mangroves and coral reefs. The genetic and species diversity existing in some of the marine ecosystems especially of the Gulf of Mannar on the Bay of Bengal, and Vandoor in the Andaman Islands are unique and extremely valuable.

2477. **Subramanian, G., P. Chandrasekaran, M. Eashwar and S. Guruviah** 1990. Corrosion potentials of metals and alloys as influenced by microbiological slime in seawater. *Bull. Electrochem.,* 6(6): 582-583.

Address : Corrossion Testing Centre, CECRI Unit, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : The influence of marine microbiological film formation on the free corrosion potentials of some alloys has been investigated. 304 and 316 stainless steels, and 3004 aluminium show considerable ennoblement of potentials in natural seawater compared to sterile seawater and 3% sodium chloride solution. Mild steel, copper and titanium have been found to be less susceptible to this effect. Galvanic currents measured between different couples in natural seawater are quite different from those obtained in the microbe-free situations. Results of the experiments, particularly of aluminium-mild steel couple, provide reasons for the consideration of microbiological component of seawater in predicting galvanic corrosion behaviour of certain alloys. The validity of conventional 3% NaCl tests is critically examined and results are discussed.

2478. **Subramanian, G., V. Ananth, S. Palraj and M. Sundaram** 1993. Corrosion behaviour of aluminium alloys in tropical marine environment. *Bull. Electrochem.,* 9(8-10): 410-415.

Address : Corrosion Testing Centre, CECRI Unit, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : The corrosion behaviour of commercially available aluminium alloy-rods and tubes were studied for a period of 2 years in tropical marine environment at Mandapam Camp (India). The monthly and quarterly corrosion rate values of the alloys are directly related to and determined by the weathering conditions, such as salt content in the air, percentage relative humidity and rainfall prevailing during a particular monsoon. The exponential decrease in the corrosion rate values of the cumulative exposures of the alloys, in general, are indicative of the protective nature of the corrosion product film. The pitting corrosion behaviour of the alloys is discussed in the light of pit density, pitting probability and width of pit. The surface characteristics of the alloys,

both transverse and longitudinal section are highlighted with scanning electron microscope. Heterogeneity in the alloy matrix favour pitting and intergranular corrosion.

2479. **Subramanian, G., S. Palraj, P. Chandrasekaran and D. Mukherjee** 1995. Susceptibility of copper alloys to microbial corrosion. *Trans Saest.,* 30(2): 79-86.

Address : Corrosion Testing Centre, CERCI Unit, Mandapam Camp - 623519, Tamilnadu, India.

Abstract : Conventional studies on the corrosion of metals and alloys in the laboratory seldom reproduce the severity of natural seawater environment, in view of the complex and diversified conditions prevailing in natural seawater. In this study an attempt has been made to investigate the susceptibility of copper alloys to microbial corrosion. Different thickness of biofilm was obtained over the test coupons of commercial copper and 70/30 brass by effecting cathodic protection using sacrificial zinc coupons in natural seawater, over a period of 15 days. The biofilmed coupons of copper and brass were aseptically transferred to the culture media of various strengths of aerobic and anaerobic nature. Sterilised and unsterilised seawater media were also used to supplement the data of the culture media. The biofilmed coupons of brass experienced less corrosion in culture media than that of commercial copper. In API based mixed culture media the biofilmed coupons of copper and brass experienced corrosion, due to the hostile H_2SO_2 environment created by aerobes and SRB. The surface of the biofilmed coupons of copper and brass were examined with scanning electron microscope, optical metallurgical microscope and X-ray diffractometer, to analyse the nature of the sulfide film and susceptibility to pitting corrosion.

2480. **Subramanian, G., S. Palraj and T.M. Balasubramanian** 1999. Galvanic corrosion interactions of zinc and SS.304 in the tropical marine atmosphere of Mandapam. *Anti-Corrosion Methods and Materials,* 46(5) : 332-337.

Address : Corrosion Testing Centre, CECRI Unit, Mandapam Camp - 623 519, Tamilnadu, India; Central Electrochemical Research Institute, Karaikudi, Tamilnadu, India.

Abstract : The galvanic corrosion interactions of zinc and SS304 have been studied in a tropical marine environment over a period of 427 days, under different area ratios. The galvanic interaction of zinc and SS304 are highlighted in terms of the corrosion rate of zinc or SS304 resulting from galvanic coupling, and the susceptibility of zinc to pitting due to galvanic corrosion. The galvanic potential and galvanic current of the system are monitored. The corrosion products at the interface of the bimetallic contacts are analyzed with XRD technique and the pitting/grooving on zinc resulting from galvanic corrosion is measured using a high resolution microscope. The weathering parameters and environmental pollutants are monitored to give an insight into the possible means of favouring the galvanic interactions. The results of the study are discussed in the light of the above factors towards predicting a mechanism for the galvanic interactions of zinc and SS304.

2481. **Subramanian, K.** 1974. Intertidal ecology of a rocky shore at Mandapam Camp, India. *Indian J. Mar. Sci.,* 3(1): 58-60.

2482. **Subramanian, P., S. Sambasivam and K. Krishnamurthy** 1985. Structural components of some algal beds among coral islands. (Gulf of Mannar, South India). *Proc. 5th International Coral reef Congress, Tahiti,* 2: 66.

2483. **Subramanian, S.K and M.S. Krishnamurthi** 1997. Studies on the species composition of Neritic diatoms in the aquatic realm off Tuticorin coast in the Gulf of Mannar - Bay of Bengal. *Seaweed Res. Utiln.,* 19(1&2): 1-11.

Address : Department of Botany, Thiagarajar College, Madurai-625 009, Tamilnadu, India.

Abstract : In the neritic biotope of Tuticorin marine environment on the East Coast, a total of 177 species of diatoms belonging to 63 genera (91 pennate diatoms and 86 centric diatoms) were collected. A greater number of species belonging to the genera *Chaetoceros* (14), *Nitzschia* (14), *Coscinodiscus* (13), *Navicula* (12), *Biddulphia* (8), *Odontella* (4), *Rhizosolenia* (8), *Diploneis* (8), *Amphora* (5), *Bacteriastrum* (5) and *Pleurosigma* (5) were recorded from here. Species composition during post monsoon season has large number of diatom taxa as compared to the monsoon season. The maximum number of species and total number were observed only during summer season. The pre -monsoon was characterized by the presence of more centric diatoms. All the 177 collected are the new distributional record to the Tuticorin coastal region, in the Gulf of Mannar.

2484. **Subramanian, S.K and N. Hemalatha** 1997. Histochemical investigation on the tissue of *Gracilaria corticata*. *Seaweed Res. Utiln.,* 19(1&2): 49-53.

Address : Department of Botony, Thiagarajar College, Madurai- 625 009, Tamilnadu, India.

Abstract : The macroscopic red alga, *Gracilaria corticata* var. *corticata* was collected from off Pudhumadam coastal regions of Gulf of Mannar. The morphological, histological and histochemical aspects, localization of different carbohydrates, proteins, lipids and pectin in various parts of the thallus of the seaweed were studied in detail. The present study shows the presence of sulphated and carboxylated polysaccharides, phycocolloids, agaroids and carrageenan in the epidermal cells of the entire gametophyte and cystocarp. The firm hard hold fast and diploid carpospores and peripheral zones of the thallus accumulate maximum amount of lipids and proteins during winter season. However traces of lipids and cytoplasmic proteins are noted in the cell wall areas of the thallus irrespective of seasons.

2485. **Subramanian, S.K and L. Kannan** 1998. Environmental parameters of the Indian marine biosphere reserve off Tuticorin in the Gulf of Mannar. *Seaweed Res. Utiln.*, 20(1&2): 85-90.

2486. **Subramanian, S.K and P. Pandi** 1998. Histochemical investigation on Marine Kelp, *Sargassum myriocystum. Ecol. Environ. Conser*., 4(4): 271-274.

Address : Centre for Research and P.G. Studies, Department of Botany, Thiagarajar College (Autonomous), Madurai - 625 009, Tamil Nadu, India.

Abstract : The brown seaweed, *Sargassum myriocystum* was collected in shallow areas of the east coast line of Pudumadam, Gulf of Mannar. The cellulose, calcium pectate, insoluble polysaccharides, pectin, protein and lipid in main axis and laterals of the kelp were studied in detail. The present investigation shows rich distribution pattern in the thallus. Hence, it is worthwhile to explore the possibility as substitute in various industries.

2487. **Sudarsan, D.** 1961. Observations on the Chaetognatha of the waters around Mandapam. *Indian J. Fish.*, 8(1&2): 364-382.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Observations on the Chaetognatha of the Gulf of Mannar and Palk Bay were made. Weekly surface plankton samples from January 1955 to December 1958 formed the material for this study. Ten species, *Sagitta enflata, S. neglecta, S. robusta, S. bedoti, S. tenuis, S. hispida, S. pulchra, Krohnitta pacifica, K. subtilis* and *Spadella cephaloptera* are recognized form the samples. The first nine species are common to both the Gulf of Mannar and Palk Bay but the last mentioned species is recorded only from Palk Bay. The record of *K. subtilis* is new for this area. Of the two areas studied Gulf of Mannar is quantitatively richer in Chaetognatha, November to March being the period of abundance. In Palk Bay Chaetognatha are invariably more abundant in the second half of the year, the peak period being July-September.

2488. **Sudarsan, D.** 1966. On the early development of the pipe-fish *Syngnathoides biaculeatus. J. Mar. Biol. Assoc. India,* 8(1): 222-225.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamiladnu, India.

Abstract : On 6-2-1959 a mature male specimen of *Syngnathoides biaculeatus* (measuring 17.2 em.) with the brood pouch full of fairly advanced embryos was brought to the aquarium at Mandapam. The development of the embryos was followed during the next three days.

2489. **Sudarsan, D.** 1966. Eggs and larvae of a Hemirhamphid fish from Mandapam. *J. Mar. Biol. Assoc. India,* 8(2): 342-346.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : A bunch of hemirhamphid eggs, attached to seaweeds and found washed ashore at Mandapam, were collected and the embryonic and larval development was followed in the laboratory. The probable identity of the eggs and larvae is discussed. Based on the characters observed in the eggs and larvae and the available circumstantial evidence they have been provisionally assigned to *Hyporhamphus quoyi* (C.V.).

2490. **Sudarsan, D and P.J. Joseph** 1978. Indian Fisheries - The role of the east coast, eastern states and Bay of Bengal. *Seafood Export J*., 10(9): 11-23.

Address : Exploratory Fisheries Project, Calcutta, India.

Abstract : This article shows the state-wise landings of maritime states on the east coast and the Andaman-Nicobar Islands in the Bay of Bengal and their share in the total marine fish production for the whole country. The total production by these states and the Union Territory has been more or less stable at 0.25 to 0.29 million

tonnes between 1967 and 1972. But from 1973 onwards the upward trend in total production and the share in the national production is significant. During the three years 1974, 1975 and 1976 the share in the all India landings has been consistently above 30%.

2491. **Sudarsan, D.** 1985. An appraisal of the marine fishery resources of the Indian Exclusive Economic Zone. *Bull. Fish. Surv. India,* 18: 1-85.

2492. **Sudarsan, D.** 1991. Marine fishery resources in the exclusive economic zone of India with special reference to deep sea fishing. *Seafood Export J*., 23(7): 18-25.

Address : Fishery Survey of India, Bombay, India.

Abstract : Estimation of fishery resources potential identifying the component stocks and assessment of the respective stock sizes are essential elements for determining appropriate exploitation strategies for fisheries development. Among the diverse techniques and different data bases used for assessment of fishery potential, the most direct are those based on resources surveys. From the results obtained in the surveys conducted by Fishery Survey of India during the past two decades the fishery potential of Indian EEZ is assessed as 3.92 million tons. Of this, the demersal stocks form about 1.93 million tons the coastal pelagic stocks 1.74 million tons and oceanic resources 0.25 million tons. Coast-wise, west coast supports 60.1 % of the resources, east coast 27.8%, Lakshadweep Sea 1.6%, Andaman& Nicobar Seas 4.1% and the oceanic waters 6.3% of the fishery potential. Depth-wise, 58.1% of the resources are supported by the coastal segment within the 50m contour, 34.9% in the outer shelf areas (50-200m depth) and the rest in the deep sea and oceanic region-C; Resource-wise, the major demersal stocks in the offshore and deepsea areas are the threadfin breams (*Nemipterus* spp,), Cat fish and Bull's eye (*Priacanthus* spp,). Indian drift fish (*Ariomma indica*) and Black ruff (*Centrolophus niger*) are among the important finfish resources in the outer continental shelf and slope. The potential pelagic stocks in the offshore waters are the coastal tunas, carangids, ribbonfish and pelagic sharks. Among the oceanic resources, yellow fin tuna and skipjack are estimated to support an annual yield of over one-lakh tonnes each. The annual marine fish production in the country is in the order of about 1.84 million tons per annum. This indicates an additional harvestable yield of about 2 million tons, to be harvested largely from the offshore sector and oceanic realm, which are only marginally exploited now. The species/group-wise assessment of the resources made for the different coastal segments and depth zones indicate the regions and resources offering scope for increased exploitation.

2493. **Sudarsan, D.** 1993. Tuna research in India- Present status and future approach. *FSI*, pp. 17-22.

Address : Fisheries Survey of India, Bombay - 400 001, India.

Abstract : Planned research on tunas in India perhaps started with the establishment of CMFRI in Minicoy in 1958. First attempt in compiling and consolidating scientific information on tuna in Indian waters was made by Marine Biological Association of India in 1962 at Mandapam. Till 1962, CMFRI concentrated on coastal tunas and skipjack, till the advent of specialised tuna survey and training vessels of Fishery Survey of India and Central Institute of fisheries Nautical and Engineering Training. Recent efforts may constitute an effective beginning for planned tuna research. This paper emphasizes on the present status and future prospects of tuna research in India.

2494. **Sudarsan, D., T.E. Sivaprakasam., V.S. Somvanshi and M.E. John** 1993. Assessment of oceanic tuna and allied fish resources of the Indian exclusive economic zone based on exploratory surveys. *Proc. Nat. Conf. on Tunas, CMFRI (ICAR),* pp. 44-66.

2495. **Sudarsanam, K and S. Felix** 1990. Brine shrimp for profitable shrimp hatchery management. *Seafood Export J.*, 22(3): 15-20.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The survival of shrimps at larval stages depends largely on the availability of stable high quality feed. *Artemia salina* as live food for shrimp larvae has proved to be the best and is used in shrimp hatcheries. The nutritive value, hatching technique and process of selection of right cysts of Artemia are discussed.

2496. **Sudarshan, R and S.K. Bhan** 1988. Alternatives in remote sensing for marine fisheries. *CMFRI Spec.Publ.,*40: 28.

Address : Indian Institute of Remote Sensing, (NRSA, Department of Space), Dehra Dun, 248001, India.

Abstract : The early periods of satellite oceanography recorded a large number of physical oceanographic works owing to the availability of microwave sensors. Nevertheless, a number of alternatives through multi-spectral sensors are still left for fisheries scientists to pursue. The capabilities of past, present and future sensors

that are of interest to fisheries oceanographers are reviewed. The various research approaches that are to be considered during a phase whilst waiting for better sensors to be deployed in space are examined.

2497. **Sudheesh, P.S and G. John** 1993. Karyomorphology of *Lates calcarifer*. *CMFRI Spec. Publ.*, 54: 58-60.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstraact : Fish genetics is an emerging field in fish breeding promising the production of cheap high quality fish protein. Karyotypic differences among species or taxa may be used to determine phenetic similarities and phylogenetic relationships. In addition to understanding the systematic position of species, detecting gross genetic variation, cytogenetic studies would be an aid in experimental hybridization. Seabass *Lates calcarifer* culture has been gaining immense popularity in the Indo-Pacific region. In the present study a methodology for the chromosome preparations of *L. calcarifer* was standardised. Chromosome preparations were made from two representative populations collected from Cochin and Tuticorin. The two populations were compared cytogenetically on the basis of chromosome morphology, their total length, relative length and arm ratios.

2498. **Sugumar, G., G. Jeyasekaran and P. Jeyachandran** 1994. Pickles from edible oyster (*Crassostrea madrasensis*) meat. *Fish. Technol.,* 31(1): 72-74.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Two recipes were formulated for the preparation of pickles from edible oyster *Crassostrea madrasensis* meat, a conventional hot spicy taste and sweet and sour taste. Biochemical, microbiological and organoleptic tests were carried out during storage to assess the shelf life. The pickles had a shelf life of about 6 months at ambient temperature and organoleptically both the pickles had good acceptability.

2499. **Sugumar, G., T.J. Abraham and P. Jayachandran** 1995. Sanitation in fish curing yards of Tuticorin, Tamil Nadu. *Fish. Technol. India*, 32(2): 136-138.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The method of preparation of cured fish and the sanitary conditions prevailing in the fish curing yards of Tuticorin region were studied. The water used for washing and brine preparation did not conform to the and had high counts of viable bacteria,. Relatively high counts of viable organisms, coliforms and fungi in worker's hand, soil and curing tanks resulted in poor microbial quality of the cured fish. A lack of awareness of the importance of hygiene and sanitation among the processors and workers was observed during the survey.

2500. **Sugumar, G.** 2001. Sanitary status of fish landing sites and microbial quality of fresh fish of commerce in Thoothukkudi: Suggestions for improvement. *National Seminar on marine and coastal ecosystems and management strategies*, 26-27 Sept. 2001, Tuticorin, p. 49-50.

2501. **Suja, C.P., S. Dharmaraj and Shoji Joseph** 2003. Cryopreservation of mantle cells of the Abalone, *Haliotis varia* Linnaeus. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. p. 33.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Cryopreservation is a vital method to preserve genetically important gamete cells and commercially valuable cells. The cells obtained from the mantle explant tissue culture of the abalone, *Haliotis varia*, a pearl producing mollusc, was taken for cryopreservation. The cryoprotectants namely (DMSO) and glycerol were used for the freezing studies. Various concentrations such as 5, 7.5, 10, 12.5 and 15% of DMSO and glycerol were prepared separately in artificial seawater. The cells were equilibrated for 10 minutes and aspirated into 0.5 ml straws. The straws were sealed with Polyvinyl Alcohol powder (PVA). After 10 minutes at 30°C the straws were transferred to 5° C in a refrigerator. After 30 minutes the straws were placed at -70° C in deep freezer for 24 hours and afterwards at -196° C in liquid nitrogen in a cryocan BA-40. The survival rate decreased with the increase in the duration of freezing from 0 to 70 days in both cryoprotectants namely glycerol and DMSO. The viability of cells decreased from 72.1 to 38.2%; 74.3 to 40.5%; 85.9 to 51.8%; 79.4 to 37.5% and 67.6 to 35.1% at 5, 7.5, 10, 12.5, and 15% concentration of glycerol respectively. In the case of DMSO the survival was 74.3 to 45.3% at 5% concentration; 79.6 to 47.9% at 7.5%; 88.1 to 54.2% at 10%; 86.2 to 50.5% at 12.5% and 76.6 to 41.2% at 15% concentration. After 70 days of freezing, it was found that 10% concentration of glycerol and DMSO was optimum for higher survival of cells more than 50%.

2502. **Sujatha, K and R. Madhavi** 1988. Trematodes as biological tags for movement of sillaginid fishes. *CMFRI Spec. Publ.*, 40: 40.

Address : Department of Marine Living Resources, Andhra University, Visakhapatnam, India.

Abstract : Most of the commercially important exploited Indian fishes in the marine environment are comparatively short lived. Most of the exploited species constitute a seasonal fishery in each area. Of the 9 species of sillaginids represented in the commercial catches off Visakhapatnam, *Sillago lutea* is the most common species. During the course of a survey on digenetic trematodes of marine fishes, 150 sillaginid fishes collected from inshore and offshore regions of Waltair coast were examined. The juvenile sillaginid fishes while in inshore regions acquire infections with *Helicometrina nimia*, *Decemtestis* spp., metacercaria of *Galactosomum* spp. and didymozoid larvae which complete the life cycles in the intertidal region. The adult sillaginids, while they move into deeper waters, gradually get rid of these flukes and acquire infections with metacercaria of *Stephanostomum* spp. and *Prosorhynchus* spp. which probably use benthic molluscs as intermediate hosts. The trematodes can be used as biological tags for the movement of sillaginid fishes.

2503. **Sukumar, P. and M. Mohan Joseph** 1988. Larval development of the rock oyster *Saccostrea cucullata* (von Born). *Proc. on Indian Fisheries Forum, Mangalore (India), 4 Dec 1987.* pp. 255-258.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The development of artificially fertilised eggs of the rock oyster, *Saccostrea cucullata* was studied in the laboratory. The morphological and behavioural characteristics of the developing larvae were observed. A mixed diet of single celled algae consisting of *Isochrysis galbana* and *Tetraselmis gracilis* was fed to the larvae. The larval developmental stages observed include trochophore, D-veliger, late veliger, umbone stage, pediveliger and plantigrade. The time taken for the development of D-veliger, umbone stage, pediveliger and plantigrade stages were 22 hours, 12 days, 18 days and 20 days after fertilisation respectively and their corresponding average length x breadth were 67 x 54 µm, 109 x 108 µm, 143 x 160 µm and 166 x 174 µm. The length-breadth relationship of veliger larvae was linear.

2504. **Sukumar, P., J. Vasanthakumar and P. Selvaraj** 1988. Training fisherwomen in fish processing. *CMFRI Spec. Publ.*, 40: 78-79.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A project on training fisherwomen for their participation in rural development was started by the Centre for Agricultural and Rural Development Studies, at the Fisheries College, Tuticorin. The project aims to select a few literate rural women with leadership qualities for imparting to them a training in the organisational and managerial aspects of a viable fish processing enterprise. It also aims to assist the trained fisherwomen in organising and operating cottage industries by continued technical backing and thus making the production units demonstration centres for the benefit of other women in the region.

2505. **Sukumar, P., J. Vasanthakumar and P. Selvaraj** 1990. Training Fisherwomen in fish processing. *CMFRI Bulletin*, 44(3): 498-502.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A project on training fisherwomen for their participation in rural development, sponsored by Ford Foundation (U.S.A), has been started by the Centre for Agricultural and Rural Development Studies, TNAU., at the Fisheries College, Tuticorin. The project aims to select a few literate rural women with leadership qualities for imparting to them a training in the organisational and managerial aspects of a viable fish processing enterprise. It also aims to assist the trained fisherwomen in organising and operating cottage industries by continued technical backing and thus making the production units demonstration centres for the benefit of other women in the region. The preliminary survey helped in identifying 5 candidates from each of the 3 selected villages. The pre-survey revealed the respondents choice of subject areas to undergo training and their enthusiasm to learn techniques for the preparation of fish products like fish pickle and Masi Meen. It also revealed their desire to be exposed to new products like fish wafers, fish oil, fish meal, shark fin-rays etc. The pre- and post-evaluations of the training programme helped in i) identifying training needs in the fields of marketing and financial management; ii) identifying some low-cost technological substitutes for some of the commercial products (eg: 'Gadi' for vineger); iii) identifying the products or techniques appreciated by the trainees and the products or techniques that receive the lukewarm response with reasons for such a response; iv) identifying the level of managerial efficiency gained by the trainees and the kind of support required for each individual to start cottage industries. The programme is being followed up by interpersonal contacts and the co-ordinated efforts of the development departments.

2506. **Sukumaran, N and M.N. Kutty** 1979. Oxygen consumption and nitrogen excretion in mullet, *Rhinomugil corsula* (Hamilton), with special reference to swimming speed. *Proc. Indian Acad. Sci.*, 88B(5) : 345-351.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : An attempt is made to study the oxygen consumption, CO_2 output and the nitrogen excretion of the freshwater mullet *Rhinomugil corsula*. It is found that whereas the O_2 consumption, the CO_2 output and the respiratory quotient decreased with increase in the duration of exercise, the NH_3-N and total N excretion showed the opposite trend.

2507. **Sukumaran, N., V. Sundararaj and M. Devaraj** 1993. Shrimp farming - A small scale industry for coastal development. *Seafood Export J.*, 25(3): 29-32.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

2508. **Sukumaran, S and N. Kaliaperumal** 2001. Sporulation in *Gracilaria crassa* Harvey ex. J. Agardh at different environmental factors. *Seaweed Res. Utiln.*, 23(1&2): 81-87.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Effect of environmental factors such as exposure to air and desiccation, salinity, temperature, light and photoperiod on tetraspore shedding in the red alga *Gracilaria crassa* was studied under laboratory condition. In the tetrasporic thalli exposed to air in shade and sun for different durations, maximum quantity of spores was liberated from the thalli in submerged condition in control experiment. Spore output was observed at salinity ranging from 10 to 40 ppt with peak output at 30 ppt. Spore discharge was found at temperature ranging from 20 to 40°C with maximum quantity of spore liberation at 25°C. Spore shedding was recorded at light intensity ranging from 10 to 100 $\mu Em^2 S$ with peak discharge at 20 $\mu Em^2 S$. Maximum spore release occurred in long day condition at 12:12 LD cycle.

2509. **Sundar, K.L.S., P.V. Subba Rao and K. Subbaramaiah** 1991. Studies on carpospore shedding in the red alga *Gracilaria crassa* (Gigartinales, Rhodophyta). *Indian J. Mar. Sci.*, 20(1): 70-71.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam 623 518, Tamilnadu, India.

Abstract : The carpospore output in *Gracilaria crassa* is seasonal, moderate and attains a maximum of 436/g in June, spreading over 11 days. The number of cystocarps and carpospores correlates with the weight of the plant.

2510. **Sundar, V., P.K. Suresh, A. Selvarajah and M. Jayapalan** 2004. Model studies for the proposed fishing harbour in Rameswaram. *Third Indian National Conference on Harbour and Ocean Engineering, National Institute of Oceanography*: Dona Paula, Goa (India). 2: 606-612.

Address : Department of Ocean Engineerig, IIT Madras, Chennai - 600 036, Tamilnadu, India; E-mail: vallamsunda@hotmail.com

Abstract : Rameswaram is an Island located along the southeast coast of Tamilnadu, India. A fishing harbour is proposed to be constructed due to high potential for fishing activity. The layout that was arrived at was verified based on numerical model studies. In addition, it was finalised after validating with physical model studies. The effect of post harbour construction on the shoreline was also assessed. The details of the analysis are presented and discussed in the paper.

2511. **Sundaralingam, V.S.** 1990. Marine algae: *Morphology, Reproduction and Biology.* (eds.) Bishen Singh and Mahendra Pal Singh, Dehra Dun., 258 pp.

2512. **Sundaram, K.S.** 1974. Edible Gastropods. *CMFRI Bulletin*, 25: 54-62.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Marine gastropods form the largest group of species in the phylum Mollusca in shallow seas. Of these only a small number of species are suitable for being utilized as food by man. The univalves are fished in many parts of the world for bait, for their beautiful shells and manufacture of lime. Since the animals are passive, simple methods are used in collecting them.

2513. **Sundaram, M., P.S. Mohan and V. Ananth** 1987. Atmospheric corrosion of metals long term exposure results at Mandapam Camp. *Key Eng Mat.*, 20-28 (pt 1-4), pp. 143-146.

Address : Central Electro Chemical Research Institute, Karaikudi, Tamilnadu, India,

Abstract : Corrosion of metals in the atmosphere is greatly influenced by man made and natural environments. The presence of moisture is a must for the corrosion reaction to take place in the atmosphere. The prevalance of high humidity along with high temperature and intensive solar radiation in tropical climate is very dangerous as it causes rapid deterioration of materials. Investigations made at Mandapam Camp, a tropical marine location on the southeast coast of India, over a considerable length of period is presented in this paper.

2514. **Sundaram, N and K. Ramadoss** 1978. Methods of spat collection in the culture of shellfishes. *Seafood Export J.*, 10(6): 23-29.

Address : Central marine Fisheries Research institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Mariculture, the practice of farming marine invertebrates, vertebrates and algae for increasing the production of seafood, is of comparatively recent interest in India. In the culture practice, collection of seed is one of the essential pre-requisites. In the case of molluscs, the seed popularly called 'spat' is available in millions in natural conditions since the fecundity in bivalves, especially in oysters and mussels, is known to be very high (Ahmed, 1975) each individual liberating between 5 and 25 million eggs at spawning.

2515. **Sundaram, N and K. Ramadoss** 1983. Experiments of the transportation of seeds of brown mussel *Perna indica*. *Proc. Symp. coastal aquaculture, Cochin, January 12 to 18, 1980. Part-2: Molluscan culture.* MBAI, Cochin, India, 6 : 701.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Seeds needed for farming operations are often required to be collected and brought from areas far away from the farming site and this necessitates development of standardised techniques for the safe transportation in good condition. In the experiment on transportation of young brown mussel *Perna indica* collected from Cape Comorin to Tuticorin by road, it was found that they could survive for a period of 2 hours outside seawater.

2516. **Sundara Raj, B.** 1927. The littoral fauna of Krusadi Island in the Gulf of Mannar. Siphonophora. *Bull. Madras. Govt. Mus. New. Ser.*, 1: 21-23.

2517. **Sundara Raj, B.** 1927. Littoral fauna of Krusadai Island in the Gulf of Mannar Pycnogonida. *Bull. Madras. Govt. Mus. New. Ser.*, 1(1): 157-160.

2518. **Sundara Raj, B.** 1930. Pycnogonida of Krusadai Island (Supplement). *Bull. Madras Govt Mus. N. S. Nat. Hist.*, 1(2): 73-76.

2519. **Sundara Raj, B.** 1931. Krusadai Island research station. p. 67. ***In***: Fishery reports for 1930. Madras Fisheries, India, 230 pp.

Abstract : On the appointment of Mr. S.T. Moses as acting Assistant Director of Fisheries (Inland) in September, 1928, Mr. V. John, a Zoology graduate, was posted to Krusadai Island station. No progress was made during the year in the consideration of the schemes relating to the purchase of additional equipment for the station or the construction of an aquarium at Rameswaram.

2520. **Sundararaj, V., P. Natarajan and M.D.K. Kuthalingam** 1981. Scope for Mussel Farming in Brackish Waters. *Seafood Export J.*, 13(3): 21-23.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : This article briefly discusses the potential of mussel, Mytilidae, culture in the brackish waters of India.

2521. **Sundararaj, V., V.K. Venkataramani and B. Srikrishnadoss** 1987. Marine Fisheries of Tamil Nadu - An analysis. *Seafood Export J.*, 19(6): 21-28.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Tamil Nadu is blessed with a long coastline of about 1000 km and in this feature it secures second rank in the country, accounting for 17.57% of the total coastline (Anon, 1984). It has a continental shelf area of 41,400 km^2 and the width of this fertile and productive portion of the sea varies from 40 to 60 km in different locations with an average width of 43.1 km.

2522. **Sundararaj, V., P. Selvaraj and G. Jegatheesan** 1988. Marine fisheries development in Tamil Nadu. *CMFRI Spec. Publ.*, 40: 89-90.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Fisheries development is governed by the stock of fishery resources, the level and types of fishing effort and the use of diversified craft and gear. The growing importance of fishery resources and the level of their exploitation are examined. The marine capture fisheries account for a substantial proportion of the total fish production in Tamil Nadu. The present level of fish landings, their seasonal variation and the major species groups are described. The developmental programmes aimed at increasing fish production are reviewed. The need for innovations in and diversification of fishing methods is highlighted.

2523. **Sundararaj, V., P. Selvaraj and G. Jegatheesan** 1990. Marine fisheries development in Tamil Nadu. *CMFRI Bulletin*, 44(3): 583-593.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Fisheries development is governed by the stock of fishery resources, the level and types of fishing effort and the use of diversified craft and gear. The growing importance of fishery resources and the level of their exploitation are traced in this paper. The marine capture fisheries account for a substantial proportion of the total fish production in Tamil Nadu. The present level of fish landings, their seasonal variation and the major species groups are brought out. The developmental programme aimed at increasing fish production are reviewed. The need for innovations in and diversification of fishing methods is highlighted. The impact of investment on fish production is analysed with a time frame of ten years. Basic needs of fisherfolk which have a bearing on fisheries development are identified. Technological developments made over the last decade are mentioned with a note on the extent of non-adoption of new technology and the major determinants thereof are pointed out for remedying the situation. Culture practices in suitable areas along the coasts are stressed to provide employment opportunities that step up production. Developments in the preservation and processing of the seafoods are presented and the scope for the establishment of a stable internal and external market is explored. The state of affairs of marine or coastal fisheries management and suggestions for toning up resource management are stressed. The need for sea ranching and SCUBA diving is indicated. The vital feature of training and the nature and areas of extension programmes are also pointed out for ushering in speedier development of the sector.

2524. **Sundararaj, V., M. Devaraj and M.J. Prince Jeyaseelan** 1992. Prawn farming in India. *TFRI Conf.Proc.*, 1:51-58.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : India contributes about 4% of the world aquaculture prawn production. Prawn farming provides excellent employment opportunities and generates income, particularly, to India's coastal villagers. It, however, has caused impact on land and water resources use. India has about 55 prawn species, 11 of which (penaeids) are suitable for coastal culture. With all these, along with available natural resources, favorable climate, greater awareness of prawn farming, availability of trained human resource, and government and research support, India's prawn farming industry is expected to develop further.

2525. **Sundararaj, V and M.J. Prince Jeyaseelan** 1993. Treatment of shrimp aquaculture effluent. *Fish Chimes*, 13(8): 60-62.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Overdoses of high energy feeds, use of antibiotics, higher rate of water exchange help in increased shrimp production. However, this may cause the destruction of nearby ecology. In order to prevent this, biological control method is proposed. Culture of finfishes on these waters brings twin benefits of both treatment and additional food production. The usefulness of this method is highlighted.

2526. **Sundararaj, V and V.K. Venkataramani** 2001. Fishery resources of Gulf of Mannar: Status, problems and management strategies. *Nat. Sem. on marine and coastal ecosystems: coral and mangrove - problems and management strategies*, Tuticorin 26-27, Sept 2001, Abstract, p.20-21.

2527. **Sundara Rao, P.J and S. Ranga Rao** 1949. A note on the occurrence of a giant Balanoglossid at Krusadai Island. *J. Bomb. Nat. Hist. Soc.*, 48: 813.

Address : Department of Zoology, Presidency College, Chepauk, Madras-5.

Abstract : A specimen of this length was never recorded from Krusadai before. Another point of interest is its

solitary occurrence on the *Galaxea* reef area, though there is a separate Balanoglossus area near the Bushy point of the Island. It is proposed to work out the systematics and anatomical peculiarities of this giant specimen.

2528. **Surendranatha Kurup, N.** 1978. Features of prawns, which contribute to their suitability for culture. *CMFRI Spec. Publ.,* 3: 40-44.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Selection of suitable species for culture forms an important aspect of pre-farming activities. Success or failure of a culture enterprise largely depends upon the demand of the commodity and the economics of culture operation, which in turn are based on certain features of the species selected for culture. Thus, all the species of prawns and shrimps that occur in our waters are not suitable for culture; but only a few of them that possess the favourable features are suitable for this purpose. These characteristics of prawns are discussed in this paper.

2529. **Suresh, R and E. Rajagopalan** 1995. Insurance policy for shrimp farming. *Seafood Export J.,* 26(3): 15-19.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The exports promotion has given impetus to the aquaculture industry in India. The insurance companies have come up with attractive plans to cover rises. The insurance policy for shrimp farming including what risk it covers, premium, claim procedure, etc. is described.

2530. **Suresh Kumar, S., J.A. Christopher John and S. Ravikumar** 2002. Antimicrobial activity of acetone extracts of seaweeds against human pathogens. *Seaweed Res. Utiln.,* 24(1): 111-115.

Address : Marine Biotechnology Laboratory, Institute for Coastal Area Studies, Scott Christian College Campus, Nagercoil- 629003, Tamilnadu, India.

Abstract : The crude extracts prepared using the solvent acetone from the seaweeds *Valoniopsis pachynema* of Class Chlorophyceae; *Cheilosporum spectabile, Gelidiella indica, Laurencia flagellifera, L. poiteaui* and *Grateloupia lithophila* of Class Rhodophyceae and *Chnoospora minima* of Class Phaeophyceae were screened for antimicrobial activity against 12 human pathogens (11 bacterial and 1 fungal strains). The bacterial strains were *Staphylococcus aureus, Streptococcus mutans, Proteus vulgaris, Salmonella typhi, S. typhimurium, S. abory, Kiebsiella pneumoniae, Enterobacter aeroginosa, Vibrio cholerae, Escherichia coli* and *Citrobacter* sp. and the fungal strain was *Candida albicans*. No antimicrobial activity was noted in the extract of *V. pachynema*. The crude extracts from the tested seaweeds except *Cheilosporum spectabile* and *Chnoospora minima* showed antimicrobial activity against all the selected human pathogens except *S. typhi* and *E. aeroginosa*.

2531. **Suriyanarayana Rao, S.V., M.R. Nayar and A.P. Valsan** 1958. Preliminary investigations on the pit curing of fish in India. *Indian J. Fish.,* 5(1&2): 160-169.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Among the methods adopted for the curing of fish in India the practice of pit curing common in certain parts of the Madras State and the neighbouring region of Travancore is of considerable interest for several reasons. Broadly speaking the method consists in burying the fish after salting in mat lined pits for varying periods ranging from a few days to a fortnight or more before marketing in a partially dried condition without any further washing or drying. The products possess a distinct flavour and taste much appreciated by some sections of the public in the eastern parts of Madras State. However, the process is mainly adopted by private curers outside the Government curing yards and the quality of the commercial samples leaves much to be desired due to their unwholesome appearance and commonly observed infestation - with maggots (Krishna Pillai *et al.,* 1956,). Since pit curing forms one of the main methods of curing around Mandapam, it was considered desirable to undertake a comprehensive investigation of the local practices relating to this cure and the keeping quality of the products. A knowledge of the biochemical changes occurring during maturation under semi-anaerobic conditions, which constitute the basis of this cure, is necessary for obtaining a better product by this method.

2532. **Suseelan, C.** 1975. Resource and exploitation of juvenile penaeid prawns from Manakkudy Estuary. *Indian J. Fish.,* 22(1&2): 96-106.

Address : Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Abstract : The Manakkudy Estuary situated about 8 kilometres north of Cape Comorin in Tamil Nadu is an important source of juvenile penaeid prawns which are used as bait in hook-and-line fisheries and seed for

culture, along the coasts of Kanyakumari District. It is estimated that 4 tons of juvenile prawns are exploited on an average every year from this environment, with peak catches in February and March. The fishery is constituted by *Penaeus indicus, P. monodon, Metapenaeus dobsoni* and *M. monoceros.* This is the most dominant species forming 90% of the total prawn catch. By following the progression of modes in the size frequency distribution it is estimated that males of this species grow at the rate of 24.3 mm/month and females, 26.2 mm/month. The maximum growth rates are recorded mostly when the bar is closed when the salinity varies between 7.96 ‰ and 13.81 ‰.

2533. **Suseelan, C.** 1975. The prawn culture practices in salt-pan resources at Manakudy near cape comorin. *Bull. Dept. Mar. Sci. Univ. Cochin,* VII(3): 475-486.

2534. **Suseelan, C.** 1978. The environmental requirements for culture of marine prawns. *CMFRI Spec. Publ.*,3:103-109.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : A knowledge of the biotic and abiotic factors affecting the cultivable species of prawns is a pre-requisite for their successful culture. Of the various abiotic factors, the physical and chemical characteristics of the media in which the prawns thrive have profound influence on the successful breeding, growth and survival. The important physico-chemical factors influencing the biological processes of these animals are briefly discussed here.

2535. **Suseelan, C, G. Nandakumar and K.N. Rajan** 1990. Results of Bottom trawling by FORV Sagar Sampada with special reference to catch and abundance of edible crustaceans. *Proc. First Workshop Scientific Results, FOR V Sagar Sampada 5-7 June,* 1989. pp. 337-346.

2536. **Suseelan, C and K.R. Manmadan Nair** 1990. Quantitative distribution of pelagic shrimps in the deep scattering layers of the Indian EEZ. *Proc. First Workshop Scientific Results, FORV Sagar Sampada 5-7 June*,1989. pp. 361-370.

2537. **Suseelan, C.** 1996. Crustacean biodiversity, conservation and management, pp.41-65. ***In***: *Marine biodiversity : Conservation and Management,* (*eds*.) N.G. Menon and C.S. Gopinadha Pillai, CMFRI, 205 pp.

2538. **Svedelius, N.** 1906. Ecological and systematic studies of the Ceylon species of *Caulerpa. Ceylon Marine Biol. Rep.,* 2(4): 81-144.

2539. **Swaminath, M.** 1988. Man-power needs for marine fisheries by 2000 AD. *CMFRI Spec. Publ.* 40: 74.

Address : Central Institute of Fishery and Nautical Engineering Training, Cochin - 682 016, India.

Abstract : Accent on innovations of harvest and of marine capture fisheries and necessitated upgradation and modernisation of training processes of CIFNET. This has been done following a series of studies and evaluations commensurate with the type and kind of technologies, breed and nature of craft and gear introduced etc.

2540. **Swati Mishra** 1996. A preliminary investigation on the antagonistic actinomycetes of coral reefs of Gulf of Mannar region. *M.Sc. Dissertation*, Annamalai University, India, 24 pp.

2541. **Syda Rao, G., V.T. Subramaniam, M. Rajamani, P.E. Sampson Manickam and G. Maheswarudu** 1993. Stock assessment of *Penaeus* spp. off the east coast of India. *Indian J. Fish.*, 40(1&2): 1-19.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Penaeid prawn landings increased from 20,744 tons in 1980 to 37,410 tons in 1986 and then declined to 31,029 tons in 1989 (average 29,642 tons). Prawns of the genus *Penaeus* supported good fishery all along the east coast of India forming 40% of the penaeid prawn landings. The three commercially important species, viz. *Penaeus indicus, P. semisulcatus* and *P. monodon,* contributed 5849, 4387 and 639 tons respectively, to the annual penaeid prawn landings of the east coast. Tamil Nadu with annual landings of 7,880 tons was the major contributor to the *Penaeus* landings of the east coast followed by Andhra Pradesh (1,639 tons), Orissa (387 tons), Pondicherry (119 tons) and large trawlers (850 tons). Past work on biological aspects such as postlarval immigration, juvenile emigration, food and feeding habits and maturation and spawning has been reviewed. Age and growth parameters of *P.indicus* and *P. semisulcatus* were estimated by employing ELEFAN I method. Population estimates of *P.indicus* and *P. semisulcatus* showed very high fishing mortality and declining yield

while those of *P. moflodofl* indicated scope for increasing the landings. HSY estimates for *P. indicus, P.semisulcatus* and *P. monodon* are 5,961 tons, 4,681 tons and 652 tons respectively. Species-wise and state-wise catch quotas have been suggested based on MSY and the present landings.

2542. **Syda Rao, G and M. Devaraj** 1996. Prospects of large scale onshore marine pearl culture along the Indian coasts. *Mar. Fish. Infor. Serv. T & E Ser.,* 143: 1-7.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The hydrographic and ecological conditions and the need of cement tanks for the large scale culture of marine pearls are discussed in this article.

2543. **Sykes, E.R.** 1903. Report on the polyplaeophora collected by Prof. Herdman at Ceylon in 1902. *Rep. Govt. Ceylon pearl oyster Fish. Gulf of Mannar,* 1: 177-180.

2544. **Sylvia Angelin, T., M. Baluswami, M.D. Vijaya Parthasarathy and V. Krishnamurthy** 2004. Physicochemical properties of carrageenans extracted from *Sarconema filiforme* and *Hypnea valentiae*. *Seaweed Res. Utiln.,* 26(1&2): 197-207.

Address : Department of Botany, Madras Christian College, Chennai - 600 059, Tamilnadu, India.

Abstract : Carrageenan was extracted from two marine algal species namely *Sarconema filiforme* and *Hypnea valentiae* collected from Tiruchendur and Mandapam camp, Tamil Nadu, India respectively. Carrangeenan extraction was done by three methods viz., alkaline extraction, Craigie and Leigh method and semi-finished carrageenan. Of these extraction procedures, the percentage yield of carrageenan by Craigie and Leigh method was more when compared to alkaline extraction. In S*arconema filiforme*, carrageenan content was higher when compared to *Hypnea valentiae* in the Craigie and Leigh method and alkaline extractions. The semi-finished carrageenan content was high in *H. valentiae*. The physicochemical and infrared spectroscopic analyses confirm that the phycocolloid extracted from *Sarconema filiforme* and *H. valentiae* are iota carrageenan and kappa carrageenan respectively. It is therefore suggested that these two algal species can be used as raw material in phycocolloid industry. *Sarconema filiforme* particularly can be recommended to the industries for carrageenan extraction due to its high yield in the alkaline extraction and by Craigie and Leigh method. Semi-finished carrageenan obtained at a low cost from *Sarconema filiforme* exhibits better results regarding physicochemical properties particularly in milk reactivity. Hence it can be used in preparation of milk products.

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2545. **Talwar, P.K.** 1962. Studies on the food and feeding relationships of the half beak fishes (Hemirhamphidae) from the Gulf of Mannar and Palk Bay. *Indian J. Fish*., 9(1&2): 1-9.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : In the present study the food and feeding habits of the half beaks, *Hyporhamphus georgii* (C.V.), *H. quoyi* (C.V.), *Hemirhamphus marginatus* (Forsk.) and *H. far* (Forsk.) were studied for a period of about three years. The gut contents were analyzed by the Points and Numerical methods. The seasonal variations in the composition of the gut contents are discussed in relation to the environmental biota and maturity stages. The studies have revealed that different types of feeding relationships are maintained by the different species and that they do not belong to the group of filter feeders but feed selectively.

2546. **Talwar, P.K.** 1962. A contribution to the biology of the half beak *Hyporhamphus georgii* (cuv. & val.). *Indian J. Fish*., 9(1&2): 168-196.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The hemirhamphids constitute an important group of the neretic-pelagic fisheries of the Gulf of Mannar and Palk Bay. Although there are eight species of halfbeaks distributed in these waters, *Hyporhamphus georgii* (C.V.) and *Hemirhamphus marginatus* (Forsk.) are the only species which may be considered of sufficient importance to constitute a distinct fishery. In a view to obtaining accurate information on the fishery biology of these common species, a detailed investigation was taken up during 1957-59. Most of the work so far done on the halfbeaks is more or less of taxonomic nature and very little precise information is available on their biology. The most significant references on the subject are those of Delsman (1924) Uchida (1930 and 1958), Nakamura (1933), Devanesan (1937), Job and Jones (1938), Hubbs and Kampa (1946), Devanesan and Chidambaram (1948) Ling (1958) and Hattori and Seki (1959). The present paper deals with the results of the investigation on the various aspects of the biology *Hyporhamphus georgii* (C.V.).

2547. **Talwar, P.K.** 1967. Studies on the biology of *Hemirhamphus marginatus* (Forskal) (Hemirhamphidae-Pisces). *J. Mar. Biol. Assoc. India*, 9(1): 61-69.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : The spawning population of *Hemirhamphus marginatus* (Forsk.) constitutes a highly seasonal fishery in the Gulf of Mannar (Mandapam area) from November to January. Observations on the length frequency, duration of spawning, sex ratio, fecundity and eggs and larvae are discussed.

2548. **Talwar, P.K.** 1968. Mural-thoondi, a gear for half beak fishes. *J. Bomb. Nat. Hist. Soc.*, 65(1): 235-236.

Abstract : The mural-thoondi is an indigenous gear for the capture of halfbeaks in the Gulf of Mannar and Palk Bay (Mandapam area). Capture by this gear is so ingenious as to be worthy of record.

2549. **Talwar, P.K.** 1984. The Commercial Sea Fishes of India. *Zool. Surv. India*, 997 pp.

2550. **Tampi, P.R.S.** 1949. On the eyes of Polychaetes. *Proc. Indian Acad. Sci.*, 29B: 129-147.

2551. **Tampi, P.R.S.** 1958. Pelagic Swarming of Bolyophthalmus (Family : Opheliidae - Polychaeta). *J. Bomb. Nat. Hist. Soc.*, 55(2): 371-374.

Address : Central Marine Fisheries Research institute, Mandapam camp, Mandapam, India.

Abstract : While making certain observations relating to the experimental Kelong fishing operation being conducted at this research station, I came across an interesting phenomenon which seems worthy of record, Surface collections made in the Gulf of Mannar during February and March 1958 with the help of a hand net.

2552. **Tampi, P.R.S.** 1958. The anatomy of *Armandia leptocirris* crue (Polychaeta). *J. Zool. Soc. India*, 10: 15-32.

2553. **Tampi, P.R.S.** 1959. On the food of *Chanos chanos* (Forskal). *Indian J. Fish.*, 5(1&2) : 107-117.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India.

Abstract : During the last few years several observations have been reported, particularly from the East Asian countries, regarding the food of the milkfish and most of the existing information is reviewed in a paper by

Schuster (1949). Abstracts of other publications on this subject are also available in the bibliography on Chanos culture prepared by him (1952 b). Excepting for Sunier (1922) in Java and Chacko (1945 and 1949) in India, observations by others seem to have been based mostly on fish reared in saltwater ponds for commercial purposes. The absence of the fish in appreciable numbers in commercial catches from the sea in any part of the coast where the fish is known to occur, unfortunately, is a barrier hindering our progress towards the elucidation of many important aspects in the life of the fish and leaves several problems inadequately solved. Thus, in understanding the food and feeding habits or for determining the age, maturity and spawning behaviour, we have necessarily to depend on the occasional specimens caught during fishing operations intended for other species. Recently, after consistent efforts, it has been possible to obtain a few adult fish around Mandapam through the co-operation of the local fishermen. The examination of the stomach contents of these fish revealed certain interesting features and these, together with previous data collected by the author, are presented here, mainly to supplement our existing information on the food of the fish from their natural habitat, as these may be of some importance to fish culturists of the Indo-Pacific region.

2554. **Tampi, P.R.S.** 1959. The ecological and fisheries characteristics of a salt water lagoon near Mandapam. *J. Mar. Biol. Assoc. India,* 1(2): 113-130.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : This account forms a preliminary ecological and biological survey of one of the saline water lagoons seen along the southeast coast of India. The salient physical and chemical characteristics in relation to the rather peculiar ecological nature of the area and its consequent low biological production are discussed. Not withstanding some of these drawbacks, a rough estimate of the annual fish yield from this lagoon has indicated a moderate rate of fish production compared to that from other uncultivated natural waters in similar surroundings. The possible means of more organized work and effective utilization of the resources in such an area are also generally outlined.

2555. **Tampi, P.R.S.** 1960. On the early development of *Protula tubularia* Family Serpulidae - Polychaeta). *J. Mar. Biol. Assoc. India,* 2(1): 53-56.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The growth of serpulid polychaetes inside marine aquaria and the consequent need for their frequent cleaning is a common experience. Ever since the experimental aquarium of the Central Marine Fisheries Research Station has been in operation, where unfiltered sea water is being circulated, a large number of serpulids were observed to grow either as solitary individuals or sometimes in clusters inside the concrete tanks, particularly in the less illuminated corners and grooves. These were carefully scrapped out from the substratum and were identified as *Protula tubularia* (Montagu), a species widely known from circummundane areas. However, since Willey (1905) recorded this species from the Ceylon Pearl Oyster beds and described it as *Protula (Protulopsis) palliata* (but considered as a synonymy of *Protula tubularia* by Fauvel in 1953), there do not seem to be other collections from the Indian Ocean. The Indian Museum material includes only the anterior portion of a specimen of *Protula* from Andamans whose specific identity had not been ascertained (Fauve1, 1932). Owing to the hardy nature of the eggs and the ease with which they can be reared in the laboratory, serpulids have received comparatively greater attention among polychaetes as regards their development. For a review on the subject the reader is invited to the account on the development of *Pomatoceros triqueter* by Segrove (1941). It is apparent from literature that similar studies on tropical species are lacking and, therefore, a brief description of the early development in *Protula* is given.

2556. **Tampi, P.R.S.** 1960. Utilization of saline mud flats for fish culture- An experiment in marine fish farming. *Indian J. Fish.,* 7(1&2): 137-146.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The first results of marine fish culture experiments in Mandapam are reviewed here indicating the possible means of increasing the yield of fish in a region that is normally a poor biological environment. The drawbacks as well as the advantages in organizing a marine fish farm scheme in this locality are briefly discussed.

2557. **Tampi, P.R.S.** 1963. On the swarming of heteronereids in the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 5(2):246-250.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : A brief description and discussion of the swarming phenomenon of the heteronereid polychaetes in the shallow waters of the Gulf of Mannar are given. While majority of the swarming individuals consisted of *Platynereis abnormis,* three other species were also involved.

2558. **Tampi, P.R.S.** 1967. Saltwater fish culture in India. *Souvenir 20th Anniversary, CMFRI.* pp. 112-116.

Address: Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Abstract: Despite a tradition that dates back to the very ancient times, salt water fish culture as a profitable industry is only a recent development in India, largely prompted by the urgent need to increase our much needed protein food. But within the past half a century even after the realization of our potential, it must be said at the outset that we have not made this industry as taken in the east-Asian countries or along the Adriatic coast of the Mediterranean region.

2559. **Tampi, P.R.S.** 1969. New hope in salt water fish culture. *Indian Farming*, 19(9): 53-55.

2560. **Tampi, P.R.S.** 1973. Culturable marine fish fry resources from brackish-water environments. *Proc. Symp. Living Resources of seas around India.* pp. 390-399.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The wealth derived from estuaries, backwaters, salt marshes and similar saline environments cannot be underestimated while assessing the marine resources. The fact that these saline regions, which represent an important connecting zone in the transition from land to sea, constitute an integral part of the overall marine environment is also well recognised. Vulnerability to human influence is an advantageous characteristic of the coastal brackish-waters, unlike the open sea, which still remains beyond man's control. Many such brackish-waters represent unified ecosystems and are areas of high fertility, supporting a variety of biological life. Surrounding these areas there is invariably a rich natural fishery, which is of considerable significance in the rural economy of developing countries like ours. Besides such a lucrative fishery, enormous amounts of culturable fish fry are also caught from these areas. It has been estimated that several lakhs of milkfish fry are collected every year from certain centres along the coast of South India. However, we are at present tapping only a fraction of this potential source. With the expansion of our coastal fish farming activities, many of the existing fry collection centres could be developed into centres of fish fry trade. The paper thus discusses in some detail the various aspects connected with the brackishwater environments and their resources.

2561. **Tandon, K.K.** 1959. On a specimen of *Selaroides leptolepis* without the usual detached anal spines. *J. Mar. Biol. Assoc. India*, 1(1): 95.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : One of the characteristic features in Carangids is the presence of two spines detached from the rest of the anal fin. In the course of an investigation on the biology of *Selaroides leptolepis*, a common Carangid of this area, a specimen was collected on 11-2-1959 from Pudumadam, without the two detached spines. Except for this it resembled the normal specimens. The abnormal specimen, a female, measured 13.6 cm in total length and weighed 28 g and had ovaries in the IV stage of maturity.

2562. **Tattersal, W.M.** 1938. Discovery of *Coeloplana* sp. at Krusadai Island, Marine Biological Station, Madras. *Nature*, 142: 482.

2563. **Tewari, A., H.V. Joshi, R.H. Trivedi, V.G. Sravankumar, O.S. Kotiwar, S.K. Mandal and P.K. Ghosh** 2004. Physico-chemical nature of highly turbid seawater and its effect on growth and species diversity of phytoplankton. *Seaweed Res. Utiln.*, 26: 111-119.

Address : Central Salt and Marine Chemicals Research Institute, Bhavnagar-364 002, Gujarat, India.

Abstract : The highest concentration/count of TSS, DO, NH_4-N total Nitrogen, $P0_4$-P total phosphorus and total count of phytoplankton were the highest at different stations and/or transects of Alang and/or Piram where turbidity caused by the TSS is very high. However, pH, salinity, DO, BOD, NO_3-N, total phosphorus, total no. of phytoplankton genera as well as total count of phytoplankton were the highest at control site (Poshitra) where seawater is very clear. Similarly the salinity, NO_2-N and generic diversity of phytoplankton were also maximum at Mahuva where seawater is the least turbid as compared to Alang. However, the concentration/count of DO, NO_3-N, total Phosphorus and generic diversity of Phytoplankton in the different stations and/or transects were the lowest at Alang, whereas the concentration of salinity and BOD were the lowest at Piram. Similarly, pH and the concentration of total Nitrogen were the lowest in the different stations and/or transects of Mahuva. The concentration of TSS, DO, BOD, NO_2-N, NH_4-N and PO_4-P were the lowest at Poshitra. Forty nine genera of phytoplankton were recorded from different transects respectively. Twenty genera were common to different transects. *Celoneis, Climacodium, Grammatophora, Rhabdonema, Skeletonema* and *Synedra* were observed

only *at Poshitra,* while *Osytosum* was recorded only from Mahuva. Similarly, *Podocystis* and *Surirella* were observed only at Piram. In general, *Coscinodiscus* gave the highest count of phytoplankton, as compared to other species at all four transects. However, *Surirella* gave the highest count at Alang where *Coscinodisus* was sub-dominent. The similarity index indicated that all the transects were more or less similar. However, the Mahuva was slightly more similar than the others, where turbidity of seawater was very high. It may be concluded that turbidity of seawater has significantly reduced the total number of genera as well as total count of phytoplankton at Alang and Piram, where seawater is highly turbid, as compared to control site where seawater is very clear.

2564. **Thajuddin, N and G. Subramanian** 1989. Cyanobacterial phytoplankton of the Gulf of Mannar region. *Proc. Natl. Symp. Cyanobacterial Nitrogen fixation,* pp.457-463.

2565. **Thajuddin, N and G. Subramanian** 1991. New report of marine cyanobacteria from the southeast coast of India. *Phykos,* 30 (1&2) : 19-23.

Address : Bharathidasan University, Tiruchirapalli - 620 024, Tamilnadu, India.

Abstract : The southern east coast of India from Nagore in Bay of Bengal (Lat. 10º 50' N ; Long. 79° 50' E) to Kanyakumari (Lat. 8° 5' N.; Long. 77° 33'E.) facing the Indian Ocean was extensively surveyed for the occurrence of natural populations of cyanobacteria from January 1987 to December 1989. The survey included main sea, stagnated sea water ponds and puddles, backwaters and salt pans. A major portion of the survey resulting in the enumeration of 14 species were already reported. Three species of cyanobacteria viz., *Radaisia violaceae* Fremy (Family: Pleurocapsaceae), *Siphononema polonicum* Geitler, I.C. (Family: Siphononemataceae) and *Dichothrix spiralis* Fritsch, F.E. (Family: Rivulariaceae) recorded during the present study have not been reported earlier from any Indian coast.

2566. **Thajuddin, N and G. Subramanian** 1992. Survey of cyanobacterial flora of the south east coast of India. *Bot. Mar.,* 35: 305-314.

2567. **Thajuddin, N and G. Subramanian** 1995. Additions to the new reports of marine cyanobacteria from the east coast of India. *Phykos,* 34(1&2): 33-37.

Address : National Facility for Marine Cyanobacteria, Bharathidasan University, Tiruchirapalli-620 024, Tamilnadu, India.

Abstract : A detailed survey of cyanobacterial flora covering over 2,660 km of the coastline from Tirakol of Goa state (Lat. 15º 45'N and Long. 72^{O} 37'E) to Cape Comorin (Lat. 8º 5'N and Long. 77º 33'E) of Tamil Nadu and from Cape Comorin to Bhimunipatnam of Andhra Pradesh (Lat. 17º 55'N and Long. 83º 25'E) encompassing the regions such as Arabian sea, Indian Ocean, Gulf of Mannar, Palk Bay, Palk Strait and Bay of Bengal was made. The survey included different habitats like open sea and shore, stagnant seawater ponds and puddles, backwaters and saltpans. A total of 196 species of 51 genera belonging to 14 families were recorded.

2568. **Thangam, T.S and K. Kathiresan** 1998. Mosquito larvicidal activity of mangrove plant extracts and synergistic activity of *Rhizophora apiculata* with pyrethrum against *Culex quinquefasciatus*. *Int. J Pharm.*. 35(1): 69-71.

Address : 20-44, Church View, Puthoor, Pozhikkarai - 629501, Kanyakumari Dist., Tamil Nadu, India.

Abstract : Plant samples were collected from 15 mangrove species, *Acanthus ilicifolius, Aegiceras corniculatum, Avicennia marina, A. officinalis, Bruguiera cylindrica, Ceriops decandra, Excoecaria agallocha, Rhizophora apiculata, R. Lamarckii, R. mucronata, Salicornia brachiata, Sesuvium portulacastrum, Sonneratia apetala, Suaeda maritima, S. monoica* and *Xylocarpus granatum.* The 22 samples were extracted in acetone and petroleum ether separately, and the extracts were tested for their activity against the larvae of mosquito, *Culex quinquefasciatus*. Petroleum ether extract of *R. apiculata* was found most effective with LC_{50} of 25.7 mg /l. The extract was studied further with pyrethrum for its synergistic larvicidal activity. The extract exhibited synergism and the synergistic factor was 0.81 at 5 mg/l.

2569. **Thangaradjou, T and L. Kannan** 2005. Marine sediment texture and distribution of seagrasses in the Gulf of Mannar biosphere reserve. *Seaweed Res. Utiln., 27*(1&2): 145-154.

Abstract : Distribution of seagrasses with reference to sediment texture was studied in nine different marine locations of the Gulf of Mannar Biosphere Reserve. It was found that the seagrasses viz. *Enhalus acoroides, Thalassia hemprichii*, and *Halophila* spp., preferred silty to clayey soils while *Cymodocea* spp and *Syringodium*

isoetifolium preferred sandy soil for their growth. Though some of the stations surveyed recorded higher silt and clay contents (suitable for the growth of many seagrasses), the seagrass species composition was not impressive at these stations. It is therefore inferred that in addition to sediment characteristics, other physico-chemical characteristics are important in governing the occurrence and distribution of seagrasses.

2570. **Thangaraj, M and S.G.P. Vincent** 2004. Assessment of vitellogenin stimulating activity in tiger shrimp, *Penaeus monodon. Indian J. Fish.*, 51(2): 133-138.

Address : Marine Biotechnology Laboratory, Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Mountain View Campus, Rajakkamangalam-629 502, Tamil Nadu, India.

Abstract : Studies on the effect of brain and sub-oesophageal ganglionic extracts of *Penaeus monodon* on the hemolymph vitellogenin concentration of *Emerita asiatica* showed that the total hemolymph protein level increased, by about 58 ± 3%, at the sixth hour after injection with brain extract of *P. monodon.* The densitometric scanning and volume analysis of total protein and vitellogenin were carried out using a gel documentation system. The vitellogenin [Relative front value (Rf) =0.1411] in the hemolymph was identified with the relative mobility of yolk protein lipovitellin of the ovary [Rf = 0.1413]. Brain extract injected animals showed a pronounced increase in the hemolymph vitellogenin level by about 210.7 ± 4%, at the sixth hour and sub-oesophageal ganglionic extract induces vitellogenin by about 71.4 ± 2%.

2571. **Thangavelu, R and N. Sundaram** 1983. Experiments on edible oyster spat collection at Tuticorin. *Proc. Symp. on coastal aquaculture, Cochin, January 12 to 18, 1980. Part-2: Molluscan culture,* MBAI. pp. 460-466.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Standardizing the technique of spat collection is an important aspect in oyster farming. Although several established methods are in vogue in different countries, appropriate method of spat collection has to be developed to suit the local conditions taking into consideration the availability and cost of the materials employed. The paper gives details and results of experiments conducted at Tuticorin with different types of spat collections. Lime-coated tiles proved to be the most effective for spat collection while the use of corrugated asbestos sheets, oyster and mussel shells also gave satisfactory results.

2572. **Thangavelu, R and P. Muthiah** 1983. Predation of oyster *Crassostrea madrasensis* by gastropod *Cymatium cingulatum* (Lamarck) in the oyster farm at Tuticorin. *Proc. Symp. on coastal aquaculture, Cochin, January 12 to 18, 1980. Part-2: Molluscan culture.* MBAI, Cochin, India, 6: 488-494.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India**.**

Abstract : At Tuticorin it has been observed that the gastropod belonging to the species *Cymatium cingulatum* causes considerable damage to the stock in the oyster farm especially when the oysters are 3 to 4 months old.

2573. **Thanikachalam, M.** 2001. Management of coral reef in Gulf of Mannar using remote sensing and GIS techniques - with reference to coastal geomorphology and land use. *Ph.D Thesis*, Anna University, Chennai.

Address : Institute of Ocean Management, Anna University, Chennai-600 025, Tamilnadu, India.

Abstract : For mapping of coastal geomorphology, IRS LISS-III imagery and GIS software have been used. Visual interpretation of satellite data was adopted for this mapping, using Survey of India toposheet as the base. For shoreline change mapping, Survey of India toposheet (1969) and IRS LISS- III (1998) data were utilised and the sites where shoreline changes such as coastal and island erosion/accretion occurred and their influence on coral reef degradation were identified. Multidate bathymetry data along with GIS and ERDAS software were used for mapping shelf morphology and its changes. IRS LISS-II (1988) and IRS LISS-III (1998) satellite data were used for landuse/landcover mapping. Change detection studies were carried out in a GIS environment and the influence of landuse/ landcover changes on coral reef degradation was studied. To map the landuse/landcover, visual interpretation. technique was used with collateral data from Survey of India toposheets. The IRS LISS-II (1988) and IRS LISS-III (1998) satellite data with GIS and ERDAS software were used for mapping coral reef, change detection and demarcation of coral reef zonations. Various enhancement techniques and classification methods like K-Means classification, Maximum Likelihood Classification (MLC) and Principal. Component Analysis (PCA) were used to identify the best suitable techniques to map coral reef. Both, digital analysis of satellite data using ERDAS imagine system and visual interpretation techniques were used to map the coral reef area together with collateral data from Survey of India toposheet. Using visual interpretation of IRS LISS-III image, various coastal geomorphic features like, beach, spit, beach ridges, swales, mudflats, back swamp, sand dune complex, teri dune complex, natural levee, flood plain, deltaic plain, strand lines etc were mapped along

Gulf of Mannar coast. All the geomorphic features particularly beach ridges, strandlines and swales and backwater system indicate various stages of sea level. The analysis of multidate shoreline map showed that 4.34 sq.km of the coast has been eroded and 23.49 sq.km of the coast has accreted in Gulf of Mannar over a period of thirty years (1969-1998). This study indicates that the migration of the coastline is towards the seaward side and is very active in Gulf of Mannar. The accretional nature or seaward migration of shoreline indicates that the Gulf of Mannar is undergoing progradation or the sea level falling. The analysis of multidate shoreline map showed that 4.160 sq.km and 3.310 sq.km areas of islands in Gulf of Mannar have been eroded and accreded respectively over a period of thirty years (1969-1998). The analysis of multidate bathymetry map indicated that the Gulf of Mannar seafloor is gradually rising due to sedimentation and tectonic upliftment or sea level fall. The calculation shows that the average rise in sea floor is about 0.021m/year of which 0.00l m/year is due to sediment deposit and 0.02 m/year is due to the influence of tectonics. Visual interpretation of 1988 IRS LISS-II and 1998 IRS LISS-III imageries showed that 539.86 sq.kms of cropland has been reduced to 417.66 sq.km, 50.17 sq.km of fallow land has increased to 52.56 sq.km, 185.56 sq.km of agricultural plantation has increased to 192.57 sq.km, 115.29 sq.km of forest plantation has increased to 145.02 sq.km, 243.48 sq.km of scrub land has increased to 294.02 sq.km, 39.28 sq.km of sandy area has been reduced to 36.80 sq.km, 70.84 sq.kms of tank has increased to 74.85sq.km, 3.81sq.km of island vegetation has been reduced to 2.28 sq.km and 3.86 sq.km of natural forest has been reduced to 0.062 sq.km over a period of ten years (1988-1998). The validation of this result by ground truth confirmed that enormous growth of population and activities related to them have caused landuse/landcover changes. The multidate remote sensing data analysis indicates that 0.860 sq.km of mangroves, 0.375 sq.km of marsh vegetation and 1.840 sq.km of mudflat areas have increased over a period of ten years (1988-1998). The increase of land cover categories indicate that the study area is under going progradation or falling of sea level. Socioeconomic studies indicate varying occupational structures of the coastal people in Gulf of Mannar and the activities were mainly related to fisheries, seaweed collection, shell collection, coral mining and agriculture. Visual classification of 1988 IRS LISS-II and 1998 IRS LISS-III imagery showed that 25 sq.km of coral reef area in Gulf of Mannar has been lost over a period of ten years (1988-1998).

2574. **Thanikachalam, M and S. Ramachandran** 2002. Remote sensing and GIS techniques for mapping coastal geomorphology in Gulf of Mannar, Southeast coast of Bay of Bengal. *ISPRS commission VII symposium on Resource and environment monitoring, IAPRS & SIS, Vol. 34, part 7*, Hyderabad, India.

Address : Institute of Ocean Management, Anna University, Chennai-600 025, Tamilnadu, India.

Abstract : Coastal geomorphology map could help in various coastal zone management planning. Coastal geomorphology map of Gulf of Mannar form Dhanushkodi to Tuticorin was prepared with data on 1: 50,000 scale using IRS LISS-III satellite data and Survey of India (SOl) topographic sheets and validated by ground truth. Various coastal landform units have been identified and delineated based on the remote sensing data. The landforms are grouped in to marine, fluvio-marine, fluvial, aeolian and biogenic landforms. Most of the landform units such as spits, beach ridges, beaches, strand line, back swamp, mud flat etc indicate that the coast is prograding towards the seaward side.

2575. **Thanikachalam, M and S. Ramachandran** 2002. Management of coral reef in Gulf of Mannar using remote sensing and GIS techniques with reference to coastal geomorphology and land use MAP ASIA 2002. *Proc. Asian Conference on GIS, GPS, Aerial photograph and remote sensing. Bangkok, Thailand.*

Address : Institute of Ocean Management, Anna University, Chennai-600 025, Tamilnadu, India.

Abstract : The coral reefs characterise an ecosystem of high biological diversity, having the greatest number of species of any marine ecosystem. Livelihood of many millions of people is dependent on this unique ecosystem as a considerable proportion of their food and earning is from the productivity of coral reef. Coral reefs are considered as one of the most important critical resources for various ecological, environmental and socioeconomic reasons. Coral reefs act as a barrier against wave action along coastal areas thus preventing coastal erosion. In addition, coral reefs protect mangroves and seagrass beds in certain areas, which are the breeding and nursing grounds of various economically important, fauna. Coral reefs are also important breeding, spawning, nesting, and feeding areas for many economically important varieties of fishes and other marine organisms. As a result of the increasing human population along the. coastal area, anthropogenic impacts on the coastal zone have become severe over the past few decades. Coral ecosystem also face many threats, of which some are of natural origin like storms and waves particularly tropical storms and cyclones that cause major intermittent damage to reefs. The majority of damage to coral reefs around the world has been through direct anthropogenic stress. In Gulf of Mannar, the coral reefs have been used as a source of calcium carbonate and building blocks. In general, coral reefs in Gulf of Mannar can be categorised as ”degrading”, and hence, monitoring and management of these

valuable marine resources are of prime importance. In this contest Survey of India Topographic Sheet (1969), Naval Hydrographic Chart (1975) IRS LISS-II (1988), IRS LISS-III (1998) satellite data and ARC-INFO and ARC-VIEW GIS software were used for coastal geomorphology, seafloor, shoreline, coastal land use/land cover and coral reef mapping from Gulf of Mannar. The current status of coral reef, changes and important coastal problems (coastal geomorphological and land use/land cover changes) for coral reef degradation of Gulf of Mannar are identified.

2576. **Thanikachalam, M., S. Ramachandran., J. Devasenapathy and D.Chitra** 2003. Remote sensing and GIS Techniques for monitoring the coastal ecosystem changes- A case study in Tuticorin coast, India. *Proc. International Conference on Coastal and Freshwater Issues.* p. 113.

Address : Institute of Ocean Management, Anna University, Chennai-600 025, Tamilnadu, India.

Abstract : The coastal ecosystems are now highly disturbed and threatened due to rapid increase of population and developmental activities along the coast. It is necessary to protect coastal ecosystem to ensure sustainable development. This requires information on coastal wetlands and geomorphology. Remote sensing data have been found to be extremely useful for to provide information on this aspects. IRS LISS-1i & III satellite data (1988 and 1998), Survey of India, Topographic map (501 1969) and Naval Hydrographic Chart (NHO, 1975) has been used to generate the coastal ecosystem, coastal land use and land cover, coastal landforms, shoreline and bathymetry maps on 1:50,000 scale. This information has been used for the assessment of present status and identification of the changes in coastal ecosystem. The analysis of multi-date coral reef maps showed that 2 km^2 of reef area in Tuticorin coast have been lost over a period of ten years. The changes in coastal land use and land cover indicate that the major changes occurred in mangrove, crop land, fallow land, agriculture plantation, forest plantation, scrub land, sandy area and tanks. Various coastal landform units have been identified and grouped in to marine, fluvio-marine, fluvial, aeolian and biogenic landforms. The analysis of multi-date shoreline maps showed that 0.84 and 2.73 km^2 of the mainland coast and 0.35 and 0.13 km^2 areas of island coast have been eroded and accreted, respectively, in Tuticorin coast. The analysis of multi-date bathymetry data indicates that, the depth of seafloor has decreased along the coast and around the islands. The average reduction of depth in seafloor has been estimated as 0.31m over a period of twenty-four years. Most of the coastal geomorphic features such as spits, back swamp, mud flat, seaward migration of shore line, reduction of seafloor depths and some of the increased land cover features such as mangrove and mud flat etc., indicate that the coast of Tuticorin is going on emerging by tectonic movement. The coastal ecosystem particularly coral reef ecosystem is very severely affected by anthropogenic and natural factors. The validation by ground truth has also confirmed these results.

2577. **Thanikachalam, M and S. Ramachandran.** 2003. Shoreline and coral reef ecosystem changes in Gulf of Mannar, southeast coast of India. *J. Indian Soc. Remote Sensing,* 31(3): 158-173.

Address : Institute of Ocean Management, Anna University, Chennai – 600 025, Tamilnadu, India.

Abstract : Changes in shoreline, coral reef and seafloor have been mapped using remote sensing satellite data of IRS LISS-III (1998), IRS LISS-II (1988), Survey of India Topographic sheet (1969), Naval Hydrographic Chart (NHO) 1975 and bathymetry data (1999) with ARC-INFO and ARC-VIEW GIS. The analysis of multi-date shoreline maps showed that 4.34 and 23.49 km^2 of the mainland coast and 4.14 and 3.31 km^2 areas of island coast have been eroded and accreted, respectively, in the Gulf of Mannar. The analysis of multi-date coral reef maps showed that 25.52 km^2 of reef area and 2.16 km of reef vegetation in Gulf of Mannar have been lost over a period of ten years. The analysis of multi-date bathymetry data indicates that the depth of seafloor has decreased along the coast and around the islands in the study area. The average reduction of depth in seafloor has been estimated as 0.51m over a period of twenty four years. The increased suspended sediment concentration due to coastal and island erosion, and raised reef due to emerging of coast by tectonic movement are responsible for coral reef degradation in the Gulf of Mannar. Validation by ground truth has confirmed these results.

2578. **Thanikachalam, M and S. Ramachandran** 2004. Degradation of coral reefs in Gulf of Mannar, southeast coast of India - with special reference to land use/land cover changes: A remote sensing and GIS approach. *Third Indian National Conference on Harbour and Ocean Engineering, NIO, Dona Paula, Goa (India).* 2: 587-598.

Address : Department of Civil Engineering, Sona College of Technology, Salem - 636 005, Tamilnadu, India; E-mail: alsuwariyaa@yahoo.com

Abstract : Coral reef and land use/land cover maps were prepared using multi-date remote sensing data to assess the current status and changes of coral reefs and land use/land cover in Gulf of Mannar. The changes in

land use/land cover indicate that the major changes occurred in crop land, fallow land, agriculture plantation, forest plantation, scrub land, sandy area and tanks. Data also reveals a reduction of 25.52 km^2 in coral reef lost over a period of ten years, due to changing land use/land cover and other anthropogenic activities along Gulf Mannar coast. This study also reveals that in Gulf of Mannar, nearly 67.2% of the corals were dead, 13.1% coral reefs are directly removed by coral mining and remaining 19.6% were live corals.

2579. **Thankavel, K and T. Kannupandi** 1988. Nutritional value of geographical and temporal strains of Indian Artemia and the marine diatom *Chaetoceros gracilis* to the shrimp *Penaeus indicus* larvae and post larvae. *Proc. Aquacult. Int. Congr. Expo. Vancouver, B.C. (Canada), 6-9 Sep 1988.* p. 47.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : Geographical and temporal variability in the nutritional quality of Artemia cysts has been observed for various Artemia strains. Hence two different lots each of two geographical strains (Gujarat and Tuticorin) of Indian *Artemia* nauplii and the marine diatom *Chaetoceros gracilis* were evaluated for the mysis and post larvae of the shrimp, *Penaeus indicus.* Biochemical composition, calorific value including fatty acid profiles of *Artemia* nauplii are provided. The extra mysis stages are illustrated and the possible reasons for the same are discussed.

2580. **Thevanathan, R., I.L.G. Bhavani and A. Khrienuo** 2002. Diurnal rhythm in the activity of ammonia assimilating enzymes of some marine macroalgae. *Phykos,* 41(1&2): 35-41.

Address : Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : Four marine algae, *Ulva fasciata, Enteromorpha clathrata, Padina tetrastromatica and Grateloupia lithophila* were investigated for the presence of diurnal rhythm in the levels of glutamine synthetase, NAD (P) H-GOGAT and NAD (P) H-GDH, the enzymes of nitrogen assimilation. Presence of all the three enzymes in the tissues of the experimental algae was observed. *Ulva fasciata* exhibited maximum activity of these enzymes. All the three enzymes exhibited a definite diurnal rhythm in their activity. GS and GOGAT showed similar patterns with low activity in dark and maximum activity during day time reaching a peak at noon. A reverse trend was observed for GDH.

2581. **Thevanathan, R., R. Dhamotharan, R. Rajarajan, R. Pari and I.L.G. Bhavani** 2005. Sterol and fatty acid profiles of some marine macroalgae. *Seaweed Res. Utiln.,* 27(1&2): 61-68.

Address : Post Graduate and Research Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : The fatty acid and sterol profiles of ten marine algae namely *Bryopsis plumosa, Valoniopsis pachynema, Chnoospora minima, Stoechospennum marginatum, Fading tetrastromatica, Cystoseira indica, Sargassum cervicome, Acanthophora spicifera, Laurencia papillosa* and *Gymnogongrus pygmaeus* were studied. The experimental algae revealed the presence of nearly twenty two fatty acids in their tissues. None of the algae contained all the twenty two fatty acids in its tissue. The fatty acids, caprylic acid, lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, pahnitic acid, heptadecanoic acid, stearic acid, pahnitoleic acid, oleic acid, linolenic acid were found in all the ten experimental algae. Pahnitic acid was the major fatty acid comprising nearly 90-93% of the total fatty acid fraction. Stigmasterol and b-sitosterol were found in all the experimental algal samples. Fucosterol was detected in the brown algae and the red alga *Acanthophora spicifera.* Campesterol was found in *Laurencia papillosa* and *Gymnogongnls pygmaeus* only. In addition to these, three unidentified peaks were also obtained for sterols in the red algae. Of these three unknown sterols, one (unknown l) appeared to be of common occurrence and was detected in all the seven experimental algae.

2582. **Thevanathan, R., R. Dhamotharan, S. Selvaraju, R. Pari and I.L.G. Bhavani** 2005. Antioxidant potential of some marine algae from the coastal regions of Tamilnadu. *Seaweed Res. Utiln.,* 27(1&2): 81-85.

Address : Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : Eight marine algae namely *Chaetomorpha antennina, Enteromorpha clathrata, Cladophora fascicularis, Ulva fasciata, Fading tetrastromatica, Stoechospermum marginatum, Hypnea musciformis* and *Laurencia obtusa* collected from the coastal regions of Tamilnadu were screened for their antioxidant potential. Algal extracts were administered to liver microsomal and mitochondrial suspensions of male rats (Wistar strain) and the extent of incubation of lipid peroxidase (LPO) activity in these suspensions was estimated. Observed LPO inhibition rates were compared with that of Butyl hydroxyanisole (BHA), a commercial antioxidant. All

the eight algae exhibited antioxidant potentials comparable to that of BRA Brown and red algae showed higher antioxidant potential than green algae.

2583. **Thevanathan, R., Anjana Dutta, D.S. Dinamani and I.L.G. Bhavani** 2005. Effect of liquid fertilizer of some seaweeds on nodulation by Rhizobia in some legume seedlings. *Seaweed Res. Utiln.,* 27(1&2): 111-115.

Address : Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : Seedlings of *Cyamopsis tetragonoloba, Lablab purpureus; Arachis hypogea* developed from seeds treated with the liquid fertilizer preparations of seaweeds were assessed for their nodulation potential by two rhizobial strains (CP-l and MB-l). The treatment promoted nodulation by MB-l at all concentrations and inhibited that by CP-l. A selective promontory effect by the algal LF was observed.

2584. **Thevanathan, R., R. Rajarajan and I.L.G. Bhavani** 2005. Liquid fertilizer preparations of marine macro algae to enhance the yield and quality of tea. *Seaweed Res. Utiln.,* 27(1&2): 117-123.

Address : Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : The possibility of utilizing extracts of *Hypnea musciformis, Laurencia obtusa, FadinG tetrastromatica* and *Stoechospermum marginatum* as a biostimulant to increase the productivity of tea without affecting the quality of tea was investigated. Aqueous extracts or LF of the algae were tried at 500ml, l000ml and l500ml ha^{-1} and the commercial biostimulant 'Biozyme' at a concentration of 200ml ha^{-1}. As foliar spray, the aqueous extracts of the four algae were able to enhance the yield in tea without affecting the quality of made tea. The results are comparable to that obtained for the commercial biostimulant 'Biozyme'.

2585. **Thevanathan, R., Anjana Dutta, D.S. Dinamani and I.L.G Bhavani** 2005. Studies on the impact of application of marine algal manure and liquid fertilizer on the linear growth of the seedlings of some pulses. *Seaweed Res. Utiln.,* 27(1&2): 125-133.

Address : Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : The effect of seed treatment with liquid fertilizer preparations of *Fading tetrastromatica, Stoechospermum marginatum, Hypnea valentiae* and *Laurencia obtusa* and the application of shade-dried and seasoned manure preparation of the algae to soil was investigated on the linear growth of the seedlings of *Cyamopsis tetragonoloba, Lablab purpureus and Arachis hypogea.* Seedlings of the pulses developed from treated seeds showed increase in linear growth of both shoots and roots. The response was linear with the concentration of the LF tried. Brown algal extracts were more effective than those of red algae. When applied as manure, the algal preparations drastically reduced the linear growth of the seedlings and promoted the lateral root production irrespective of the algal manure used.

2586. **Thevanathan, R., D.S. Dinamani, Anjana Dutta, R. Pari and I.L.G. Bhavani.** 2005. Effect of liquid fertilizer preparations of some marine macro algae on the growth of rhizobia in culture. *Seaweed Res.Utiln.,* 27 (1&2) : 135-138.

Address : Department of Botany, Presidency College, Chennai - 600 005, Tamilnadu, India.

Abstract : The LF preparations of the four algae promoted the growth of two effective strains of rhizobia namely, CP-1 and MB-I of cowpea miscellany group in culture. Increasing the concentration of the LF in the medium exhibited positive correlation with the growth of the rhizobia. Nearly three to four fold increases in growth could be observed with 1.0 ml of LF. Of the four algae tried in this study, *Stoechospermum marginatum* yielded maximum results.

2587. **Thiagarajan, R., P. Nammalwar and K.M.S. Ameer Hamsa** 1984. Stranding of *Pseudorca crassidens* at Rameswaram, Gulf of Mannar. *Mar. Fish. Infor. Serv. T & E Ser.,* 55: 16-17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of *Pseudorca crassidens* at Rameswaram, Gulf of Mannar was discussed.

2588. **Thiagarajan, R and S.D. Daniel** 1998. Influence of Seasonality and lunar periodicity on the maturity pattern of *Pinctada fucata* for nucleus implantation in pearl culture. *Mar. Fish. Infor. Serv. T & E Ser.,* 155: 15-18.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamlnadu, India.

Abstract : The daily percentage occurrence of inactive oysters and tht mean values during full moon, new moon and semi-lunar periods during September-85 to August-86 are discussed.

2589. **Thirumal Thangam, R., S. Maria Victoria Rani and M. Peter Marian** 2003. Effect of seaweed liquid fertilizers on the growth and biochemical constituents of *Cyamposis tetragonoloba* (L.) Taub. *Seaweed Res. Utiln.*, 25(1&2): 99-103.

Address : Department of Botany, Vivekananda College, Agasteeswaram-629 701, Tamilnadu, India.

Abstract : The effect of Seaweed Liquid Fertilizers (SLFs) of *Caulerpa scalpelliformis* and *Gracilaria carticata* on the growth and biochemical constituents of cluster bean *Cyamposis tetragonoloba* (L.) Taub, seeds was investigated at different concentrations: 0.5, 1.0 and 1.5%. The SLFs promoted seed germination and other parameters namely shoot length, root length, leaf area, fresh weight of shoot and root, Chl. a, Chl. b, xanthophyll + carotenes, total carbohydrate, total protein and lipid. The SLF obtained from *Caulerpa scalpellifarmis* promoted more growth than the SLF of *Gracilaria corticata.*

2590. **Thirumal Thangam, R and S. Maria Victoria Rani and M. Peter Marian** 2004. Seaweed Liquid Fertilizer (SLF): Pot culture manurial experiments on bhendi. *Seaweed Res. Utiln.*, 26(1&2): 161-166.

Address : Department of Botany, Vivekananda College, Agastheeswaram-629 701, Tamilnadu, India.

Abstract : The effect of SLF *(Padina pavonia)* on the uptake of nutrients applied as inorganic form as evidenced by the yield and biochemical characteristics was made on bhendi crop grown in pots. The performance of SLF is better than the recommended rate of inorganic fertilizers.

2591. **Thirumal Thangam, R and S. Maria Victoria Rani** 2006. Effect of Seaweed Liquid Fertilizers on photosynthetic pigments of *Sorghum bicolor* (L.) Moench. *Seaweed Res. Utiln.*, 28(1) : 81-84.

Address : Department of Botany, Vivekananda College, Agasteeswaram - 629701, Tamilnadu, India and Department of Botany, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : The effect of Seaweed Liquid Fertilizers (SLFs) on photosynthetic pigments of *Sorghum bicolor* (L.) Moench.var. APK-l plant has been studied. *Caulerpa scalpelliformis* and *Padina pavonia* SLFs not only promoted the seedling growth but also increased the chlorophyll *a,b* and Xanthophyll+carotene contents. The lowest concentration of both the SLFs (0.5%) showed remarkable effect on pigments than higher concentration.

2592. **Thirumilu, P., P.K. Mahadevan Pillai, K.S. Krishnan and P. Poovannan** 1991. The fishing gears used in the exploitation of marine and brackish water fishery resources along Tamilnadu coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 114: 16-28.

Address : Central Marine Fisheries Research Institute, Madras, Tamilnadu, India.

Abstract : The different types of fishing gears operated along the Tamilnadu coast and their mode of operations are tabulated in this article.

2593. **Thirumilu, P., P.K. Mahadevan Pillai, P. Poovannan and M. Bose** 1994. Specifications of different artisanal and mechanised fishing craft employed in marine fisheries along Tamilnadu coast. *Mar. Fish. Infor. Serv. T & E. Ser.*, 128: 8-12.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The specification of artisanal crafts fitted with and the details on the specification of the non mechanized fishing crafts operated along the Tamilnadu coast are discussed.

2594. **Thiruppathi, S., M. Ganesan, P.V.S. Rao and A. Tewari** 2001. Effect of different light intensities and salinities on the growth of stellate bulbils of *Hypnea valentiae* (Turn.) Mont. (Gigartinales, Rhodophyta) under laobratory conditions. *Seaweed Res Utiln.*, 23(1&2): 13-18.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : To study the optimum salinity and light intensity for the growth of stellate bulbils of *Hypnea valentiae*, bulbils have been cultured under different light intensities 9, 18, 28µ Em^2s and salinities (25, 30, 35, 40, 45 ppt). From the culture experiments, the maximum SGR was observed at 25 ppt and at the light intensity of 28µ Em^2s, while the maximum EGR was observed at 35 ppt and at light intensity of 18µ Em^2s.

2595. **Thiruppathi, S and M. Ganesan** 2002. Effect of salinity and light intensity on growth of carpospores of *Hypnea valentiae* (Turn.) Mont. (Gigartinales, Rhodophyta) under laboratory conditions. *Seaweed Res.Utiln.*, 24 (1) :139-144.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp - 623 519, Tamilnadu, India.

Abstract : Carpospores of *Hypnea valentiae* were cultured under five different salinities (25, 30, 35, 40 and 45 ppt) with three different light intensities (9, 18 and 28µ Em^2s) in the laboratory condition (20 ± 2 α C with 12:12 light and dark periods). Higher Extension Growth Rate (EGR) and Specific Growth Rate (SGR) were observed in lower salinity level (25 ppt) at high light intensity (28 µ Em^2s) and in higher salinity level (45 ppt) at low light intensity (9µ Em^2s). Therefore it is obvious that *H. valentiae* growth in salinity ranges better 25-45 ppt which conforms to the earlier observation that *H. valentiae* can tolerate wide range of salinities 15-55 ppt.

2596. **Thiruvenkatachari, S and P. Subba Rao** 1998. Nearshore turbidity/bathymetry studies along Tuticorin coast through satellite sensing. *NRSA Report 0120, NRSA, Secunderabad, India, 1980.*

2597. **Thivy, F.** 1951. Investigation of seaweed products in India with a note on some properties of various Indian agars. *Tech. Pap. Proc. Indo. Pacific Fish. Council, 3rd Meeting.* pp. 173-175.

2598. **Thivy, F.** 1958. Economic seaweeds. ***In***: *Fisheries of the west coast of India*, (*ed*.) S. Jones, CMFRI, Mandapam Camp, 74-80.

2599. **Thivy, F.** 1959. On the morphology of the gametophytic generation of *Padina gymnospora* vickers. *J. Mar. Biol. Assoc. India,* 1(1): 69-76.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : The gametophytes of *Padina gymnospora* (Kuetzing) Vickers are far from well known. It was possible to obtain ten oogonial and two antheridial plants in the Mandapam area. The antheridial plant is being reported for the first time. The frond structure in the two phases of the gametophytic generation of this species is found to agree with that of the sporophyte. A peculiarity in the structure of the hairs in the species, noticed in the present material, has been described. Germination *in situ* was seen, and a few oogonial sori were found to show the presence of the subsidiary cell. A few of the hairs of the piliferous bands of the frond, in one case, were seen to give rise to a propagule which was terminally or laterally placed on the hair. The evidence that the gametophytic generation of *P. gymnospora* (Kuetzing) Vickers has unisexual plants proves that it is distinct from *P. australis* Hauck, a species having a bisexual gametophyte, which was synonymised with it. Observations indicate the existence of periodicity in the development of gametes in *P. gymnospora* (Kuetzing) Vickers.

2600. **Thivy, F.** 1959. Seaweed utilisation in India. *Proc. Symp. Algology,* ICAR. pp. 345-365.

2601. **Thivy, F.** 1964. Marine algal cultivation. *Salt Res. Ind.,* 1(1): 23.

2602. **Thomas, A.** 1978. Mussels as food. *Seafood Export. J.,* 10(12): 29-31.

2603. **Thomas, D.** 1966. Natural history of dugong in Rameswaram waters. *Madras J. Fish.,* 2: 80-82.

2604. **Thomas, H.S.** 1884. *A report on Pearl Fisheries and Chank Fisheries,* Madras. 234 pp.

2605. **Thomas, M.M.** 1968. On a new distributional record of *Parapenaeopsis tenella* from the south eastern coast of India. *J. Mar. Biol. Assoc. India,* 10(1): 166-167.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : *Parapenaeopsis tenella* (Bate) has been recorded from Japan (Bate, 1888 ; Kishinouye, 1900); China (Liu, 1955); and Australia (Dall, 1957) in the Pacific Ocean. In 1961 Hall reported it from Malaysia. DeBruin's (1965) record of this species from the east coast of Ceylon extended the distribution of this species further west. Racek and Dall (1965) considered the Palk Strait at the zoogeographical barrier limiting the distribution of the species from the west coast of India where its congener *Parapenaeopsis acclivirostris* (Alcock) occurs. But the present collection of *Parapenaeopsis tenella* from Palk Bay and Gulf of Mannar has established its presence beyond the Palk Strait which obviously does not act as a barrier. The discontinuous distributional records are probably due to the small size of the specimen and hence the rarity in the commercial catches. Male and female specimens of *Parapenaeopsis tenella* were collected from the early morning landings on the Gulf of Mannar side of Mandapam Camp and the Palk Bay side of Rameswaram Island. The specimens were obtained only from the night catches of shore seines as well as boat seines from depths of 1-2 fathoms and 5-6 fathoms respectively.

2606. **Thomas, M.M.** 1969. Notes on some interesting penaeid prawns (Crustacea Decapoda) from the southeast coast of India. *J. Mar. Biol. Assoc. India,* 11(1&2): 191-197.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : During routine collection of prawn samples of commercial catches from certain localities in Palk Bay and Gulf of Mannar on the southeast coast of India specimens of *Penaeus latisulcatus* Kishinouye, *Trachypenaeus pescadoreensis* Schmitt, *Trachypenaeus sedili* Hall and *Parapenaeopsis uncta* Alcock were collected. The occurrence of these prawns is reported for the first time from this area.

2607. **Thomas, M.M.** 1972. Growth of the spiny lobster, *Panulirus homarus* (Linnaeus) in captivity. *Indian J. Fish.*, 19(1&2): 125-129.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India.

Abstract : The growth of *Panulirus homarus* (Linnaeus) in captivity is traced in relation to moulting. The growth per moult of 4 to 9 mm carapace length and annual rate of growth of 30 mm in male and 17 mm in female are found to be in agreement with those of its congeners. Instances of moulting without growth and death during exuviations are also reported.

2608. **Thomas, M.M.** 1972. Studies on Indian Decapods. *Ph.D., Thesis*. Kerala University, Kerala, India.

2609. **Thomas, M.M.** 1974. Reproduction, fecundity and sex ratio of the green tiger prawn *Penaeus semisulcatus*. *Indian J. Fish.,* 21(1): 152-163.

Address : Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Abstract : Investigations on the reproduction, gonadosomatic index, fecundity and sex ratio of *Penaeus semisulcatus* were carried out at Mandapam Camp, from April, 1967 to March, 1969. Five stages of maturity could be differentiated depending on the colour of the ovarian lobes, the thickness of the ovary and the size of the ova. Female prawns with mature ovaries occurred throughout the year showing that they spawn continuously, the peak season being June to September and January to February. The gonado-somatic index exhibited a variation from 2.2 to 13.2. The minimum size at maturity in females was found to be 23 mm carapace length. The fecundity of the species was found to range between 51,605 and 6,60,904. There was no relation between the fecundity and the length of prawn, weight of prawn or weight of ovary. The samples examined contained more or less same number of males and females, although, during certain months the males were more in number while in other months the females were dominating.

2610. **Thomas, M.M.** 1975. Age and growth, Length, weight relationship and relative condition factor of *Penaeus semisulcatus. Indian J. Fish.,* 22(1&2): 133-142.

Address : Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Abstract : Attempts have been made to determine the age and growth of *Penaeus semisulcatus* by the method of length-frequency analysis and the results were verified by using von Bertalanffy's equation. Males showed a growth of 2mm carapace length per month from 7th to 8th month of age. Females had a higher growth rate viz., 3.5mm per month at the same period. Male prawns reached the estimated carapace length of 26.2 mm at one year and 29.4 mm at two years while the size of females at ages of one and two years were 38.16mm and 41.08 mm respectively.

2611. **Thomas, M.M.** 1976. A sporozoan infection in *Penaeus semisulcatus* at Mandapam. *Indian J. Fish.*, 23(1&2): 282-284.

Address : Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Abstract : A few specimens of *P. semisulcatus* collected from Mandapam area were found infected with a microsporidian parasite tentatively identified as *Thelohania duorara* which has been earlier reported only from the USA. Although these parasites resemble *T. duorara* closely, they differ significantly from the American specimens in the shape of the spores and pansporoblasts.

2612. **Thomas, M.M**. 1977. A New Record of Nobili (Bopyridae, Isopoda) Parasitic on *Penaeus semisulcatus* De Haan From Palk Bay and Gulf of Mannar. *Indian J. Fish*., 24(1&2): 258-261.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The isopod *Epipenaeon ingens* Nobili parasitic on *Penaeus semisulcatus* De Haan is reported for the first time from Indian waters. One of the parasite is given along with the percentage of incidence and their effect on the host.

2613. **Thomas, M.M.** 1978. Artificial feed. *CMFRI Spec. Publ.,* 3: 89-91.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Supplementary feeds are used in prawn culture to increase the growth rate so that prawns can be harvested in a shorter duration. These feeds can be either natural item of artificial feeds compounded as per the requirements of the prawns. Although natural food items such as clams and mussels have very good conversion values, the difficulty to get these in large quantities regularly all through the seasons and their easily perishable nature make artificial compounded food more suitable for use in prawn culture.

2614. **Thomas, M.M.** 1978. Food and Feeding of Prawns. *CMFRI Spl. Publ.,* 3: 44-48.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : The study of food, feeding and assimilation is of fundamental importance for the proper understanding of the growth rate, population concentrations, gonadial maturation and other metabolic activities. Although prawns which inhabit the shallow areas form the bulk of the crustacean resources of the world very little work has been done in many countries on the food, feeding and assimilation in these animals. Detailed studies have been made in India on the 'stomach' contents of *Penaeus indicus* (Gopalakrishnan 1952) food and feeding of *Penaeus monodon* from Korapuzha Estuary (Thomas 1973), *Penaeus semisulcatus* from the Gulf of Mannar and Palk Bay.

2615. **Thomas, M.M.** 1979. On a collection of deep-sea decapod crustaceans from the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 21(1&2): 41-44.

Address: Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract: Seven decapod crustaceans belonging to sections Penaeidae (4 species), Caridea (2 species) and Astacidae (1 species) collected during the exploratory cruises of the fishing vessel belonging to the Integrated Fisheries Project, Cochin from the Gulf of Mannar, off Mandapam are reported. All these species are recorded from the Gulf of Mannar for the first time, three of which are newly reported from the east coast of India.

2616. **Thomas, M.M**. 1980. Food and feeding habits of *Penaeus semisulcatus* De Haan at Mandapam. *Indian J. Fish.*, 27(1&2): 130-139.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : *Penaeus semisulcatus* feed on a variety of food items viz., polychaetes, crustaceans, molluscs, diatoms, foraminiferans and radiolarians, even though detritus and sand formed bulk of the stomach contents. There was marked difference in the food composition of the species from the Palk Bay and Gulf of Mannar. Actively fed prawns were found to be more in the night catches. The species do not exhibit preference to any particular food item. It is concluded that the abundance of a particular food item was dependent on its availability during the season when they are predominant. There was no significant difference in the food and feeding habits in the various size groups.

2617. **Thomas, M.M.** 1986. Decapod crustaceans from Palk Bay and Gulf of Mannar, pp. 405-438. ***In***: *Recent advances in Marine Biology,* (ed.) P.S.B.R. James, Today and Tomorrow, New Delhi, 1986: 591 pp.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Extensive collections were made from various places in the Gulf of Mannar from Tuticorin to Kundugal and in Palk Bay from Rameswaram to Muthupet. Besides, field collections were made from shallow waters in the coral reefs of Vala Tivu, Hare Island, Manauli Island, Pulli Island, Pullivasal Island, Krusadai and Shingle Islands and their lagoons. The details of the material with their distribution, and notes on topics of interest are given for twenty four species of penaeid prawns belonging to the genera, *Penaeus, Metapenaeopsis, Trachypenaeus* and *Parapenaeopsis* and eleven carideans belonging to the genera, *Palaeman, Macrobrachium, Periclimenes, Anchistus, Hippolysmata, Hippolyte, Latreutes* and *Alpheus* are presented in this paper.

2618. **Thomas, M.M.** 1989. On a collection of hermit crabs from the Indian waters. *J. Mar. Biol. Assoc. India*, 31(1&2): 59-79.

Address : Central Marine Fisheries Research Institute, Cochin-682 018, India.

Abstract : Twenty seven species of Hermitcrabs belonging to eight genera : *Puguropsis, Paguristes, Clibanarius, Dardanus, Diogenes, Trizopagurus, Calcinus* and *Triglopagurus* collected from shallow waters and deep sea along the Indian coast are presented with remarks on their distinctive characters, colour patterns and distribution.

2619. **Thomas, P.A.** 1965. The occurrence of the red mullet (Goat fish) *Upeneus luzonius* in the Indian seas. *J. Mar. Biol. Assoc. India,* 7(2): 473-475.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : During my studies on the taxonomy and biology of goatfishes some specimens of *Upeneus luzonius* Jordan and Seale (1907) hitherto unreported from Indian waters have been collected from the Palk Bay and Gulf of Mannar near Mandapam. This species has been previously reported from Philippines (Jordan and Seale 1907, Herre and Montalban 1928, and Fowler 1933), Borneo (Seale 1910, Herre and Montalban 1908 and -Fowler 1933) and Singapore (Herre and Myers 1937).

2620. **Thomas, P.A.** 1968. Studies on Indian sponges-I: Two new species of silicious sponges belonging to the genera *Echinodictyum Ridley* and *Rhadberemia Topsent*. *J. Mar. Biol. Assoc. India,* 10(2): 245-249.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Our knowledge of the sponges of the Indian region is still in its infancy. The only area which has been studied somewhat extensively is the Gulf of Mannar by various spongologists like Carter (1E80, 1881), Dendy (1905), Burton (1930, 1937) and Rao (1941). Besides these, some occasional reports are there about the sponges of Madras or of Gulf of Kutch; but such information often is too fragmentary when the vast shoreline of about 4800 km of India is taken into consideration. With the idea of studying the Indian sponges in a comprehensive manner, the present author took up this work in 1964. Collections from various parts of India by the author himself over the years have been supplemented by those forwarded by many other scientists from different parts of the country including Andamans and Laccadive Islands. The Mandapam region, however, has been surveyed in greater detail, with particular stress given to the Palk Bay, since the sponges of Palk Bay is poorly known. The sponge fauna of the Indian region has been found to be quite rich and varied and its relationship with those of adjacent parts like the Red Sea and the Australian region is quite striking. The taxonomy of those species that are of special interest is presented here, in a series 'Studies on Indian Sponges' of which the present communication forms the first part. All types described here are deposited in the Reference Collection Museum of the Central Marine Fisheries Research Institute, Mandapam Camp.

2621. **Thomas, P.A.** 1968. Studies on Indian sponges-II. Two new species of silicious sponges belonging to the genera Aka De Laubenfels and Damirina Burton. *J. Mar. Biol. Assoc. India,* 10(2): 250-254.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : During an extensive collection of sponges from the coral rocks of the Gulf of Mannar, the author has come across two new species of sponges. The first one, *Aka diagonoxea,* is a boring sponge and the other, *Damirina papillala,* usually grows with its base rooted deep in the coral. Detailed descriptions of these species are given here. All specimens are deposited in the Reference Collection Museum of the Central Marine Fisheries Research Institute.

2622. **Thomas, P.A.** 1968. Studies on Indian Sponges-III. Two species of silicious sponges of the family (Class: Demospongiae, order: Poccilosclerida). *J. Mar. Biol. Assoc. India,* 10(2): 255-259.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Many species belonging to the genus *Mycale* Gray (1867) are recorded from Indian region by previous authors (Carter, 1880, 1887 ; Dendy, 1905 ; Burton and Rao 1932; Annandale, 1914; Burton 1937 and Rao 1941). The present account deals with a new species of and a new record of *Carmia sulevoidea* (Sollas) from the Indian region.

2623. **Thomas, P.A.** 1968. Studies on Indian sponges - IV. Additions to the Genus Corticium schmidt with notes on the distribution of *Corticium candelabrum. J. Mar. Biol. Assoc. India,* 10(2): 260-263.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Two species of the genus *Corticium* Schmidt (1862) of the Order Carnosida Carter (1875), family Halinidae de Laubenfels (1936) were collected by the author. The first one, *Corticium acanthastrum* is a new

species and the second, *C. candelabrum* Schmidt is reported here from Indian region. The discovery of the latter species here helps in bridging a wide gap in its distribution in two widely separated zoogeographical areas such as Mediterranean Sea and Western Pacific.

2624. **Thomas, P.A.** 1968. Studies on Indian sponges- V. Two new records of silicious sponges belonging to the families *Mixillidae* and *Spirastrellidae* from the Indian region. *J. Mar. Biol. Assoc. India*, 10(2): 264-268.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The present author, during an extensive collection of sponges from the coastal waters of India, has come across two interesting species of sponges and these are described herein. The first one is *Hymedesmia mertani* Hentschel. Its previous records are from Am Island (Hentschel, 1912) and Great Barrier Reef (Burton, 1934). The present discovery of this has greatly extended its distribution westward to Indian Ocean. . Similarly the other species, *Spirastrella pachyspira* Levi is originally known from Red Sea (Levi, 1958), and later from Western Indian Ocean (Levi, 1961, Vacelet and Vasseur, 1965). The present record of the same from Indian region, hence, widens its distribution in Indian Ocean.

2625. **Thomas, P.A.** 1969. Catalogue of sponges in the reference collections of the Central Marine Fisheries Research Institute. *Bull. Cent. Mar. Fish. Res. Inst.*, 7: 13-21.

2626. **Thomas, P.A.** 1970. Studies on Indian sponges-VI. Two new records of silicious sponges (Poecilosclerida: Tedaniidae) from the Indian ocean. *J. Mar. Biol. Assoc. India*, 12(1&2): 43-50.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : The occurrence of two species of silicious sponges, *Acarnus thielei* Levi and *Acanthacarnus souriei* is reported here from the Palk Bay and the Gulf of Mannar. These are new records for the Indian region.

2627. **Thomas, P.A.** 1970. Studies on Indian sponges - VII. Two new records and a new species of the genus *Plakina* (Carnosida: Halinidae) from the Indian region. *J. Mar. Biol. Assoc. India*, 12(1&2): 51-56.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : *Plakina monolopha* and *Plakina trilopha* Schulze (1880) are recorded here from the Indian region. Another species *P. acantholopha* is described here as new to science.

2628. **Thomas, P.A.** 1970. On some deep sea sponges from the Gulf of Mannar, with descriptions of three new species. *J. Mar. Biol. Assoc. India*, 12(1&2): 202-209.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Mandapam, India.

Abstract : In this paper, 9 species of Demospongiae collected during the cruises of the I.N.P. fishing vessel "Klaus Sunnana" in the Gulf of Mannar are dealt with. Of these, 3 species, *viz., Hymedesmia mannarensis, H. stylophora, Ectyodoryx lissostyla* are new to science and two, *Microciona rhopalophora* (Hentschel) and *Poecillastra schulzii* (Sollas) are new records from the Gulf of Mannar. All these specimens were collected by trawl net from depths varying between 180 and 325 metres. The type materials are deposited in the Reference Collection Museum of the Central Marine Fisheries Research Institute Regional Centre, Mandapam Camp.

2629. **Thomas, P.A.** 1972. A new genus and species (*Qasimella indica*) of Demospongiae from Indian Seas. *J. Mar. Biol. Assoc. India*.,16(1): 311-313.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : A new genus and species of Demospongiae, *Qasimella indica* from the Gulf of Mannar is described and illustrated in this account.

2630. **Thomas, P.A.** 1972. Boring sponges of the reefs of Gulf of Mannar and Palk Bay. *Proc. Symp. Corals & Coral reefs, MBAI.* pp. 333-362.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Boring sponges form a major group among the marine organisms causing considerable destruction to the reef system. The bores made by the sponges weaken the entire reef, making it more susceptible to the wear and tear caused by waves. A systematic account of the major coral-boring sponges of the fringing reefs of Gulf of Mannar and Palk Bay, based on a study over a period of three years, is presented in this paper. Other

aspects like intensity of boring, pattern of growth are also briefly discussed.

2631. **Thomas, P.A.** 1973. The sponge resources of India. *Proc. Symp. Living Resources of Seas around India, CMFRI.* pp.693-699.

2632. **Thomas, P.A.** 1976. The history of spongology of the Indian Ocean. *J. Mar. Biol. Assoc. India,* 18(3): 610-625.

2633. **Thomas, P.A.** 1977. Studies on Indian sponges VIII. Four new records of silicious sponges, *Echinochalina glabra, Gigginsia mixta, Geodia lindgreni* and *Pachamphilla dendyi* from the Indian ocean. *J. Mar. Biol. Assoc. India,* 19(1): 115-122.

Address : Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Abstract : Four species of silicious sponges *Echinochalina glabra* (Ridley and Dendy), *Gigginsia mixta* (Hentschel), *Geodia lindgreni* (Lendenfeld) and *Pachamphilla dendyi* (Hentschel) are recorded here from the Indian region. All these four species are known previously from Australia and adjacent regions.

2634. **Thomas, P.A.** 1983. Some pathological aspects akin to sponge boring in molluscan shells. *Proc. Symp. Coastal Aquaculture,* MBAI, 2: 671-676.

Address : Central Marine Fisheries Research Institute, Cochin - 628 018, India.

Abstract : Boring sponges are considered to be a menace to the oyster beds and coral reefs in many parts of the world. In India too, where the molluscan population exists in fishable magnitude, the boring sponges pose a serious threat to their fishery. The main target of the boring sponge is the calcareous shell of the host and the techniques adopted by the sponge to gain entry into the hard parts of the host are the same for all the species of boring sponges. But the shells of the different species react differently to the intruder, namely the sponge. These reactions often produce a wide variety of pathological symptoms in the host. Several live shells infested by boring sponges have been collected during the years 1964-1978 from both natural and artificial beds and the pathological aspects have been investigated, the results of which are presented in this paper.

2635. **Thomas, P.A., K.K. Appukuttan, K. Ramadoss and S.G. Vincent** 1983. Calcibiocavitological investigations. *Mar. Fish. Infor. Serv. T & E. Ser.,* 49: 1-13.

Address : Central Marine Fisheries Research Institute, Cochin - 628 018, India.

Abstract : The percentage of incidence of boring sponges in chanks, mussels and oysters at different places of South India including the Gulf of Mannar is discussed.

2636. **Thomas, P.A.** 1984. Sponges collected aboard from the southeast coast of India. *J. Mar. Biol. Assoc. India,* 26(1&2): 95-102.

Address : Central Marine Fisheries Research Institute, Cochin - 628 018, India.

Abstract : Eight species of sponges collected aboard the R.V. Skipjack in Indian waters between 11° 44'- 11° 44'N and 79° 57'E-79° 58'E from a depth of 48 m are described with illustrations. Of these, 3 species viz. *Biemna microstyla, Bubaris gorgonoides* and *Acanthella megaspicula* are new to science., a species so far known to occur only in the Gulf of Mannar, is recorded here from outside its native limits for the first time. It appears from the collection that this depth zone harbours a rich population.

2637. **Thomas, P.A.** 1986. Demospongiae of the Gulf of Mannar and Palk Bay : pp.205-365. ***In***: *Recent advances in Marine Biology,* (ed.) P.S.B.R. James , Today and Tomorrow, New Delhi, 1986. 591 pp.

Address : Central Marine Fisheries Research Institute, Vizhinjam Res. Cent., Vizhinjam, Kerala, India.

Abstract : The author, while engaged in the study of Indian marine sponges during the years 1964-70, could pay special attention to the sponge fauna of the Gulf of Mannar and Palk Bay and the present account entitled "Demospongiae of the Gulf of Mannar and Palk Bay" is an outcome of this investigation. Faunistically speaking the Gulf of Mannar is rather well known. Whereas no published account is available till date on the sponges of the Palk Bay. In the present study a total of 94 species is recorded for the first time from the Palk Bay. In the present work it is attempted to provide an exhaustive account on the systematics and distribution of the Demospongean fauna of both the Gulf of Mannar and Palk Bay. For the comprehensiveness of the account, species which have been reported previously from the Gulf of Mannar by the earlier workers are also incorporated. The total number of valid species from both the Gulf and Bay is 275 and is referable to 8 orders. 38 families and

136 genera. Details regarding the morphology, colour, skeletal arrangement and spicules etc., are provided to facilitate an easy identification.

2638. **Thomas, P.A and Rani Mary George** 1987. Gorgonid Resources of India. *Mar. Fish. Infor. Serv. T & E. Ser.,* 74: 1-13.

Address : Central Marine Fisheries Research Institute, Vizhinjam, Kerala, India.

Abstract : The quantity and the price per kg of gorgonids of different species are compared in this article.

2639. **Thomas, P.A.** 1990. Systematics and ecology of the fouling and sponges in the Indian coastal waters. *Proc. Spec. Meeting on Marine Biodeterioration with reference to power plant cooling systems held at IGCAR, Kalpakkam on 26-28 April, 1989.* (*eds*) K.V.K. Nair and V.P. Venugopalan. pp. 196-217.

Address : Central Marine Fisheries Research Institute, Vizhinjam Research Centre, Vizhinjam, Kerala India.

Abstract : Some studies on sponges (especially boring sponges) from the Indian seas are discussed and it is stressed that no information is available on the rate of erosion effected in different reefs or in the commercially important molluscan beds. It is also pointed out that bioerosion profiles for each species of sponge have to be prepared and the magnitude of damage caused to coral reefs and molluscan beds assessed for each area on a long term basis. Other aspects such as the behaviour of sponge larvae are also discussed. An artificial key to the identification of all the 32 species of boring sponges in the Indian seas is provided as well as a list of the more common fouling sponges colonizing the culture rafts at Vizhinjam, Tuticorin and Mandapam.

2640. **Thomas, P.A., K. Ramadoss and S.G. Vincent** 1993. Invasion of *Cliona margaritifera* Dendy and *C. lobata* Hancock on the molluscan beds along the Indian coast. *J. Mar. Biol. Assoc. India*, 35(1&2): 145-156.

Address : Central Marine Fisheries Research Institute, Cochin 682 018, India.

Abstract : In the recent past the invasion of two new sponge pests *Cliona margaritifera* and *C. Lobata* on the molluscan beds of the southwest coast of India is reported. These two new pests made their first appearance on cultured pearl oysters on raft at Vizhinjam in 1980 and thence started spreading to the economically important molluscan beds in and around Vizhinjam. The spreading of these pests along the southwest coast of India was rather fast and from this coast *C. margaritifera* could migrate to the raft-cultured pearl oysters at Tuticorin and *C. lobata* to the chank beds off Thiruchendur (southeast coast) within two years *i.e.*, by 1982. It is also suggested in this paper that *C. margaritifera* is capable of devastating any molluscan bed as was seen in the Ceylon (Sri Lanka) pearl banks in 1902. The reappearance of *C. margaritifera* at Tuticorin after a lapse of several years might pose a serious threat to the entire molluscan population in the Gulf Mannar. A continuous monitoring of the activities of *C. margaritifera*, hence, is necessary on a long term basis.

2641. **Thomas, P.A.** 1996. The Gorgonid resources and their conservation in India, pp.32-40. ***In***. *Marine biodiversity: Conservation and management,* (*eds.*) N.G. Menon and C.S. Gopinadha Pillai Pub. CMFRI, 1996: 205 pp.

2642. **Thomas, P.A.** 2000. Sponges - systematics, as pests of molluscs, agents of bioerosion and a source of bioactive compounds. ***In***: *Marine Fisheries Research and Management,* (eds.) V.N. Pillai and N.G. Menon, CMFRI, Kochi, pp.109-123.

Address : Central Marine Fisheries Research Institute, Cochin - 628 018, India.

Abstract : This paper on sponges deals mainly with 1) systematics, 2) as pests of molluscs and agents of bioerosion and 3) as a source of bioactive compounds. Sponges have many physical and physiological peculiarities not seen in other animal groups, and hence they can be used in the study of cellular biology, evolution of nervous system, reproduction, bioerosion, bioactivity, symbiosis, etc. Many of the lower invertebrates are considered to possess chemical compounds with proven biodynamic potentials. But, in India, such studies, except in a few groups, have not progressed satisfactorily for want of sufficient expertise on the 'source material', their availability and taxonomic position. Hence, basic taxonomic studies will have to be initiated on all lower invertebrate groups as priority areas for better management of any project aimed at synthesizing 'wonder drugs' from marine animals and also to meet the biodiversity – linked mandate endorsed by the recent GATT Agreement.

2643. **Thomas, P.C., K. Rama Rao and K. Subramanian** 1975. Periodicity in and production of agar of *Gelidiella acerosa* (Forsskal) Feld. et Hamel. *Indian. J. Mar. Sci.,* 4(2): 210-211.

2644. **Thomas, P.C.** 1977. Seasonal variation in yield and physical properties of agar agar from *Gracilaria verrucosa. Seaweed Res. Utiln,* 2(2): 78-81.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : In India agar is mostly manufactured from the red seaweed *Geldiella acerosa*. Owing to the continuous and indiscriminate harvesting the availability of this alga has become very scarce. It was thought desirable to study the seasonal variation in the yield and physical properties of agar from *Gracilaria verrucosa* (Hudson) Papenfuss which is an alternate source of agar. *Gracilaria verrucosa* is generally found at low water and below, and is a characteristic inhabitant of sandy bottom. It is widely distributed in Australia, Canada, Ceylon, China, Japan, Formosa, South Africa and U.S.A. In India, it occurs in Chilka Lake, Kuda in Gujarat coast, and in Rameswaram. In size, the plants vary from country to country. *Gracilaria verrucosa* often grows to a length of 3 to 4 m on the pacific coast. Whereas the plants from the Atlantic coasts are comparatively smaller than the African plants which are mostly 20-90 cm long. Plants from Rameswaram grow to the size between 20-65cm. So far no study has been carried out in India regarding the seasonal variation in yield and physical properties of agar from *Gracilaria verrucosa.*

2645. **Thomas, P.C., K. Subbaramaiah and E.R.R Iyengar** 1978. Natural growth and agar content of *Gelidiella acerosa* (Forsskal) Feld. et Hamel in an exploited population. *Rev. Algol. Nouv. Ser.,* 13(4): 341-347.

Address : Central Salt and Marine Chemicals Research Institute, Bhavnagar - 364 002, Gujarat, India.

Abstract : The natural growth of *G. acerosa* in an exploited population at Keelakkarai is depleted in quantity from year to year. Growth of the seaweed also becomes diminished, and attains a single peak in a year. The agar content and quality were likewise found to be affected. Harvesting should be regulated in order to allow the seaweed to grow.

2646. **Thomas, P.C., B.K. Ramavat, K. Rama Rao and K. Subbaramaiah** 1987. Seasonal variation in iodine content of *Asparagopsis taxiformis* (Delile) Collins et Harvey from Mandapam region. *Phykos*, 26(1&2): 57-60.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam-623 518, Tamilnadu, India.

Abstract : In the present study the iodine content of *Asparagopsis taxiformis* showed peak value of 0.3% in December 1985 and the lowest of 0.13% in August 1985. These values coincide with the growth peak of the alga.

2647. **Thomas, P.C and K. Subbaramaiah** 1990. Seasonal variation in the natural growth of *Asparagopsis delilei* Montagne from the Mandapam region, East coast of India. *Indian J. Mar. Sci.*, 19(2): 148-150.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam-623 518, Tamilnadu, India.

Abstract : *Asparagopsis delilei* (*A. taxiformis*) grows from August to May in the Mandapam region of India. The plants attain maximum growth during January-February, when seawater temperature and salinity values are low (27°-28° C and 27-32 x 10^{-3}). Spermatangial plants occur earlier (maximum in January) than cystocarpic plants (maximum in May). Falkenbergia phase grows in all months except October and November, and produces tetraspores in March-April. Seasonality in occurrence of the 2 phases of the alga, and correlation of its biomass with the environmental factors such as salinity and temperature of seawater were observed.

2648. **Thomas, P.C and K. Subbaramaiah** 1991. Growth of marine algae in a *Sargassum wightii* dominated population at Mandapam. *Seaweed Res. Utiln.,* 13(2): 201-206.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The population growth of *Sargassum wightii* Greville and the associated seaweeds has been described from Mandapam. The occurrence of associated seaweeds during the peak growth period of *S. wightii* showed marked difference between the number of species and either the cover or the biomass fresh weight. Only 9 marine algae, viz.. *Caulerpa sertularioides, Caulerpa taxifolia, Halimeda gracilis, Stoechospermum marginatum, Gelidiopsis repens, Gracilaria corticata, Hypnea valentiae, Centroceras c1avulatum, Laurencia papillosa* were found associated with *S. wighti*, when it reached its maximum growth. The reduction in the number of associated seaweeds is attributed to the over growth and shooing effect by *S. wightii*.

2649. **Thomas, P.C and K. Subbaramaiah** 1991. Seasonal variations in growth, reproduction, alginic acid, mannitol, iodine and ash contents of brown alga *Sargassum wightii*. *Indian J. Mar. Sci.,* 20(3): 169-175.

Address: Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam-623 518, Tamilnadu, India.

Abstract : Growth of *Sargassum wightii* Greville was maximum in winter months (October-December) correlating with salinity, rain fall and pH of seawater. Annual biomass production of 2.4 kg dry wt/m^2 was estimated. Reproduction occurred concurrently with the peak growth period October-December. Rapid loss of axes followed with the end of reproduction. All chemical constituents showed seasonality and alginic acid and iodine contents showed correlation with growth in biomass and with each other. Based on the season for optimum growth with that for alginic acid and iodine contents, harvesting of the alga is advocated from August to December for obtaining better product yield.

2650. **Thomas, P.C and K. Subbaramaiah** 1992. Longevity and recolonization of *Sargassum wightii* from Mandapam. *Seaweed Res. Utiln.,* 15(1&2): 133-138.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The appearance and growth of *Sargassum wightii* Greville arising from oospores on a fresh substratum and subsequent growth of plants from holdfasts was followed annually for five years in succession. The growth of the plants was maintained free from further colonization for recording longevity. Initial colonization took place during February and the plants attained maximum growth in December. The density (number of plants) 36/m^2 remained constant for three years. Further, the population was found to propagate from the holdfasts every year and showed longevity over 4-5 years. Recolonization of the alga occurred on the cleared substratum within two months, when harvested in December. During recolonization, 20 taxa were found initially associated with the growth of the alga. As its growth attained maximum, the number of associated seaweeds got reduced to a minimum of 10 namely *Padina tetrastromatica, Liagora ceranoides, Cheilosporum spectabile, Jania adhaerens, Gracilaria corticata, Champia parvula, Centroceras clavulatum, Ceramium cruciatum, Wrangelia organs,* and *Laurencia papillosa.*

2651. **Thomas, P.C and K. Subbaramaiah** 1994. Seasonal variations in growth and phycocolloid content in *Hypnea pannosa* J. Agardh (Gigartinales, Rhodophyta) from Mandapam region. *Proc. Indian Natl. Sci. Acad. B Biol. Sci.,* 60(1): 93-98.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam-623 518, Tamilnadu, India.

Abstract : Seasonal variation in growth and carrageenan content in *Hypnea pannosa* from two different habitats in the Mandapam region and its correlation with certain physico-chemical parameters of seawater have been studied. Seasonality in growth and carrageenan content was observed. Plants remained generally vegetative with tetrasporangia developing during September and October. Growth characteristics of the plant cover and biomass showed maxima in different seasons in the open shore and lagoon habitats. Although peak growth period coincided with low seawater temperature, growth was not correlated with temperature. However, positive correlation between growth and salinity and also with carrageenan was observed. While growth (biomass) of the plants in the lagoon habitat was higher, the carrageenan content in the plants recorded higher values in the open shore habitat.

2652. **Thomas, P.C.** 1995. Colonization and growth of certain seaweeds on the SRFT cultivation of *Gracilaria edulis* Silva. *Seaweed Res. Utiln.,* 17(1&2): 161-164.

Address : Central Salt and Marine Chemicals Research Institute, Marine Algal Research Station, Mandapam-623 518, Tamilnadu, India.

Abstract : Monthly collections and observations of all the seaweeds growing on the ropes of SRFT method of cultivation (Single Rope Floating Raft Technique) of *Gracilaria edulis* at Krusadai Island were made for over twenty months in order to study the periodicity in occurrence and extent to which they grow on the rope. In all 24 taxa were recorded, out of which 6 belong to chlorophyceae, 4 belong to Phaeophyceae, 13 belong to Rhodophyceae and one belongs to Cyanophyceae. The minimum number of plants (8) and maximum number (16) were recorded during the month of January, and March-May and July respectively. *UIva lactuca, Jania adhaerens, Hypnea valentiae* were found throughout the year. The growth of these algae occurred due to the settlement of spores on ropes which were shed in the seawater from the plants growing in the vicinity of the cultivation experiment. Occurrence of reproductive bodies was observed in *Ulva lactuca, Boergesenia forbesi, Ectocarpus sp., Jania adhaerens, Hypnea valentiae, Chempia parvula, Ceramimum cruciatum* and *Laurencia obtusa.* The other seaweeds which were present only for a few months did not produce any reproductive structures.

2653. **Thomson, J.A and W.D. Henderson** 1905. Report on the Alcyonaria collected by Professor Herdman at Ceylon in 1902. *Report to the Govt. of Ceylon on the Pearl Oyster Fisheries of the Gulf of Mannar by W.A. Herdman*

Supplementary Report XX: 269-328, Pl.VI

2654. **Thurston, E.** 1887. Preliminary report on the marine fauna of Rameshwaram and the neighbouring Island. *Madras Govt. Central Mus. Sci. Ser.,* 1: 1-41.

Abstract : The Island of Rameswaram, best known on account of its temple and as being the last place visited by Hindus in their pilgrimage, is connected to the mainland of the Madras Presidency on the one hand and the Island of Mannar on the other by an interrupted ridge of rocks known as Adam's Bridge, concerning which Davy says, writing in 1821.

2655. **Thurston, E.** 1890. Notes on the Pearl and Chank fisheries and Marine fauna of the Gulf of Mannar. *Bull. Madras Govt. Mus.,* 1890: 77-80.

2656. **Thurston, E.** 1890. Notes on the pearl and chank fisheries and Marine Fauna of the Gulf of Mannar. *Bull. Madras Govt. Mus.,* 113-114.

2657. **Thurston, E.** 1889. The Tuticorin Pearl fishery. *Nature,* London, 40: 174-176.

2658. **Thurston, E.** 1894. Rameswaram Island and fauna of the Gulf of Mannar. *Madras Govt. Mus.Sci. Ser.,* 1: 78-138.

2659. **Thurston, E.** 1894. The Tuticorin chank fishery. *Bull. Mad. Govt. Mus.,* 1: 55-62.

2660. **Thurston. E.** 1895. The occurrence of the Dugong in the Indian seas. *J. Bomb. Nat. Hist. Soc.,* 9(4): 489-490.

Abstract : One *Dugong dugon* was caught at Pamban with a young one.

2661. **Thurston, E.** 1895. Rameswaram Island and fauna of the Gulf of Mannar. 2nd Edition. *Bull. Madras Govt. Mus.,* 3: 102-105.

2662. **Tilvi, S., P.S. Parameswaran and C.G. Naik** 2002. Two bromotyrosine alkaloids from the *Psammaplysilla purpurea*. *Proceedings of the National Conference on Utilization of Bioresources - NATCUB-2002, October 24-25, 2002.* pp. 558-463.

Address : National Institute of Oceanography, Dona Paula, Goa - 403 004, India.

Abstract : The sponge *Psammaplysilla purpurea* (Order: Verongidae, Family: Aplysinellidae) is a well known source for several bromotyrosine alkaloids of unique structural features and exhibiting promising biological activities such as cytotoxicity, antimicrobial properties etc. Herein is reported isolation and structure determination of two such alkaloids: 16-debromo aplysamine-4 1 and purpuramine 1 2 from the sponge *P. purpurea* collected from Mandapam, Tamil Nadu, India. The structures of these compounds were finalized from the respective spectral data including IR, UV-Vis, NMR and MS and their comparison with those of similar compounds from literature.

2663. **Toor, H.S.** 1964. Biology and fishery of the Pig-face bream, *Lethrinus lentjan.* II Maturation and Spawning. *Indian J. Fish*., 11(2): 581-596.

2664. **Toor, H.S.** 1971. Taxonomic position of *Lethrinus mahsenoides* Valenciennes and *Lethrinus sanguineus* Smith. *Res. Bull. Panjab. Univ.,* 22(3&4): 375-378.

Address : Department of Zoology and Entomologym, Punjab Agriculture University, Ludhiana, India.

Abstract : The taxonomic position of *L. mahsenoides* and *L. sanguineus* is discussed. Diagnostic characters of *L. mahsenoides* have been presented. This new record of *L. mahsenoides* from Indian Coast (Palk Bay and Gulf of Mannar) has bridged the Gulf in the distribution of this species, which has already been reported from South Africa on the one hand, and Australian waters on the other.

2665. **Tripathy, B and B.C. Choudhury** 2002. Recent occurrence of the Green Turtle *Chelonia mydas* on the Coast of Andhra Pradesh, India. *Mar. Turtle News Lett.,* 98: 3-4.

Address : Wildlife Institute of India, P.O. Box # 18, Chandrabani, Dehradun - 248 001, Uttaranchal, India; E-mail: tripathyb@yahoo.co.uk

Abstract : The green turtle, *Chelonia mydas*, has a fairly wide but scattered distribution in India. Nesting has been recorded in the Gulf of Kutchh, Gujarat, Maharastra coast in Sindhudurg and Ratnagiri district and Quilon coast of Kerala. In the Lakshadweep Islands of Arabian Sea, this species is fairly common. In the east coast of India, along the Bay of Bengal however, nesting green turtles have been recorded only in Gulf of Mannar, Tamil Nadu and Andaman & Nicobar Islands. Bhaskar (1984) based on his survey, reported green turtle as occurring close or in coral reef areas with rocky algal growth and sea grasses; these areas were considered to be the preferred foraging sites for this species.

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2666. **Udayaganesan, P., N. Angusamy and G. Victor Rajamanickam** 1998. Heavy mineral distribution and provenance of Vaippar basin sediments, south east coast of India. *Indian J. Mar. Sci.*, 27: 179-184.

Address : Department of Earth Science, Tamil University, Tanjore, Tamilnadu, India.

Abstract : Auger samples have been collected from 18 stations of Vaippar river, its tributaries and beach for heavy mineral distribution and provenance studies. The heavy mineral distribution varies from 3.14 to 27.31 % in the river sediments and 62.83% in the beach. While the absence of glaucophane characterise the upstream sediments, the abnormal increase of zircon, opaque, epidote, muscovite, topaz and tremolite signifies the beach. The upstream sediments are dominated by colourless garnet while the downstream sediments are enriched with pink garnet. The results of Q-mode factor analysis indicate the metamorphic and plutonic assemblages like granulites, gneisses and granites as source rocks for the Vaippar basin sediments. It also evidences the contribution from off-shore source to the Vaippar beach.

2667. **Udhaya Shankar, T.R.** 1986. Vegetation of Mandapam Region: A note on economic importance, *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp,* pp. 37-41.

Abstract : The vegetation of Mandapam region mainly comprises of zerophytes, the plants that are adapted to low water requirements and Mesophytes, the plants of habitats, which are neither extremely dry nor very wet, owing to low rainfall mostly limited between September and December during the Northeast monsoon. Apart from these plant communities, the littoral fringes of the coasts of Gulf of Mannar and Palk Bay support a varied number of halophytes or the plants of saline and marsh habitat The seas around Mandapam harbour a diversity of marine flora consisting of microalgae, Seaweeds and Seagrasses.

2668. **Umamaheswara Rao, M.** 1967. Seaweed Resources of India. *Souvenir 20th Anniversary CMFRI.* pp. 125-129.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Seaweeds yield valuable Phycocolloids like agar-agar and algin which are widely used in many industries. They are also utilized as food, fodder and fertilizer. Survey of natural seaweed resources and investigation of the chemical composition, methods of extraction, ecology, cultivation and other aspects related to their utilisation are therefore of utmost importance. Majority of the economic seaweeds come under three classes namely the Green algae (Chlorophyceae), the Brown algae (Phaeophyceae) and the Red algae (Rhodophyceae) and they are generally restricted to the relatively narrow littoral and sub-littorial belts of the marine environment.

2669. **Umamaheswara Rao, M.** 1968. Additions to the Algal Flora of the Gulf of Mannar and Palk Bay from Mandapam area. *J. Mar. Biol. Assoc. India,* 10(2): 366-369.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : As early as 1927, Prof. M. O. P. Iyengar gave a brief account of the flora of Krusadai Island and other collecting grounds in the Gulf of Mannar and Palk Bay areas near Mandapam. Later Boergesen (1937a, b; 1938) reported a large number of the algae occurring around Mandapam in his contributions on south Indian algal flora, but the green algae of this area were not included in this work. Since then, detailed attempts have not been made to study the algal flora of Mandapam, but for a provisional list of algae of Krusadai Island (Chacko *et. al.*, 1955) and this paper on a new species of *Halicystis* (Iyengar & Ramanathan, 1954). While working on some ecological aspects of marine algae of Mandapam, the author had the opportunity to collect algae in the different seasons of the year, in the vicinity of Mandapam (79°8' E, 9°17' N) and nearby places like Pudumadam and Keelakarai. Among the collections made since 1964 some plants have not been previously recorded from Mandapam area a list of these algae is given in this report with brief notes on their distribution.

2670. **Umamaheswara Rao, M.** 1968. On two new records of codiaceae from India. *J. Mar. Biol. Assoc. India,* 10(2): 407-409.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : During the course of studies on marine algae growing around Mandapam (79° 8' E., 9° 17' N.) the author collected two green algae of the family Codiaceae; namely *Udotea javensis* A.& E.S. Gepp and *Penicillus sibogae* A. & E. S. Gepp. As these two algae have not hitherto been recorded from the Indian coast, their occurrence is reported in this communication. *Udotea javensis* was collected from surfaces of dead corals in the sublittoral

zone near Pam ban and Krusadai Islands. *Penicillus sibogae* was first gathered near Pamban and subsequently several collections were made from Mandapam, Pudumadam and Shingle Island. It grows as small patches on sand covered rocks in the sublittoral fringe and sublittoral zones and sometimes specimens of *Penicillus sibogae* were found on dead coral pieces along with *Udotea javensis* as reported by Gepp and Gepp (1911). Brief descriptions of the Indian plants are given.

2671. **Umamaheswara Rao, M.** 1968. Seasonal variations in growth, alginic acid and mannitol contents of *Sargassum wightii* and *Turbinaria conoides* from the Gulf of Mannar, India. *Proc. Sixth Int. Seaweed Symp., Spain*, 9-13 September 1968. pp. 579-584.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Seasonal variations in growth, alginic acid and mannitol contents of *Sargassum wightii* and *Turbinaria conoides* growing in the Gulf of Mannar near Mandapam have been followed for a period of two and a half years from August 1965 to January 1968. Marked seasonal changes occur in the growth of these two brown algae with a slow growth in the population up to July or August and a rapid growth from October to December when reproductive receptacles were noticed in both the species. Results obtained on the alginic acid and mannitol contents indicate that these two carbohydrates vary with the seasonal growth behaviour of the two brown algae investigated. Yield of alginic acid is high during the peak growth and fruiting periods. Mannitol content is at its maximum in the early stages of the growth cycle from May to August and minimum after the initiation of the reproductive receptacles.

2672. **Umamaheswara Rao, M.** 1969. The agar and algin yielding Seaweeds of India. *Proc. 6th Int. Seaweed Symp., Spain*, 1968. pp. 715-721.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Agar and algin-yielding seaweeds form the basis of a small seaweed industry in India. Various investigations carried out to utlize the Indian agarophyte such as *Gelidiela acerosa*, *Gracilaria* spp., and algin – bearing seaweeds like species of *Sargassum* and *Turbinaria* are reviewed, together with some observations made by the author on these plants. Commercially valuable agar and algin-yielding plants occurring in many localities along the east and west coasts of India are described with special reference to their habitats and vertical zonation. Information on the seaweed resources available and the seaweed industry developed in the country is given.

2673. **Umamaheswara Rao, M.** 1970. The economic seaweeds of India. *CMFRI Bulletin*, 20: 1-68.

2674. **Umamaheswara Rao, M.** 1972. Coral reef flora of the Gulf of Mannar and Palk Bay. *Proc. Symp. Corals and Coral reefs, MBAI*, 217-230.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The flora of the coral reefs occurring in the Gulf of Mannar and Palk Bay areas around Mandapam was studied, selecting transects from shore to the fringing reefs. Marine algae and Sea Grasses growing on the transects were sampled at five-metere intervals and a total number of 1,850 samples was taken all along the 19 transects surveyed. Physical conditions of the transects and relative abundance of the algae and sea grasses are given, along with a list of macroscopic forms present in the quadrat samples. Distribution of the important and common algae like *Halimeda, Caulerpa, Ulva, Microdictyon, Padina, Pocockiella, Sargassum, Turbinaria, Gelidiella, Amphiroa, Gracillaria* etc., and sea grasses is described. Influence of the nature of substratum and other environmental conditions on the algal distribution are discussed.

2675. **Umamaheswara Rao, M.** 1972. Ecological observations on some intertidal algae of Mandapam coast. *Proc. Ind. Nat. Sci. Acad.* 38B: 298-307.

2676. **Umamaheswara Rao, M.** 1972. On the Gracilariaceae of the seas around India. *J. Mar. Biol. Assoc. India*, 14(2): 671-696.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Taxonomic investigations of members of the family Gracilariaceae of the seas around India are very limited and many of the *Gracilaria* species hitherto reported from this area are inadequately described. During the course of studies on the agar-yielding seaweeds, different species of *Gracilaria* and *Gracilariopsis* were collected from the east and west coasts of India, Lakshadives, Andaman and Nicobar Islands. In this paper

seventeen species and two varieties of *Gracilaria* and two species of *Gracilariopsis* are described in detail. The species of these two genera are as follows: *Gracilaria arcuata* v. *typica* Zanardini, *G. arcuata* v. *attenuata* var. nov., *G. cacalia* (J. Agardh) Dawson, *G. canaliculata* (Kuetzing) Sonder, *G. corticata* v. *typica* J. Agardh, *G. corticata* v. *cyliruirica var*. nov., *G. cylindrica* Boergesen, *G. disticha* J. Agardh, *G. edulis* (Ornelin) Silva, *G. foliifera* (Forsskal) Boergesen, *G. indica* sp.nov., *G. kanyakumariensis* sp. nov., *G. mannarensis* sp. nov., *G. millardetii.(Montagen)* J.Agardh, *G. obtusa* (Kuetzing) De Toni, *G. opuntia* (Svedelius) Durairatnam, *G. textorii* (Suringer) J. Agardh, *G. verricosa* (Hudson) Papenfuss, *Gracilaria* sp., *Gracilariopsis megaspora* Dawson and *G. sjoestedtii* (Kylin) Dawson. Of the 21 algae reported in this paper, three species and two varieties of *Gracilaria* are new taxa and *G. cylindrica, G. millardetii, G. opuntia* and *Gracilariopsis megaspora* are the first records from the Indian waters. Cystocarps of *G. canaliculata;* antheridia of *G. cortirata, G. folifera, G. canaliculata, G. obtusa, G. edulis, G. cylindrica, Gracilariopsis megaspora* and tetrasporangia of *G. megaspora* and other species were observed and these have been described here for the first time. Details regarding the habitats of the species and their distribution in India and other geographical areas are also included here.

2677. **Umamaheswara Rao, M.** 1973. Growth and reproduction in some species of *Gracilaria* and *Gracilariopsis* in the Palk Bay. *Indian J. Fish.*, 20(1): 182.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India.

Abstract : Growth and fruiting behaviour of the populations of *Gracilaria edulis, Gracilaria folifera* and *Gracilariopsis sjoestedtii* are described based on the field studies conducted from January 1969 to June 1971 in the Palk Bay near Rameswaram. Populations of these three agar-yielding red algae have been observed throughout the year with two half yearly growth cycles, one from October/November to April and the other from May/June to September. The rate of growth was found to vary in the growth cycles. Plants with reproductive structures occur in *Gracilaria edulis* and *Gracilaria folifera* in all months of the year and in *Gracilariopsis sjoestedtii* for a short period from November to March. Variations observed in the abundance of sexual, asexual and sterile plants and the abnormal features noticed in the reproductive behaviour of these three algae have been discussed.

2678. **Umamaheswara Rao, M.** 1973. Growth and Reproduction of *Gelidiella acerosa* in the Palk Bay and Gulf of Mannar near Mandapam. *Indian J. Fish*., 20(2): 411-416.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapm, India.

Abstract : Studies on Growth and Reproduction of *Gelidiella acerosa* growing in the Palk Bay near Rameswaram and in the Gulf of Mannar near Pudumadam, have been carried out for three years from 1968 to 1970. Results obtained show that the plants of *Gelidiella aceroso,* which occur throughout the year, attain maximum size in two seasons with a half yearly growth cycle and that the main growth season varies in the Palk Bay and Gulf of Mannar. The main growth season with peak number of large size fronds was found between December and April on the Palk Bay side and between July and August on the Gulf of Mannar side; The fruiting cycle of *Gelidiella acerosa* extends for a period of 1 to 9 months in a year and maximum number of tetrasporic plants occur in the population just after the two peak growth periods. Considering the local changes in growth behaviour, slow growth rate and the fruiting cycle, the period from December to April was found to be suitable for collecting *Gelidiella acerosa* in the Palk Bay and from July to August / September in the Gulf of Mannar.

2679. **Umamaheswara Rao, M.** 1973. The Seaweed potential of the seas around India. *Proc. Symp. Living Resources of seas around India*. pp. 687-692.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The present paper deals with the Indian seaweeds of economic value and the potential resources available in the inshore waters of the country. Results of the sample surveys carried out to estimate the standing crops of all marine plants growing in the Palk Bay area are given. Possibilities of cultivating the commercially valuable species in sheltered and calm areas of the coastline are indicated based on the culture experiments conducted with *Gracilaria lichenoides* and *G. corticata.*

2680. **Umamaheswara Rao, M.** 1974. Additions to the algal flora of the Gulf ofMannar and Palk Bay from Mandapam area. *Phykos*, 13:56-69.

2681. **Umamaheswara Rao, M.** 1974. Observations on fruiting cycle, spore output and germination of tetraspores of *Gelidiella acerosa* in the Gulf of Mannar. *Bot. Mar.*, 17(4): 204-207.

Address : Department of Botany, Andhra University, Waltair, Andhrapradesh, India.

Abstract : Results obtained for 1yr (from April 1972 to March 1973) on the fruiting cycle, spore output and germination of tetraspores of *G. acerosa*, growing in the intertidal region at Pudumadam, are presented. Minimum number of fertile plants were found during the 2 maximum growth periods and maximum number between April and June and Oct and Dec. Shedding of tetraspores was maximum between 2 and 6 PM in a day and liberation of spores was seen during the entire fruiting season with peak output in May and June and in Nov and Dec. Germination of tetraspores is of Gelidium-type and 3 modes of early development have been observed in the present study.

2682. **Umamaheswara Rao, M.** 1975. Studies on the Growth and Reproduction of *Gracilaria corticata* near Mandapam in the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 17(3): 646-652.

Address : Deparment of Botany, Andhra University, Waltair, Andhrapradesh, India.

Abstract : Studies on the growth and reproductive behaviour of *G. corticata* carried out at Mandapam and Pudumadam in the Gulf of Mannar, over a period of three years from 1968 to 1970 have been presented, along with some observations on the distribution and harvest of the crop. The growth of the species appears to be irregular and the peak growth occurs during June to August/September and December to February/March, Seasonal changes have not been observed in the abudance of reproductive plants, which occurred throughout the year. Tetrasporic plants are predominant in the populations examined at Mandapam and Pudumadam over the sexual plants. Harvesting experiment conducted at Pudumadam showed that the time of harvest and periodic collection of plants influence the rate of production and density of the alga in the natural habitats and that it is profitable to harvest *G. corticata* twice in a year, during June to August/September and December to February/March.

2683. **Umamaheswara Rao, M and N. Kaliaperumal** 1976. Some observations on the liberation and viability of oospores in *Sargassum wightii* (Greville) J. Agardh. *Indian J. Fish.*, 23(1&2): 232-235.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Some observations made on the output and viability of oospores in *S. wightii* are presented. Maximum output of healthy spores was observed for seven days in the laboratory experiments, without any periodicity in the liberation of oospores. Spore-shedding season extends for three months, from November to January, with the highest value in December. In viability experiments 47.6% of the spore lings have been found in healthy condition at the end of 60 days.

2684. **Umamaheswara Rao, M.** 1989. Indian seaweed resources and their management. *J. Mar. Biol. Assoc. India*, 31(1&2): 234-238.

Address : Department of Botany, Andhra University, Waltair- 530003, Andhrapradesh, India.

Abstract : During the last three decades detailed information was obtained on the occurrence of economically useful seaweeds on the Indian shores and their utilization as sources of phycocolloids, food, fodder and fertilizer. Many ecological and biological investigations have also been undertaken on agarophytes, alginophytes and other seaweeds to understand their growth and reproductive behaviour in the natural habitats. Systematic resources surveys were made in some maritime States and manufacturing of agar-agar and algin was started from the sources available in different parts of the country. The work done on Indian seaweeds is reviewed in this paper to get an idea of the present status of the seaweed industry and resources position in the country. From the data available on productive seaweed areas and harvesting seasons, steps to be taken for proper management and rational exploitation of the existing natural resources are suggested.

2685. **Umamaheswara Rao, M.** 2003. New species of *Gracilaria* (Gracilariaceae, Rhodophyta) from Indian shores. *Seaweed Res. Utiln.*, 25(1&2): 1-12.

Address : Department of Botany, Andhra University, Visakhapatnam - 530 003, Andhrapradesh, India.

Abstract : *Gracilaria stolonifera, G. idinthakaraiensis* and *Grostrata*, collected from three different localities of South India, are described as new species. The morphological, anatomical and reproductive features of these red algal members of the family Gracilariaceae are presented.

2686. **Umamaheswari, P and P. Daniel** 1999. *Leucas anandaraoana* (Lamiaceae) - A new species from southeastern India. *Kew Bulletin*, 54(4): 1003-1005.

Address : Botanical Survey of India, Coimbatore- 641003, Tamilnadu, India.

Abstract : *Leucas anandaraoana*, a new species allied to the *Leucas flaccida* Gulf of Mannar Biosphere Reserve in southeastern India, is described and illustrated.

2687. **Uma Maheswari, R.** 2001. Application of Remote Sensing and Geographical Information System in critical coastal habitat management - A case study in Gulf of Mannar. *Ph.D Thesis.* Anna University, Chennai.

Address : Institute of Ocean Management, Anna University, Chennai-600 025, Tamilnadu, India.

Abstract : Remote sensing, GIS and RDBMS along with field surveys have been used in developing the critical habitat information system for this region. The coral reef maps were prepared using IRS-IC, LISS III data with the help of ERDAS imagine a image processing software. The spatial data were organized using ARC/INFO, GIS software. The external database created using Oracle 8.0 is linked with the spatial database created in ARCVIEW 3.1, using Open Database Connectivity (ODBC) driver. The GIS-ID that indicates the sampling station with respect, to their lat/long position is used as the primary key to link external database with the spatial database. This resulted in the, creation of a critical habitat information system for the Gulf of Mannar. The summary of the results are: Critical habitat information system for Gulf of Mannar is developed as a scientific database; which can be used as a baseline for all future long term monitoring programs to be undertaken in this area. The islands are mapped with respect to the coral and sea grass ecosystem, which helps in studying the present status of the corals. The sea grass bed covers an area of about 85.71 km^2 and the coral reefs cover an area of about 99.31sq.km in the Gulf of Mannar area. The water quality such as pH (8.0 to 8.4), Temperature (27 to 30), DO (3.69 to 6.98 mg/l), Salinity (30.34 to 35.89 ppt), Nitrate (0.17 to 9.02 µM), Nitrite (0.03 to 0.27 µM), Total Phosphate (0.08 to 3.1 11M) and Inorganic Phosphate (0.08 to 8.6 µM) during the study. There is not much influence in the water quality parameters of Gulf of Mannar. In (1992) 12 species of seagrasses were recorded, (1996) around126 species of Phytoplankton, in 1998, 360 species of Zooplankton, 51 species of Protozoa in 1986, around 275 species of Porifera, in 1998 128 species of Cnidarians, 75 species of Annelida, 281 species of Arthropoda, 731 species of Mollusca, 264 species of Echinodermata, 5 species of Turtles, and 11 species of *Mammals* were recorded. In 1970 around 147 species of seaweeds, in 1974, 9 species of Nematoda, in 1987, 9.Mangrove and 7 Mangrove associated species. During present study around 78 species of Phytoplankton, 62 species of Zooplankton, 11 species of *Protozoa*, 17 species of Porifera, 49 species *of Cnidarians*, 19 species of Annelida, 2 species Plathyhelminthes, 9 species of Nematodes, 46 Arthropoda, 33 species Mollusca, 16 species of Echinodermata, 5 species of *Turtles*, 5 species of *Mammals*, 12 species sea grass, 147 species of seaweed 9 species of Mangroves and 7 Mangrove associated sp., were recorded. Both the past and present data were compared to study the present biodiversity of the study area. With the help of GIS it is possible to integrate the information derived from satellite data, the environmental parameter from field and analyze the environmental conditions that cause the degradation of critical habitat.

2688. **Ummerkutty, A.N.P.** 1960. Studies on Indan copepods, *J. Paralepeopsyllus mannarensis*, a new genus and species of cyclopoid copepod from the Gulf of Mannar. *J. Mar. Biol. Assoc. India*, 2(1): 105-114.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Mandapam, India.

Abstract : Thompson and Scott (1903) in their supplementary reports of the faunistic survey of the Pearl Oyster Fisheries of Ceylon reported on a number of copepods, many of which were new to science. Two of the new species, *typicus* and *ovalis*, both belonging to the genus *Lepeopsyllus*, which was also newly erected, were remarkable in their general resemblance to the members of the harpacticoid family Peltidiidae, especially in the shape of the body, in the posterior growth of the last prosomal segment and the complete overlapping of the urosome by the latter so that when viewed dorsally only the caudal rami are visible besides the prosomal region. A flattened oval or circular body as seen in *Lepeopsyllus* Thomp., and Scott is shared by many other cyclopoids and the prosomal segments may exhibit varying degrees of expanded growth posteriorly or laterally. But in all such instances the urosome is never fully covered over by the prosome. In *Lepeopsyllus*, however, the last prosoma1 segment grows over the urosome so that the latter is hidden by the former. Nevertheless a study of the various appendages of this copepod shows beyond doubt that it is a siphonostomous cyclopoid, very much related to dyspontiids, and understandably Thomspon and Scott placed this genus under Asterocheridae of Giesbrecht which in fact is included in the Siphonostoma by Sars (1918) wherein he groups together all those cyclopoids having a siphon in the oral region. Wilson (1932) included the genus *Lepeopsyllus* under the family Dyspontiidae Sars, and placed it very nearto *Dyspontius* Thorell and *Cryptopontius* Giesb. Nicholls (1944) follows Wilson and treats it in the same way. In his brief systematic review of the different genera that should be included in the family Dyspontiidae, he states that *Lepeopsyllus* Thomp. and Scott is recognisable as belonging to this family, with no further comments. In a latter part of this paper I have tried to draw attention to all the distinctive characters of this genus which distinguish it from a typical dyspontiid. The very close affinities that exist between *Lepeopsyllus* and the present form described below, and their distinctness from all other cyclopoids in certain important morphological features appear to suggest the creation of a new sub-family or family for their reception; this point is considered later *(vide infra).*

2689. **Ummerkutty, A.N.P.** 1960. Studies on Indian copepods 2. An account of the morphology and life history of a harpacticoid copepod, *Tisbintra jonesi* from the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 2(2): 149-164.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Tamilnadu, India.

Abstract : Sewell (1940) erected the genus *Tisbintra* to receive a single female copepod which he obtained during the John Murray Expedition in a surface tow-netting in the Nankauri Harbour, Nicobar Islands. To my knowledge no other species has so far been added to this genus and the genotype itself, *T. nankaurica* Sewell, has never again been recorded (Dr. Sewell has confirmed this in a personal communication). The discovery of a new representative of this genus with many morphological deviations is, therefore, of interest; especially so, because of the light it throws on the systematic position of the genus. Below is given an account of the morphology and life history of a new copepod obtained from the Gulf of Mannar and identified as a species of *Tisbintra* Sewell. The occurrence of this species was first observed by Dr. S. Jones and it was at his instance that a detailed examination was undertaken. I have, therefore, much pleasure in naming the species *T. jonesi.*

2690. **Ummerkutty, A.N.P.** 1960. Studies on Indian Copepods 3. *Nearchinotodelphys indicus,* a new genus and species of Archinotodelphyid copepod from Indian seas. *J. Mar. Biol. Assoc. India,* 2(2): 165-178.

Address : Central Marine Fisheries Research Station, Mandapam Camp, Tamilnadu, India.

Abstract : Hansen (1923) obtained from *Phallusia obliqua* (=*Ascidia obliqua*) an interesting species of copepod which he named *Cyclopina phallusiae.* Hansen himself was uncertain about the correct systematic position of this copepod, for a species of genus Cyclopina was never known to live within the ascidian. Lang (1949) suggesested the creation of a new family Archinotodelphyidae to receive *C. phallusiae* and a new species of copepod which he gathered from *Pyura georgiana* during the Swedish Antarctic Expedition. He placed the two species in monotypic genera, *Archinotodelphys* to contain his own new species and *Parar lotodelphys* to include *C. phallusiae.* This was a fitting arrangement in view of the important and far-fetching suggestions he had already made regarding the calcification of copepods (Lang, 1948). Lang (1955) discovered a second species of *Pararchinotodelphys* from the brain cavities of *Styela partita* caught off Marthas Vineyard, Massachussetts. He vided an excellent discussion regarding the systematic position of all the three species and that of *Pseudocyclopina belgicae* Giesbrecht which was considered as generic with *Cyclopina phallusiae* by Lindberg (1952). In fact Lang's account is new family and the two genera contained therein were very short and it was who enlarged our understanding of this group.

2691. **Ummerkutty, A.N.P.** 1960. Studies on Indian copepods. 4. Description of the female and a redescription of the male of *Pseudodiaptomus ardjuna* Brehm (Copepoda: Calanoida) with notes on the distribution and affinities of the species. *J. Mar. Biol. Assoc. India,* 2(2): 179-185.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The unknown female of a calanoid copepod *Pseudodiaptomus ardjuna* Brehm is described. A redescription of the male also is rendered as it is found that a few differences of structural details exist between male fifth leg of the present specimens and the male fifth leg described and sketched by Brehm (1953). The systematic kinship of the species is briefly considered. It is very close to *Pseudodiaptomus salinus* and *P. hickmani.* A note is also given on the distribution of the species in the light of our present knowledge.

2692. **Ummerkutty, A.N.P.** 1961. Studies on Indian copepods 5. On eleven new species of marine cyclopoid copepods from the South-east coast of India. *J. Mar. Biol. Assoc. India,* 3(1&2): 19-69.

Address : Central Marine Fisheries Research Institute,, Mandapam Camp, Tamilnadu, India.

Abstract : Eleven new species of cyc1opoid copepods, four belonging to the section Siphonostoma and the rest to the section Poecilostoma are described in detail. Six of the species are represented by both the female and the male sexes while others are known only from the females. The material of the present investigations was collected both from the Gulf of Mannar and the Palk Bay off Mandapam on the southeast coast of India during the months of May, June, July and August 1960. The collections were made in the inshore waters and the methods of collection are discussed. The composition of the cephalosomal appendages of the siphonostomatous cyclopoids is briefly considered. The present study shows that there are four pairs of oral appendages, the mandible, the maxillule, the maxilla and the maxilliped besides the preoral antennule and antenna on the cephalosome**.**

2693. **Ummerkutty, A.N.P.** 1964. Studies on Indian Copepods 6. The post embryonic development of two calanoid copepods. *Pseudodiaptomus aurivilli* cleve and *Labidocera bengalensis* Krishnaswamy. *J. Mar. Biol. Assoc. India,* 6(1): 48-60.

2694. **Ummerkutty, A.N.P.** 1965. Observation on the breeding and seasonal abundance of copepods of the Gulf of Mannar. *Proc. Symp. Crustaceana, MBAI, II* : 685-697.

2695. **Ummerkutty, A.N.P.** 1965. Observations on the breeding and seasonal abundance of ten species of planktonic copepods of the Gulf of Mannar. *Proc. Symp. Crustacea, MBAI.* 2(2): 685-697.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The quantitative biology of the following ten species of planktonic copepods is included in the present study. *Pseudodiaptomus aurivilli, Calanopia thompsoni, Acartia erythraea, Paracalanus aculeatus, P. parvus, Calanopia aurivilli, Acrocalanus, Euterpina acutifrons* and *Oithona rigida.* There have been three principal aims: (a) determination of the breeding seasons of different copepods; (b) estimation of quantitative seasonal distribution and (c) determination, if possible, of the number of broods in a year and the longevity of broods. The data obtained during the present studies on these subjects are presented, and compared with earlier works and points of interest are discussed. Based on the breeding habits, the planktonic copepods of the Gulf of Mannar are divided into three groups; those having a single, well-defined breeding season; those having more than one breeding season and those having irregular breeding periods. It may be added that this division is purely tentative for, it is hard to explain why organisms living under similar environmental conditions should have different breeding habits.

2696. **Ummerkutty, A.N.P.** 1966. Description of two species of cyclopods, *Pseudanthessius anormalus N.* sp. & *P. brevicauda N.* sp. *Proc. Symp. Crustacea, MBAI,* 1: 107-113.

2697. **Ummerkutty, A.N.P.** 1966. Studies on Indian copepods-16. On some rare and interesting copepods from South east coast of India. *J. Mar. Biol. Assoc. India,* 8(2): 302-319.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : During the period of a three year investigation at the Central Marine Fisheries Research Institute, Mandapam Camp on the copepod fauna of the surrounding Gulf of Mannar and Palk Bay, a total of one hundred and eighty two species of copepods were gathered and identified. Out of these, twenty three species were found to be new to science, and they have been described elsewhere (Ummerkutty, 1960, 1960a, 1960b, 1961, 1963, 1966, 1966a, 1966b). In the present communication brief notes are given on some rare and interesting copepods.

2698. **Ummerkutty, A.N.P.** 1967. Studies on Indian copepods 8. Observations on the diurnal vertical movements of planktonic copepods in the Gulf of Mannar. *J. Bomb. Nat. Hist. Soc.*, 63(2): 332-343.

2699. **UNDP/FAO.** 1974. Plankton, fish eggs and larvae studies. *UNDP/FAO Pelagic Fishery Project Progress Report,* 7: 21.

2700. **UNDP/FAO.** 1975. Young fish studies. *UNDP/FAO Pelagic Fishery Project Progress Report,* 10: 14.

2701. **UNDP/FAO.** 1976. Survey Results. *UNDP/FAO Pelagic Fishery Project Progress Report,* 13: 30.

2702. **Unnithan, K.A.** 1976. Four new records of Prosobranch gastropods from Mandapam. *Indian J. Fish.*, 23(1&2): 279-282.

2703. **Unnithan, K.A.** 1982. Observations on the biology of cuttlefish *Sepiella inermis* at Mandapam. *Indian J. Fish.*, 29(1&2): 101-111.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Sepiella inermis* was found to grow to a size of 50 mm at the end of first year and 80 mm of mantle length at the end of second year. The size at first sexual maturity is 50 mm for males and 31 mm for females. Prawns were the main item of food of the species.

2704. **Upreti, A and T. Shamugaraj** 1997. *Gulf of Mannar Marine Biosphere Reserve.* Tamilnadu Forest Department, Tamilnadu, 47 pp.

Address : Wildlife Warden Office, Gulf of Mannar Marine National Park, Ramanathapuram - 623 503, Tamilnadu, India.

Abstract : Gulf of Mannar Marine Biosphere Reserve lies between India and Sri Lanka covering an area about 10,500 km^2. It runs along the mainland (India) coast for about 117 nautical miles and includes about 21 islands in the Indian part on the Gulf.

2705. **Usha, K and S.P. Subramanian** 1989. Analysis of waves and beach behaviour of Kanyakumari coast. III *Natl. Conf. Dock and Harbour Engg.,* 6-9, *Dec, 1989.* pp. 561-568.

Address : Indian Institute of Technology, Ocean Engineering Centre, Madras - 600 036, Tamilnadu. India.

Abstract : From the visually observed wave data, wave characteristics of a coast such as wave height and wave period can be obtained with some limitations. A stretch of coast near Kanyakumari, India, was selected for analysis. The seabed of the coast consists of calcareous sand and beach sediment is dominantly sandy in nature and clay fraction is present only in traces. Data from 1979-88 were taken for the study. The probability density function and cumulative probability density function for wave height and wave period were obtained. From the two dimensional diagrams, most frequency occurring wave height and wave period ranges were derived. Berm oscillation and the mean rate of change of berm oscillation over the decade were also obtained.

2706. **Usha, T., T. Shanmugaraj, S. Sundaramoorthy and B.R. Subramanian** 2000. Critical habitat information system using relational-hybrid GIS, Gulf of Mannar - A case study. ***In***: *Marine Remote Sensing Applications.* (*ed.*) S. Ramachandran, Institute for Ocean Management, Anna University, Chennai. pp. 358-372.

Address : ICMAM Project Directorate, NIOT Campus, Chennai, Tamilnadu, India.

2707. **Usha, T., S. Sundaramoorthy, T. Shanmugaraj, G.V.M. Gupta and R.S. Kankara** 2003. Application of GIS in management of coastal critical habitat. *Proc. COT'03, International Conference on Coastal and Ocean Technology*, pp.15-24.

Address : ICMAM Project Directorate, NIOT Campus, Chennai, Tamilnadu, India.

Abstract: Effective monitoring and management of coastal critical habitats require data and information for making timely and appropriate decisions on the problems at hand and to understand the spatial relationships that exist therein. GIS, along with remote sensing is being increasingly used for resources management and to improve the land use. Spatial and non-spatial data on various aspects such as land use, soils, geology, hydrology, topography, etc., need to be analyzed for management decisions. Satellite remote sensing provides a convenient means for deriving such data. Integration of GIS and RS technologies thereby provide an efficient way for resource management. India's long coastline is dotted with critical habitats, which are sensitive and fragile ecosystems such as mangroves and coral reefs. These critical habitats are under threat due to both natural and anthropogenic activities and this paper discusses the applications of GIS and remote sensing in the management of these critical habitats.

2708. **Uusitalo, J.** 1987. Commercial seaweed collection and agar/alginate industries in Tamil Nadu, India. Seaweed cultivation as a solution to overexploitation of a natural resource? Report from a minor field study in November-December 1986. *Fish. Dev. Ser. Natl. Swed. Board Fish.* 23 : 1-61.

Address : National Swedish Board of Fisheries, Goeteborg, Sweden.

Abstract : A preliminary survey was conducted to study the economical and social feasibility of seaweed cultivation in Ramnad district, Tamil Nadu, India. During this survey, fishing villages engaged in seaweed collection, agar and alginate factories, and experimental sites were visited. The bulk of commercially harvested seaweeds in India are collected along the coast of the Gulf of Mannar and is one of the main sources of income in the concerned villages. In the Hindu villages it also gives the women one of their few cash incomes. The present situation and possible future development of the fishing societies is discussed. The internal Indian demand for agar exceeds supply, due to lack of sufficient quality and quantity of seaweeds. Four seaweeds that are commercially collected in India; *Gracilaria edulis*, *Gelidiella acerosa*, *Sargassum wightii* and *Turbinaria* spp. Different methods of seaweed cultivation are discussed from biological, technical, economical and sociological aspects. The economical feasibility of a "longline" method is discussed, as well as different methods to enhance the productivity of the cultivation.

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2709. **Vaidyanadhan, R and R.N. Ghosh** 1993. Quaternary of the east coast of India. *Curr. Sci.,* 64(11&12): 804-815.

Address : Geological Society of India, Bangalore - 560 019, Karnataka, India.

Abstract : The East Coast plain of India is made up predominantly of deltaic sediments of Kaveri, Pennar, Krishna, Godavari, Mahanadi-Brahmani-Baitarani, Subarnarekha and Hooghly (Ganga) rivers, besides aeolian and marine patches. The configuration of coastline in the Hooghly delta front is conspicuously different from those of others. The eastern coastline of the Peninsular India originated in the post-Cretaceous times though it was modified considerably during the Quaternary due to progradation of deltas and impacts of glaciation and deglaciation. The Quaternary sediments comprise laterites and unconsolidated gravel, sand, silt and clay, with occasional horizons of caliche. Numerous surfaces have been recognized and mapped, most of them being depositional. Correlation has been attempted particularly among surfaces in Ganga (Hooghly) and Mahanadi deltas. Preliminary dating of samples (^{14}C, TL, ESR) collected from different horizons from Kanyakumari in the south to Calcutta in the Northeast invariably indicates Holocene age, though some dates point to Upper Pleistocene.

2710. **Vaithyanathan, C and V.U. Bhagan** 2003. Seasonal variations in the chemical parameters of salt in various salt-pans of Kanyakumari district. *Asian J. Chem*., 15(3&4): 1405-1410.

Address : Department of Chemistry, S.T. Hindu College, Nagercoil-629 002, Tamilnadu, India.

Abstract : The seasonal variations in the chemical parameters of the salt samples collected from various salt-pans of Kanyakumari district were studied. Parameters like the percentage of moisture, insoluble impurities, calcium sulphate, magnesium sulphate, magnesium chloride and sodium chloride were analyzed. Variations in the different samples were observed and it was due to the atmospheric climate and strong dusty winds.

2711. **Valsan, A.P.** 1955. Alginic acid content of some of the common seaweeds of the Gulf of Mannar area. *Curr. Sci.,* 24: 343.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India..

Abstract : Of the many commercially valuable products obtained from seaweeds, alginic acid (polymer of d-mannuronic acid) and salt have come to occupy a very important place. As in many other fields, the exploitation of the marine resources in India is still in its rudimentary stage and very little is known about the alginic acid content of the seaweeds of Indian waters except for the work done on *Sargassum* of Cape Comorin.

2712. **Vanitha, J., S. Prakash, B.V. Bhimba and S. Lazarus** 2003. Antibacterial action of seaweeds against human upper respiratory tract pathogens. *Seaweed Res. Utiln.,* 25(1&2): 181-187.

Address : Microbiology Laboratory, Institute for Coastal Area Studies, Manonmaniam Sundaranar University, Rajakamangalam - 629502, Kanyakumari District, Tamil Nadu, India.

Abstract : Seaweed extracts were studied for their antibacterial activity against human upper respiratory tract (URT) bacterial pathogens. The upper respiratory tract bacterial pathogens were isolated from 50 infected patients both male and female. The isolated bacterial species were Gram positive and Gram negative such as *Staphylococcus aureus, Enterobacter aerogenes, Streptococcus pyogens, Klebsiella pneumoniae, K. ozaneae, Morganella morganii* and *Proteus myxofaciens* of which Gram positive *Staphylococcus aureus* and *Enterobacter aerogenes* contributed the maximum percentage of incidence towards upper respiratory infections among 50 patients. Bioassay was carried over with 45 extracts of 9 algae namely *Sargassum wightii, Chaetomorpha antennina, Ulva fasciata, Colpomenia sinuosa, H. floresia, Amphiroa fragilissima, Spatoglossum* sp. *Gracilaria edulis* and *Enteromorpha* sp. Among the 45 extracts, *H. floresia* crude was found to produce maximum growth inhibition against Gram positive and Gram-negative bacteria. Five solvents were used for the extraction of antimicrobials of which butanol showed maximum extraction of antimicrobials. Among the bacterial isolates *Enterobacter aerogenes* was highly inhibited by the seaweed extracts. Highly active *H. floresia* alga was subjected to Soxhlet to extract the antimicrobials using butanol, which showed high extraction in the primary studies.

2713. **Vanmathi, G and S. Gopalakrishnan** 2000. Heavy Metals in Tuticorin Coast. *Indian J. Environ. Prot.*, 20(6): 447-451.

Address : Manonmaniam Sundaranar University, Department of Chemistry, Tirunelveli - 627 012, Tamilnadu, India.

Abstract : The levels of heavy metals (Mn, Pb, Cr, Cd, Hg and Zn) in seawater and sediments of four different

coastal biotopes in Tuticorin have been studied for a period of two years (March 1994-March 1996). Their accumulation index in sediments has been calculated to find out the impact of pollutants from various sources along this coast. All the stations under study showed signs of accumulation of Zn, Cd, Cr and Hg. These metals showed enrichment in the order Cd>Zn>Cr>Hg. A positive correlation between sedimentary heavy metals and sedimentary organic carbon has been observed.

2714. **Varadarajan, S.** 1939. Discovery of a species of Coeloplana commensal on the star fish *Pentaceros hedemanni* in the sea off Krusadai Island, Gulf of Mannar. *Curr. Sci.,* 8(7): 3-6.

2715. **Varadarajan, S and P.I. Chacko** 1943. On the arrow worms of Krusadai. *Proc. Nat. Inst. Sci.India,* 9:245-248.

2716. **Vasanthakumar, J.** 1988. Adoption behaviour of traditional fishermen of Chidambaranar District, Tamil Nadu, India. *Proc. Indian Fisheries Forum, Mangalore (India), 4 Dec 1987.* pp. 459-461.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamil Nadu, India.

Abstract : Information seeking behaviour of traditional fishermen, extent of adoption of improved technology and problems limiting adoption of technology by traditional fishermen were studied from a sample of sixty fishermen with reference to 1986-87. Private dealers formed more important sources of information than fisheries development organisations and mass media. The respondents were aware of all innovation reference except copper chrome arsenic compound and creosote. 100% adoption was noticed only in the use of cheaper wood material and synthetic net material. Reasons for non-adoption of other innovations by some respondents were identified and reasons for conflicts between artisanal and mechanised fishing groups were discussed.

2717. **Vasanthakumar, J., V. Sundararaj, N. Sukumaran and P. Selvaraj** 1988. Research and development in marine fisheries extension. *CMFRI Spec. Publ.,* 40: 76.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamil Nadu, India.

Abstract : Improvement in the standard of living of fishing households and fishing labour households and optimal utilisation of fishery resources for employment, production and export are the important goals of marine fisheries extension service. The present strategies of fisheries extension service in Tamil Nadu are analysed identifying the pitfalls and listing suggestions for improving the efficiency of fisheries extension work in the state. The extension teaching methods used for individual contact, group contact and mass contact, the subject-matter fields covered in extension teaching with their relative importance, the characteristics and extension personnel, research support provided, co-ordination among the various agencies involved and participation of the clientele and their organisations are discussed.

2718. **Vasudeva, K.** 1990. Gracilaria resources of India with particular reference to the Bay of Bengal. *Gracilaria production and utilization in the Bay of Bengal. Seminar papers: Session II small-scale Agarophyte processing. pp 97-98.*

Address : Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat, India.

Abstract : Thirty one species of *Gracilaria* are found on the Indian coastline of the Bay of Bengal. The estimated biomass of *Gracilaria* from Indian waters is 1,700 tons. Studies on the cultivation and harvesting of *Gracilaria edulis* have shown that an interval of about six months between harvests will ensure continued good growth of the crop.

2719. **Vasuki, S., M. Ganesan, P.V. Subba Rao and O.P. Mairh** 1999. Seasonal growth and reproduction of marine red alga *Asparagopsis delilei* (Rhodophyta/ Bonnemaisoniales) from the Mandapam region, southeast coast of India. *Indian J. Mar. Sci.,* 28(1): 60-65.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp-623 519, Tamilnadu, India.

Abstract : *Asparagopsis delilei* Montagne occurs beyond 2.5 m depth on the coral reef adjoining the Islands-Krusadai, Putty and Valai in the Gulf of Mannar region, southeast coast of India. Seasonal growth and carpospore liberation in this alga were studied from three Islands. Maximum growth (length and fresh wt) was found during November-March. Maximum number of carpospores 22300, 11917 and 5037 per g fresh weight was recorded for the plants of Krusadai, Putty and Valai Island respectively. A positive correlation was observed between length and fresh weight of the plants, whereas a negative correlation was found between Number of cysticarps and carpospores shed per cystocarp, fresh weight of the plant and carpospores shed per g fresh weight. Diurnal

periodicity in carpospore shedding was also seen for four months during the peak growth period from August 1994 to January 1995.

2720. **Vasuki, S., M. Ganesan and P.V. Subba Rao** 2000. Effect of plant growth regulators on growth of the marine brown alga *Padina boergeseni* Allender and Kraft. *Phykos*, 39(1&2): 107-111.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp-623 519, Tamilnadu, India.

2721. **Vasuki, S., M. Ganesan, P.V. Subba Rao and O.P. Mairh** 2000. Seasonal variation in the growth of marine red alga *Asparagopsis delilei* (Rhodophyta/Bonnemaisoniales) from the Mandapam region, southeast coast of India. *Indian J. Mar. Sci*., 29(1): 61-64.

Address : Marine Algal Research Station, Central Salt and Marine Chemicals Research Institute, Mandapam Camp-623 519, Tamilnadu, India.

Abstract : The growth of *Asparagopsis delilei* and other seaweeds have been described from Putty and Valai Islands of Mandapam region from August 1993 to March 1995. At both the Islands, plants started appearing on the reef from August, attained maximum growth during November - March and subsequently disappeared gradually from the reef. Antheridial and cystocarpic plants and tetrasporic phase (Falkenbergia) of *Asparagopsis delilei* were recognised. A positive correlation was observed between length and fresh weight, whereas, negative correlation was observed between algal biomass and the environmental parameters such as salinity and temperature of seawater. Thirty two taxa were found in association with *A. delilei* at both the Islands. Of these, *Sargassum wightii* and *Chondrococcus hornemanii* were occurring throughout the study period. The results indicated good biomass of *A. delilei* can be harvested from these Islands during its peak growth period December and January to meet our iodine requirements partially.

2722. **Vedavyasa Rao, P., M.M. Thomas and G. Sudhakar Rao** 1973. The Crab fishery resources of India. *Proc. Symp. Living Resources of seas around India.* pp. 581-591.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstraact : Crabs support a sustenance fishery of appreciable importance, although, its present status is not comparable with that of those major crustacean fisheries such as prawns and lobsters. In addition to the marine fishery, large numbers of crabs are landed from the estuaries and brackish water lakes adjoining the coastal areas. To meet the increasing demand for frozen crab meat and to develop an organized crab fishing industry, an evaluation of the existing resources is quite essential. The fishery at present is supported mostly by the edible crabs belonging to the family Portunidae and available information on the various aspects of the fishery show that the fishing is restricted to the inshore areas mostly by operations of small indigenous crafts and gears. In most of the places crabs form an ancillary catch along with other crustaceans and fishes, intensive fishing for crabs alone existing only in selected areas. The annual catch which is less than 4,000 tons is subject to marked fluctuations. However, the distribution of the species and the trend in production indicate scope for further expansion. An attempt is made here to study the abundance and production of crabs from three general areas *viz.*, west coast of India, Gu1f of Mannar and Palk Bay and the northern part of the east coast from Point Calimere to Sunderbans with a view to understand the crab resources of the country. The estimation of the potential resources of the offshore waters as indicated by the trawler catches is also made. The need for biological investigations on factors governing yield and crab population is stressed.

2723. **Vedavyasa Rao, P.** 1978. Maturation and Spawning of cultivable marine penaeid prawns. *CMFRI Spl. Publ.*, 3: 57-67.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An understanding of the reproductive biology of species selected for culture is an essential pre-requisite for their successful farming or culture. The subject assumes further importance in the context of intensive culture involving establishment of hatcheries for selective breeding under controlled conditions and largescale production of seed of desired species. Salient features of the reproductive activities of the marine penaeid prawns, particularly of Indian penaeids which are important from the point of view of culture, are briefly summarized in this background paper.

2724. **Vedavyasa Rao, P.** 1986. A review of the present status of the prawn fishery of India, pp. 367-404. ***In***: *Recent advances in marine biology,* (*ed.*) P.S.B.R. James, Today and Tomorrow's New Delhi, 1986: 591 pp.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

2725. **Vedavyasa Rao, P and S.C. Soni.** 1993. Pathological investigations in penaeid prawns. *CMFRI Spl. Publ.*, 56: 9-14.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

2726. **Vedavyasa Rao, P., N. Neelakanta Pillai, E.V. Radhakrishnan, P.E. Sampson Manickam, G. Maheswarudu, M.R. Arpudharaj and K.N. Gopalakrishnan** 1993. Sea ranching of Prawn. *Mar. Fish. Infor. Serv. T & E Ser.*, 124: 2-5.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Sea ranching of prawns is an idea conceived by Japanese. In Japan, the Kuruma Shrimp *(Penaeus japonicus)* culture techniques are highly developed and the average annual production through farming was about 1800 tons in the early eighties. As the demand for this species was ever increasing and they have only limited culture grounds, they thought of increasing the natural production of this species by releasing large number of hatchery and nursery raised post larvae/juveniles into the natural environment which in turn will grow and ultimately get recruited in the commercial catches.

2727. **Veeraswamy, K and T. Harinarayana** 2005. Electrical signatures due to thermal anamolies along mobile belts reactivated by the trail and outburst of mantle plume: Evidences from the Indian subcontinent. *J. Appl. Geophy.*, 58(4): 313-320.

Address : National Geopysical Research Institute, Hyderabad-500 007, Andhrapradesh, India.

Abstract : In this study the geodynamical scenario along with concepts of mantle plume and mobile belts is utilized to show that most of the existing and potential high thermal regions fall along the (mobile arms affected by the outburst and) traces of mantle plumes. Effects of channeling and partitioning of thermomagmatic flux (TMF) due to these mantle plumes along the mobile belts, particularly near the triple junctions, can be seen in the form of high heat flow and presence of hot springs. Triple junctions manifest over the Indian lithosphere are: KutchCambay, Narmada Son-Godavari, Tapi-Mahanadi, Tapi-Damodar, Pondicherry region, Gulf of Mannar and SW corner of the subcontinent (off-shore), etc. Apart from mobile belts, the deltaic regions of Krishna, Godavari, Ganga, Cauvery, Narmada-Tapi and Indus, etc., also posses higher level of thermal anomalies as these regions seem to have been substantially influenced by outbursts and traces of Reunion, Kerguelen, Marion and Crozet hotspots. This is reflected from the correlation between plume affected mobile belts and high heat flow regions, large number of hot springs, anomalous electrical conductivity and also deformation or seismicity. Such correlation can be seen along Cambay, west coast trend, Narmada-Son lineament zone, Godavari-Damodar grabens and Bengal basin.

2728. **Velankar, N.K.** 1955. Bacteria in the inshore environment at Mandapam. *Indian J. Fish.*, 2(1): 96-112.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The quantitative distribution of bacteria in the sea-water, in association with plankton, and in the bottom muds of the Palk Bay and the Gulf of Mannar at Mandapam, at a distance of two miles from the shore was investigated during a four year period (1950-53). Bacteria were present in the sea water to the extent of a few hundreds per ml., determined by plate counts on sea-water agar; they were more numerous in the water from the surface than from near the bottom. Bacteria were present associated with plankton in large numbers, ranging from a few thousands to over 500,000 per ml of plankton, and appear to be influenced numerically by the nature of the plankton. Plate counts of the mud ranged from a few thousands to over a million per g (wet basis). Anaerobic counts were often less than the aerobic counts. Numerical changes in the sea-water bacterial population showed trends which are probably seasonal. The presence of nitrifying, denitrifying, nitrogen fixing, agar digesting and sulphate reducing bacteria in the seawater and/or mud is reported. Gram negative non-sporing motile rods predominated in the bacterial flora. The normally occurring heterotrophic bacterial flora of the environment is briefly described.

2729. **Velankar, N.K.** 1956. The bacterial flora, Trimethylamine and total volatile nitrogen of fish muscle at 3°C. *Indian J. Fish.*, 3(1&2): 261-268.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Observations on the changes occurring in the bacterial flora and the tri-methylamine and total volatile nitrogen content of fish muscle at 3°C, were reported. The results of similar studies are presented in this paper and the bacterial flora, isolated during these investigations, is described.

2730. **Velankar, N.K and P.V. Kamasastri** 1956. The bacterial flora, trimethylamine and total volatile nitrogen of fish muscle at 0°C (in ice). *Indian J. Fish.,* 3(1&2): 269-289.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Observations on the changes occurring in the bacterial flora and the tri-methylamine and total volatile nitrogen content of fish muscle at 3°C, were reported previously. The results of similar studies on fish kept in ice storage are presented in this paper and the bacterial flora, isolated during these investigations, is described.

2731. **Velankar, N.K.** 1957. Bacteria isolated from seawater and marine mud off Mandapam (Gulf of Mannar and Palk Bay). *Indian J. Fish.,* 4(1&2): 208-227.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Bacteria of the Indian coastal waters have not been studied so far. A study of these bacteria and their comparison with the marine bacteria recorded in other regions would be interesting, particularly from a consideration of the temperature differences. Moreover, a knowledge of these bacteria is necessary in the processing and presentation of fish, since fish spoilage flora is derived largely from the bacterial flora associated with the living fish (on the slime, gills and in the gut) and hence has a marine origin.

2732. **Velankar, N.K and P.V. Kamasastri** 1958. Experimental preservation of fish in Aureomycin ice. *Indian J. Fish.,* 5(1&2): 150-159.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The effect of implying ice containing 5ppm of aureomycin as compared with ice containing no aureomycin, on the trimethylamine and total volatile nitrogen content as well as the bacterial population of the muscle of fish kept in ice was examined in a series of experiments in this laboratory. The increase in the capacity of the muscle to combine with iodine which has been recently suggested as a useful index of spoilage (Truttwin, 1954) was also followed. These investigations were essentially exploratory and hence relate to different species offish and different tests for freshness. The observations are reported and discussed in this paper.

2733. **Velankar, N.K.** 1960. Bacteria associated with prawns preserved in ice. *Proc. Indian Sci. Congr. 47th Sess.,* 44: 479.

2734. **Velappan Nair, R.** 1948. Leptocephali of the Gulf of Mannar. *Proc. Indian Acad. Sci.,* 27B, 87-91.

2735. **Velappan Nair, R and B.S. Bhimachar** 1950. On some eel eggs and larvae from the Gulf of Mannar. *Proc. Ind. Acad. Sci.,* 31B: 331-338.

2736. **Velappan Nair, R and R. Soundararajan** 1973. On the occurrence of the deep sea sting-ray, *Urotrygon daviesi* Wallace in Indian waters. *Indian J. Fish.,* 20(1): 245-249.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The deep sea sting-ray, *U. daviesi*, caught off Mandapam in the Gulf of Mannar, is recorded for the first time from the Indian waters. A detailed description of the fish, based on a young female, 534 mm in length is given.

2737. **Velappan Nair, R and R.S. Lal Mohan** 1973. On a new deep sea skate, *Rhinobatos variegatus*, with notes on the deep sea sharks *Halaelurus hispidus, Eridacnis radcliffei* and *Eugaleus omanensis* from the Gulf of Mannar. *Senckenbergiana Biol.,* 54(1&3) : 71-80.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : *Rhinobatos variegates* a new species is described and illustrated from the Gulf of Mannar (200 fathoms). It is distinguished by a relatively longer snout than any known species, brown bands on the snout, pale blue markings over pectoral and pelvic fins and a number of biometric data. New finds of *H. hispidus, Eridacnis radcliffei* and *E. omanensis* are recorded, (*E. omanensis* has not been recorded since its original description.) All are redescribed and illustrated with special attention to juvenile characters in *H. hispidus*. *Eridacnis alcocki* (Misra) is synonymised with *Eridacnis radcliffei* Smith.

2738. **Velappan Nair, R and R. Soundararajan** 1973. On an instance of hermaphroditism in the electric ray, *Narcine timlei* (Bloch & Schneider). *Indian J. Fish.,* 20(1): 260-264.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A specimen of the electric ray, *Narcine timlei*, collected from the trawl catches at Rameswaram on 12th November 1971, was found to be a hermaphrodite. The specimen measured 402 mm in total length. The important features of the male and female reproductive systems are described.

2739. **Velappan Nair, R., R. Soundararajan and K. Dorairaj** 1973. On the occurrence of *Panulirus longipes, Panulirus penicillatus* and *Panulirus polyphagus* in the Gulf of Mannar with notes on the lobster fishery around Mandapam. *Indian J. Fish.,* 20(2): 333-350.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The occurrence of *Panulirus longipes longipes* (A. Milne Edwards), *P. penicillatus* (Olivier) and *P. polyphagus* (Herbst) on the south-east coast of India in the Gulf of Mannar is reported for the first time. Detailed descriptions of these species are given together with their synonyms, distribution, habitat and sexual dimorphism. The main taxonomic characters of *P. longipes longipes* are the presence of well developed exopod with a flageIlum in the second and third maxillipeds, two principal spines on the antennular plate, a transverse groove which may or many not be interrupted in the middle on all the abdominal somites, transverse grooves of abdominal somites IT-V joining the corresponding pleural grooves, pleopods of second abdominal somite of male without endopod, posterior margin of thoracic sternum with two sub-median teeth and the colour pattern of the walking legs with bright white spots; of *P. penicillatus* are the presence of four principal spines on the antennular plate which are united at the base, exopod without a flagellum in the third maxilliped and uninterrupted transverse groove with anterior margin non-crenulate and without setae on all the abdominal somites; and of *P. polyphagus* are the presence of two principal spines on the antennular plate, exopod of the second maxilliped with many jointed flagellum, all abdominal somites without transverse groove and the hind margin of each abdominal segment with a brown transverse band and a thin creamy white line running through it. Variations met with in some characters are pointed out. The lobsters are fished with bottom-set nylon nets over the coral reefs. The fishing season extends from October to May.

2740. **Velappan Nair, R and K.K. Appukuttan** 1973. Observation on the food of deep sea sharks. *Halaelurus hispidus, Eridacnis radcliffei* and *Iago omanensis* Compagno and Springer. *Indian J. Fish.,* 20(2): 575-583.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The food and feeding habits of three deep sea sharks *Halaelurus hispidus, Eridacnis radcliffei* and *Iago omanensis* were studied based on the specimens obtained from trawl catches off Mandapam, Gulf of Mannar at a depth ranging from 150 to 200 fathoms. The percentage of volume and occurrence of each item of food was found separately to determine the importance and abundance of the various food items in the diet of these sharks. They were found to be carnivorous, feeding chiefly on fishes, crustaceans and squids. Squids were conspicuously absent in the food of juveniles. An interesting phenomenon of segregation by sex was noticed in *H. hispidus* and *E. radcliffei* with the males dominating the catches.

2741. **Velappan Nair, R.** 1973. On the export potential of elvers and cultured eels from India. *Indian J. Fish.,* 20(2): 610-616.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

2742. **Velappan Nair, R and K. Satyanarayana Rao** 1974. The commercial molluscs of India. *CMFRI Bulletin,* 25:170 p.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : This bulletin deals with the resources of mussels, oysters, clams, edible gastropods, cephalopods, pearl oysters, ecology of pearl oyster, chank beds, chank fisheries, industrial uses of chanks and other commercial molluscs of India.

2743. **Velappan Nair, R., R.S. Lal Mohan and K.S. Rao** 1974. The Dugong, *Dugong dugon. CMFRI Bulletin,* 26:1-38.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The dugong, *Dugong dugon* (Muller), which is found in the coastal waters in several parts of the Indo- Pacific region, occurs in India in the Palk Bay, the Gulf of Mannar and in the Saurashtra waters and has been exploited for its flesh for several centuries. Apart from its economic importance, the dugong, also called the sea cow, is a very interesting marine herbivore with features like muzzle, horny plates on jaws, massive

bones and hair on the body. It is probable that the resemblance of dugongs to human beings when seen at a distance and the female dugong suckling the young one by holding it with a flipper might have given rise to the numerous stories of mermaids told by sailors especially in medieval times. In recent years there has been a marked decline in the dugong population in most areas of distribution. At present dugongs are found in good numbers only in the Australian region around Queensland, Northern territory and Western Australia. The number of dugongs captured annually in Palk Bay and Gulf of Mannar in recent years has decreased considerably as compared with the early part of this century. Undoubtedly there is great need for protecting the dugong from indiscriminate exploitation since it is a rare animal. For proper and effective conservation and management of the dugong populations adequate information on the distribution, habits, biology and the present level of exploitation is necessary. The taxonomy, morphology, distribution and natural history of dugong have been studied. Dugongs are being reared for the past fifteen years at the Regional Centre of the Central Marine Fisheries Research Institute at Mandapam Camp, which is the only place in the World where they are held in captivity, and aspects like habits, growth, food and parasites have been investigated. In this Bulletin the available information on the dugong is presented comprehensively so that it will stimulate further research work on this very interesting rare marine mammal.

2744. **Velappan Nair, R., P. Bensam and R. Marichamy** 1974. Possibilities of marine fish culture in the salt-pan areas at Tuticorin. *Indian J. Fish.*, 21(1): 120-126.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The paper gives an account of the environmental conditions and the aquatic biota in the salt-pan areas at Veppalodai, north of Tuticorin. Cultivable fishes such as *Chanos chanos*, *Mugil cephalus*, the crab, *Scylla serrata* and the prawn, *Penaeus indicus* have been observed to thrive well. A seasonal fishery for *C. chanos* with an average annual yield of 4,000 kg is existing at present under conditions when no controls are exercised for the normal growth and survival of the naturally recruited stock which is open to the attack of predatory birds, crabs and snakes. It is felt that the possibilities of culturing such species as *C. chanos* are good under controlled conditions and safety from predators.

2745. **Velappan Nair, R and K.K. Appukuttan** 1974. Observations on the developmental stages of the smooth dogfish, *Eridacnis radcliffei* Smith from Gulf of Mannar. *Indian J Fish.*, 21(1): 141-151.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : The structure of mature reproductive organs of 15 adult female of E.radcliffei, ranging in total length from 150 to 218 mm collected from the trawl catches off Mandapam in Gulf of Mannar during Feb, 1972 at a depth ranging from 100 to 150 fathoms were studied and the various stages of intra-uterine embryos are described and discussed. A close examination of different stages of embryos revealed that this species exhibits ovoviviparous type of development. The intra-uterine egg is enclosed in a thin shell membrane which disappears when the embryo develops inside the uterus. The embryos are seen free inside the uterus and no placental connection has been observed in any stage of development.

2746. **Velappan Nair, R., K.K. Appukuttan and M.E. Rajapandian** 1974. On the systematics and identity of four pelagic sharks of the family carcharhinidae from Indian Region. *Indian J. Fish.*, 21(1): 220-232.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Four species of pelagic sharks of the family Carcharhinidae belonging to the genera *Scoliodon*, *Loxodon* and *Rhizoprionodon viz., Scoliodon laticaudus* Muller and Henle, *Loxodon macrorhinus* Muller and Henle, *Rhizoprionodon (Rhizoprionodon) acutus* Ruppell and *Rhizoprionodon (Protozygaena) oligolinx* Springer which constitute a good fishery along the west and southeast coasts of India are described. Since there is confusion about the systematic position and identity of these species, an attempt is made to give detailed description of all the four species collected from different centres of both the coasts.

2747. **Velappan Nair, R and R.S. Lal Mohan** 1975. Studies on the vocalisation of the sea cow *Dugong dugon* in captivity. *Indian J. Fish.*, 22(1&2): 277-278.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The voice of the sea cow, *D. dugong*, is recorded for the first time, which is a chirp-squeak of frequency 3 kHz. The is compared with that of the American sea cow. The probable utility of the sound is discussed.

2748. **Velappan Nair, R and R. Soundararajan** 1976. On the occurrence of the sting ray *Dasyatis* (Dasyatis) *microps* (Annandale) on the Madras coast and in the Gulf of Mannar. *Indian J. Fish*., 23(1&2): 273-277.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The occurrence of *Dasyatis* (Dasyatis) *microps* on the Madras coast and in the Gulf of Mannar is reported with a brief of the adults. The observations on the male foetus collected from a gravid female is also given.

2749. **Velappan Nair, R., R. Soundararajan and G. Nandakumar** 1981. Observations on growth and moulting of spiny lobsters *Panulirus homarus* (Linnaeus), *P. ornatus* (Fabricius) and *P. penicillatus* (Olivier) in captivity. *Indian J. Fish.*, 28(1&2): 25-35.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The growth and moulting of 3 species of *Panulirus*, namely *P. homarus* (Linnaeus), *P. ornatus* (Fabricius) and *P. penicillatus* (Olivier) in captivity have been studied. The average growth increment per moult was 2.3-3.4 mm carapace length (6.9-9.6 mm total length) for male and 2.3-3.0 mm C.L. (6.5-9.1 mm T.L.) for female *P. homarus*, 2.7 mm C.L. (11.3 mm T.L.) for male and 3.3-4.4 mm C.L. (11.8-13.8 mm T.L.) for female *P. ornatus* and 1.5 mm C.L. (5.5 mm T.L.) for male *P. penicillatus*. The growth rate was higher in younger individuals than in older ones. *P. homarus* moulted 8 times in about 5 months, *P. ornatus* moulted 7 times and *P. penicillatus* 6 times in about 21 months. An instance of breeding in captivity in *P. homarus* is reported. The prospects for culturing lobsters in Mandapam area are indicated.

2750. **Velayudhan, T.S.** 1983. On the occurrence of shell boring polychaetes and sponges on pearl oyster *Pinctada fucata* and control of boring organisms. *Proc. Symp. Coastal Aquaculture, Cochin, January 12 to 18, 1980. Part-2: Molluscan culture.* MBAI, Cochin, India, 6: 614-618.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Boring organisms, particularly polychaetes and sponges, cause considerable damage to the pearl oyster *Pinctada fucata* reared in the farm. The most serious pests are the *Polydora cilata*. Of the several methods tried to control boring organisms, immersion of the oysters in fresh water was found to be the most effective in controlling the polychaetes. Brushing the external surface of the shells with 1% formalin was found to be effective in controlling the boring sponge.

2751. **Velayudhan, T.S and A.D. Gandhi** 1987. Morphology and anatomy of Indian pearl oyster. *CMFRI Bull*etin, 39:4-12.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu India.

Abstract : Following a brief account of the species of pearl oyster of the family Pteridae occurring in India, details are given of their morphology, muscular system, digestive system, respiratory system, circulatory system, excretory system, and reproductive system.

2752. **Velayudhan, T.S.** 1987. Prospects for selective breeding of pearl oysters in India. *CMFRI Bulletin*, 39: 87-89.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu India.

Abstract : Following a brief account of variations in the Indian pearl oyster population, the selective breeding and heritability of the pearl oyster (*Pinctada fucata*) are considered. Prospects for genetic studies in India regarding the selective breeding of these oysters are examined.

2753. **Velayudhan, T.S.** 1988. Studies on the settlement of barnacles at different depths in the pearl oyster farm at Tuticorin. *CMFRI Bulletin*, 42(2): 301-309.

Address : Central Marine Fisheries Research Station, Cochin - 682 018, India.

Abstract : Fouling on the pearl oyster cages in the farm by barnacles and other organisms is considered a big nuisance and also at times retards the growth rate of oysters leading to mortality. Removal of the barnacles is a labour intensive work. To avoid this, experiments were conducted to find out at what depth the intensity of barnacle fouling is minimal so that the cages can be lowered to that depth. It has been found that there is considerable reduction in the number of barnacles settled at Ii m depth even during the peak barnacle settlement season. It is considered to be advantageous to position the cages lower down the water column. The paper gives an account of barnacle fouling intensity on pearl oyster cages in different months and different depths in the pearl oyster farm.

2754. **Velayudhan, T.S., A.C.C. Victor, S. Dharmaraj and A. Chellam** 1993. Pearl production in relation to the graft tissue in the pearl oyster *Pinctada fucata*. *Mar. Fish. Infor. Serv. T & E Ser.*, 119: 3-4.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu India.

Abstract : The results of a study conducted in the Indian pearl oyster *Pinctada fucata* (Gould) are discussed in this paper.

2755. **Velayudhan, T.S., S. Dharmaraj, A.C.C. Victor and A. Chellam** 1995. Colour and thickness of Nacre in four generations of Indian pearl oyster, *Pinctada fucata* produced in the Hatchery. *Mar. Fish. Infor. Serv. T & E Ser.*, 137: 3-6.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu India.

Abstract : Broodstock of *Pinctada fucata* were collected from the natural stock from pearl banks off Tuticorin and they formed the parent stock of the first generation. The effective breeding population size has been calculated and the percentage of increase in the nacre colour of 4 generations starting from the base population from the natural oyster beds are tabled.

2756. **Velayutham, P., R. Santhanam and G. Jegatheesan** 1988. Seaweeds as fertilisers. *Shipp. Mar. Ind. J.*,12 (3) : 12.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Many species of seaweeds have now been used as good sources of fertilizers especially in coastal localities owing to their mineral and trace element contents. The residue after the extraction of agar in red seaweeds is dried and pulverised and used as a manure for Coconut plantations in the coastal areas of Tamil Nadu and Kerala. Brown seaweeds due to their algin content help in the conditioning of soil, facilitating aeration, moisture retention and absorption of nutrient elements. In order to increase the yields of various fruit trees, liquid seaweed fertilizer could be used as a leaf spray. Composite manures prepared out of seaweeds and cow dung have also shown better growth in brinjal, tapioca, beans, greens, gourds, lime, papaya and drumstick.

2757. **Velayutham, P., G. Jegatheesan and R. Santhanam** 1991. Determination of optimal spice combinations for *Sardinella albella* fish sauce. *Fish. Technol.* 28(1): 86-87.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A standard mixture of different spices for the production of *Sardinella albella* fish sauce is suggested.

2758. **Velayutham, P and G. Jegatheesan** 1993. Certain biochemical characteristics of fish sauces. *J. Mar. Biol. Assoc. I*ndia. 35(1&2): 46-49.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Finfishes such as *Leiognathus equulus, Sardinella albella* and *Selaroides leptolepis* were treated with salt in the ratios of 2:1, 3:1 and 4:1 to prepare good quality fish sauces. The chemical characteristics of fish sauce such as pH, salt, solids, protein, amino-nitrogen, trimethylamine (TMA), total volatile nitrogen (TVN) and total volatile acids (TVA) and organoleptic properties were studied at an interval of 3 and 6 months. The values of protein and amino-nitrogen content of the fish sauces produced from *L. equulus, S. albella* and *S. leptolepis* after 6 months, in the fish-salt ratio of 4:1 were found to be 7.76, 8.6 and 9.68 g (protein) and 401, 550 and 635 mgN (amino-nitrogen) per 100 ml of fish sauce respectively. The pH of the fish sauces of the above species were more or less similar to that of sauces produced elsewhere from quality fish. The values of TMA and TVN of *L. equulus, S. albella* and *S. leptolepis* fish sauces were also found to be within acceptable level. Among the different fish salt ratios, 4:1 ratio was found to be better with regard to the quality of sauce. The quality of sauces based on their protein and amino-nitrogen level was in the order of *S. leptolepis*, *S. albella* and *L. equulus*.

2759. **Velayutham, P., K. Venkataramanujam, V. Ramadhas and P.G.V. Nair** 1994. Distribution of mercury in different organs of the spinner dolphin, *Stenella longirostris*. *Symp. Nutrients and Bioactive Substances in Aquatic Organisms, Cochin, Kerala (India), 16-17, September 1993.* (*eds*) K. Devadasan, M.K. Mukundan, P.D. Antony, P.G.V. Nair, P.A. Perigreen and J. Joseph. Cochin India Society of Fisheries Technologists, India. pp. 286-289.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The present study deals with the distribution of total mercury in different parts such as muscle, liver, intestine, heart and lung of the spinner dolphin, *Stenella longirostris* stranded near the Thermal Power Station in

the Tuticorin Bay. Among the different parts analysed, liver showed the highest level of mercury (0.89 µg/g) and the lowest concentration of 0.05 µg/g was recorded in lungs. The total mercury content of the various organs of the spinner dolphin recorded in the present investigation is compared with that of the previous reports and its significance is discussed.

2760. **Velayutham, P and G. Indra Jasmine** 2001. Seasonal variation in the proximate composition of gorgonians collected from Thoothukkudi coastal waters. *Nat. Sem. on marine and coastal ecosystems: Coral and Mangrove - Problems and Management Strategies, 26-27, Sept. 2001, Tuticorin,* p.62.

2761. **Velayutham, P., K. Venkataramanujam and V. Ramadhas** 2001. Toxicity and feeding deterrence properties of Gorgonian collected from Thoothukkudi coastal waters. *Nat. Sem. on marine and coastal ecosystems: coral and mangrove-problems and management strategies, 26-27, Sept. 2001.* p.176.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : One of the most important selective factors that influence the evolution of living organisms is predation. In plants and animals, the antipredatory function is mainly due to the specific morphological, chemical and behavioural adaptations. Common antipredatory adaptations include feeding deterrent properties and toxicity. In the present work, feeding experiments were conducted both for *Penaeus indicus* and *Sarotherodon mossambicus* using 7 types of feed pellets incorporating the actual level of crude fat, half of the level of crude fat, dried powders of 2 % each of the tip and the base of *Gorgonella umbraculum*. Control feeds with 0.5ml, 1 ml methanol and without methanol were also prepared for conducting the experiment. Seven types of pellet feeds containing 40% protein were prepared and analysed for proximate composition such as moisture, protein, fat, carbohydrate and ash. Generally, the average number of bites were the least in *P. indicus* (30 Nos.) and *S. mossambicus* (37 Nos.) when feed contained crude fat equal to that amount found in *G. umbraculum*. Generally, lesser number of bites was encountered in the crude fat incorporated feed than dry powdered feed. The results are discussed in this paper.

2762. **Velayutham, P., V. Ramadhas and K. Venkataramanujam** 2003. Gorgonians as an indicator of metal pollution. *SDMRI Res. Publ.,* 3: 149-153.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Tropical marine environment is under the heavy pressure of heavy metal pollution from a variety of sources. The concentrations of heavy metals such as copper, zinc, manganese, chromium and lead were studied in *Echinomuricea indica* and *Gorgonella umbraculum* collected from Tuticorin coastal waters. Summer and monsoon seasons were chosen for conducting the investigation since these two seasons were contrasting with respect to change in water quality. In both the species, high accumulation of all metals could be recorded during summer season than monsoon season. *G. umbraculum* and *E. indica* showed increment in the concentration of heavy metals with increase in size. Among the five metals investigated, the highest concentration of lead and the lowest concentration of copper were recorded in both the species during the two seasons.

2763. **Velayutham, P., K. Venkataramanujam and V. Ramadhass** 2003. Species diversity, distribution and abundance of Gorgonians in the Gulf of Mannar. *Nat. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 20.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Gorgonians exported from India are commercially classified under four types, black, red, flower and monkey tail. Gorgonians are also exported from India under the head curio. India stepped up the commercial exploitation and export of gorgonians during 1975 and is now exporting to countries like France, West Germany, U.S.A. and The Netherlands. Species wise distribution and abundance of gorgonians were investigated in three landing centres, namely Rameswaram, Thoothukudi and Kanyakumari in the Gulf of Mannar region during 1991-92. Among the four different types of commercially important gorgonians, the red type contributed to the highest value of annual percentage contribution (36.70) followed by black type (32.53) during 1991- 92 at Rameswaram. The total landings of all commercially important gorgonians of Rameswaram area was 2378 kg, 2588 Kg at Thoothukudi, and 1725 kg at Kanyakumari during 1991-92. Among the four types, the red type contributed to the maximum percentage of total landings followed by black type, monkey tail type and flower tail type during 1991-92. In the Kanyakumari landing centre, black type contributed to the highest percentage of total landings followed by red type, monkey tail type and flower tail types. The results are discussed in the paper.

2764. **Velvizhi, S and V. Selvam** 2003. Community owned pearl culture - an alternative income generation opportunity for the poor fishers in the Gulf of Mannar region. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 91-93.

Address : M.S. Swaminathan Research Foundation, Mandapam - 623 519, Tamilnadu, India.

Abstract : Gulf of Mannar is rich in biodiversity and bioresources. It has been estimated that about 3600 species of flora and fauna exist in the Gulf of Mannar, which includes extensive coral reefs, sea grass meadows, seaweed beds, molluscan beds and mangrove wetlands. Apart from this, Gulf of Mannar acts as a home for the endangered marine mammals Dugong and marine turtles. The breeding and feeding grounds created by the above ecosystems and complex food web formed by various marine flora and fauna resulted in high fishery production. Annually about 1-lakh tonnes of fish including finfish, prawn, crabs, lobsters etc are harvested from the Gulf of Mannar. About l.5 lakh fishers living in about 90 fishing hamlets depend on this fishery resources and seaweed resources for their livelihood. However, due to overfishing and increased fishing population and damage to coral reefs, sea grass beds and other ecosystems by trawlers, fish catch per head of fishers is declining fast, leading to poverty among the poor fishers. Creating alternative livelihoods and additional source of income for the poor fishers is one of the options for the sustainable management of the fishery resources as well as conservation of the biodiversity of the Gulf of Mannar. With this background, M.S. Swaminathan Research Foundation is demonstrating pearl culture along with establishing community-owned agar production plant and fish pickling unit as alternative livelihoods with the participation of the local poor fishing community.

2765. **Venkataraman, G., K. Dorairaj, M. Devaraj and R. Ganapathy** 1973. On a new record of sei whale, *Balaenoptera borealis* from Indian waters. *Indian J. Fish.*, 20(2): 634-638.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The stranding of a 15.53 metres long sei whale, *Balaenoptera borealis* for the first time in the Indian shores is reported and described.

2766. **Venkataraman, G and M. Badrudeen** 1974. On the diurnal variation in the catches of silverbellies in Palk Bay. *Indian J. Fish.*, 21(1): 254-265.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A comparison of the trawl landings from Palk Bay by day and night fishing showed a marked variation in the catches of silverbellies observed on full moon nights than on new moon nights both in Palk Bay and Gulf of Mannar. From an analysis of the size groups of *Leiognathus jonesi* and *L.brevirostris* caught, it was seen that the proportion of smaller size group was greater in the night catches than in the day catches whereas the proportion of the larger size group was greater in the day catches than in the night catches. The diurnal variation in the catches of silverbellies shows that they stay at the bottom during day time and at night good many of them migrate from there and rise to surface and sub-surface waters. This and the instances of sharp difference in the catch rates observed between full moon and new moon nights indicate a close link between light and the process of migration in silver bellies. The probable cause for the variation in the size groups in the catches by day and night fishing is pointed out. Fishing at the surface, sub-surface and mid water levels at night by using suitable gear is suggested for augmenting the production of silver bellies.

2767. **Venkataraman, G and M. Badrudeen** 1975. A new distributional record of *Gerres macracanthus* Bleeker from Indian waters. *Indian J. Fish.*, 22(1&2): 290-293.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The occurrence of *G. macracanthus* Bleeker is recorded for the first time from Indian waters. A description of the species is given and the differences between this and the allied species, *Gerres filamentosus*, are pointed out.

2768. **Venkataraman, G.** 1988. The Krusadai Island. *Front Line*, May 28 - June 10, 1988, pp. 86-90.

2769. **Venkataraman, G.S.** 1957. A list of Marine Myxophyceae from Cape Comorin (Kanyakumari). *J. Indian Bot. Soc.*, 36: 472-474.

2770. **Venkataraman, G.S**. 1958. A contribution to the knowledge of the Diatomaceae of Kanyakumari (Cape Comorin) India. I-II. *Proc. Nat. Inst. Sci. India*, 23B: 80-88, 24: 307-313.

2771. **Venkataraman, K and R. Jeyabaskaran** 1998. Present status and impact on coral reefs in Mandapam group of Gulf of Mannar Islands, southeast coast of India. *Paper presented by Jason Rubens, GCRMN South Asia Coordinator in International Tropical Marine Area Management, Symposium, Australia on November 23-25.*

2772. **Venkataraman, K** 2002. Under the threat in the deep. *The Hindu* 30th *September* 2002.

Address : Marine Biological Station, Zoological Survey of India, Chennai, Tamilnadu, India.

Abstract : It is the dish of emperors and the creatures that go into its making have a very rich history. Lobster, one of the most expensive items of seafood which one can find in the coral reef areas is now being studied in captivity in the city. Sought by many for their medicinal value, lobsters earn hard cash for fishermen.

2773. **Venkataraman, K.** 2002. Status survey of the Gulf of Mannar coral reefs following the 1998 bleaching event, with implications for reserve management. *Proc. Ninth International Coral Reef Symposium*, Bali, 23-27 October 2000, Vol. 2. pp. 855-859.

Address : Marine Biological Station, Zoological Survey of India, 100 Santhome High Road, Chennai, Tamilnadu, India; E-mail: dugong@md2.vsnl.net.in

Abstract : The Gulf of Mannar Biosphere Reserve (GoMBR) encompasses 21 coastal Islands located between 8° 49' to 9° 15' N latitude and 78° 11' to 79° 15' E longitude on the southeast coast of India. The government of India established these Islands as a biosphere reserve in 1989. The Gulf's 3600 species of plants and animals make it biologically one of the richest coastal regions in India. A total of 94 species of corals belonging to 37 genera have been reported from this area and the coral reefs are mostly of fringing type. During 1998-1999, surveys had been conducted to estimate the present status of the coral reefs of this region. Line Intercept Transect surveys were conducted in three different seasons from June 1998 to May 1999 in all the 21 Islands divided into three Island groups such as Mandapam, Keelakarai and Tuticorin, each group consisting of seven Islands. The overall percentage of coral life forms amounted to 24.67% and dead coral, rubble and sand amounted to 75.04%. Among the three groups of Islands, Mandapam had a higher percentage of live coral cover (37.03%) than the other two groups (17.29% Keelakarai and 18.69% Tuticorin group). Among the life form categories, massive corals (CM) dominated the GoMBR (7.67 ± 2.23%). Next to massive corals Acropora Branching forms (ACB) dominated in two groups of Islands (Keelakarai 6.81 ± 13.37%, 8.5 ± 13.10% in Mandapam group). The order of dominance of live form in GoMBR is as follows: coral massive (CM)> Acropora branching (ACB)> coral sub massive (CS) > coral foliose (CF)> coral encrusting (CE)> coral branching (CB). The reason for the dominance of massive corals over the other groups in GoMBR may be explained by the recent 1998-bleaching event. The fragile and sensitive branching was the most affected life form group as a result of bleaching in this region. The reasons for degradation and deterioration of coral reefs of GoMBR are discussed.

2774. **Venkataraman, K., R. Jeyabaskaran, K.P. Raghuram and J.R.B. Alfred** 2002. *Faunal diversity of Gulf of Mannar Biosphere Reserve.* Zoological Survey of India, Calcutta, India. 77 pp.

2775. **Venkataraman**, **K.** 2003. Status and diversity of reef building corals, and their ecosystems of India. *Nat. Sem. Reef Ecosystem Remediation*, 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 15.

Address : Marine Biological Station, Zoological Survey of India, Chennai-600 028, Tamilnadu, India. E-mail: dugong@md2.vsn1.net.in

Abstract : The term 'coral' has been used to describe a variety of different invertebrate animals from the Phylum Cnidaria including hard corals, soft corals, precious corals and hydrocorals. However, 'coral' is most often used as the common name for hard corals from the Order Scleractinia. Scleractinian corals are divided into reef-building corals (hermatypic corals), which form the primary structure of coral reefs, and non-reef building corals (ahermatypic corals), which do not contribute significantly to reef formation (Veron, 1986). In India, all the three major reef types (atoll, fringing and barrier) occur, and the region includes some of the most diverse, extensive and least disturbed reef areas of the Indian Ocean, many of which are among the least scientifically known. Pillai (1983) recorded a total of 199 species divided among 37 genera, from India, which includes both hermatypic and ahermatypic corals recorded by him.

2776. **Venkataraman, K., Ch. Satyanarayana, J.R.B. Alfred and J. Wolstenholme** 2003. Diversity of Corals : Palk Bay and Gulf of Mannar. pp 10-12. ***In***: *Hand Book on Hard corals of India.* (*eds*.) K. Venkataraman, Ch. Satyanarayana, J.R.B. Alfred and J. Wolstenholme. Zoological Survey of India. 350 pp.

Address : Zoological Survey of India, Chennai, Tamilnadu, India.

Abstract : The threats to the Palk Bay and Gulf of Mannar are through indiscriminate exploitation of natural resources by poachers for commercial purposes. There are about thirty-eight fishing villages on the coastal stretch of Ramnathapuram district with a population of little over 32,000, entirely depending on fishing. Extensive areas of sea grass beds with species such as *Cymodocea sp.*, *Thalassia sp.* and *Enhalus sp.* are being disturbed by stake net fishing and intensive trawling operation around the islands. Large-scale collection of *Ptychodera flava* (*Balanoglossus*) as biological specimen has virtually annihilated the population density. This is another unique species occurring in the sandy flats of northern islands of Gulf of Mannar. Exploitation of fishery resources in the inshore waters has been the sole occupation of hundreds of fishing families along the coast for centuries. Reef exploitation includes reef fishery, shell (chanks) and pearl fishery, ornamental shell trade and illegal mining of corals. Over-exploitation of commercially important species such as *Turbinella pyrum, Pinctada fucata, Cypraea talpa, Cypraea serpentis, Chicoreus ramosus, Chicoreus virgineus, Conus amadis, Conus textile, Strom bus cananium, Murex adustus, Veluta lapponica* and *Murex haustellum* may ultimately threaten the very existence of these species in Gulf of Mannar reefs. Villagers around Palk Bay harvest holothurians, seahorses and pipefishes. The destruction of reefs and reef associated organisms in the Gulf of Mannar and Palk Bay is perhaps unparalleled in the history of environmental damage to nature and natural resources in the recent past (Pillai, 1996). The coral reefs of Palk Bay and Gulf of Mannar have been quarried for industrial purposes from the early sixties from Mandapam to Tuticorin before the declaration of the Marine Biosphere Reserve and National Park. The estimate of coral quarried varies. Pillai (1973) estimated the exploitation of corals for extraction of lime and for manufacture of cement from Mandapam area alone during the sixties and early seventies to be to the tune of 250 m^3 per day. Some of the islands (Vilanguchalli in Tuticorin group and Poovarasanpatti Island in Keelakari group) are totally submerged 3-5 m below water level probably due to quarrying (Venkataraman, 2000). At Tuticorin alone one estimate was 80,000 t per year (Pillai, 1986) and another estimated to an annual removal of 150,000 t of boulders and 10, 000 t of coral debris (Venkataramanujam *et al.*, 1981). Huge colonies of massive corals that occupied large areas in the lagoons of many islands are no longer found due to over-exploitation of algae and shells for commercial purposes. The corals in Gulf of Mannar are fast deteriorating, particularly due to human interference. Island based stake-net operations have entailed heavy destruction by fisher folk of the marine turtle eggs which are laid seasonally by the Olive ridley on the seaward sandy beaches of almost all the islands (Lal Mohan, 1983). Drift netting in the zone of the arrival of turtles, traps the breeders coming in for nesting. Besides, this area also has been identified as an important feeding ground for green turtle and hawks-bill turtle. The seabed of the shallow stretch of water between the island and mainland are intensively trawled for prawns thus adding another new dimension to the disturbance of the habitat. Sand quarrying, fly ash discharge from thermal power stations and installation of chemical industries in the Gulf of Mannar area are the main causes of destruction of the pearl oyster fishing, live corals and the freshwater aquifers. The export of live crabs and lobsters from this area in recent years is also causing damage to live corals. Fish traps (Koodu) used to collect live crabs for export damage coral reefs in these areas. The boring sponges cause considerable destruction to corals and about 20 species of boring sponges are recorded from this area.

2777. **Venkataraman, K., M.C. John Milton and K.P. Raghuram** 2003. Handbook on sharks of Indian waters (Diversity, Fishery, Status, Trade and Conservation). 113 pp.

Address : Zoological Survey of India, Calcutta, West Bengal, India.

2778. **Venkataraman, K., R. Jeyabaskaran, K.P. Raghuram and J.R.B. Alfred** 2004. Bibliography and Checklist of corals and coral reef associated organisms of India, ZSI. 468 pp.

Address : Zoological Survey of India, Calcutta, West Bengal, India.

2779. **Venkataraman, R., P.S. Sambandamurthy and S. Mahadevan** 1958. Some preliminary observations on the prawn catches off Punnakayal near Tuticorin. *Proc. Indian Sci. Cong. 45th Sess*., 3: 374.

2780. **Venkataraman, T.V.** 1974. Development of marine products in Tamil Nadu. *Seafood Export J.*, 6(1): 29-31.

Address : Department of Fisheries, Madras, Tamilnadu, India.

Abstract : Tamil Nadu which has a coastline of 1000 km and an extensive continental shelf of 35000 sq. km is endowed with a rich potential in the marine area for development. The Fisheries Department of Tamil Nadu, one of the oldest in the country is the main administrative organization responsible for developing the marine fish production in Tamil Nadu from 0.86 lakh tons in 1950 to 1.08 lakh tons in 1960 and to 1.59 lakhs tons in 1970. In regard to marine fish production Tamil Nadu competes with Maharashtra for the second place in India conceding the first to Kerala.

2781. **Venkataramani, G.** The Krusadai: Kalaidoscope. *Frontline, May 28 - June 10,* 1988.

2782. **Venkataramani, V.K and G. John.** 1979. Biochemical composition of frozen and dried carangid fishes. *J. Mar. Biol. Assoc. India,* 21(1&2): 86-90.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Fresh, frozen and sun dried tissues of twelve carangid species were analysed for protein, fat and moisture contents. Comparing all the species, fat content was found to be more in *Selaroides leptolepis* and protein was found to be more in *Atule mate*. Level of protein and fat contents in fresh, frozen and sun dried specimens have been studied and their nutritive values are compared.

2783. **Venkataramani, V.K., N. Ramanathan and J. Natarajan** 1982. Osteological studies on three species of Carangoides (Family: Carangidae). *J. Mar. Biol. Assoc. India,* 24(1&2): 50-60.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The systematic status of three closely related carangid fishes namely *Carangoides malabaricus* (Bl. & Schn.), *C. talamparoides* Blkr. and *C. chrysophrys* (Cuv. & Val.) was clarified by employing osteological studies. The taxonomic status of *C. talamparoides* often synonymised with *C. malabaricus* by earlier authors was assessed through the use of detailed osteological characters. In the present study distinct generic and specific osteological characters were made out for all the three closely related species. Thirteen osteological morphometrics were also taken from large number of specimens covering different length groups. Of all these, the length of the supraoccipital crest was found to be very useful in separating *C. malabaricus* from *C. chrysophrys* . The *Otolith sagitta* was also studied and species specific sculptural patterns of sagitta were also observed in all the studied species.

2784. **Venkataramani, V.K and P. Natarajan** 1988. Food and feeding habits of *Selaroides leptolepis* Val. off Tuticorin coast. *Matsya,* 14: 53-63.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Analysis of the food and feeding habits of *Selaroides leptolepis* revealed that the juveniles fed on planktonic crustaceans, but the adults preferred juvenile fishes. No difference could be seen between the food of males and that of females. In both the sexes, specimens with immature gonad fed more on planktonic crustaceans and gradually included fishes also in the diet when they attained maturity. In females, during advanced maturity stages, only empty stomachs with little mucus were observed. The percentage occurrence of the “gorged”, “full” and “3/4 full” stomachs were always less during all the months of observation.

2785. **Venkataramani, V.K and P. Gopalakrishnan** 1993. Length-weight relationship in *Parastromateus niger* (Pisces:Perciformes). *J. Mar. Biol. Assoc. India,* 35(1&2): 226-227.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Length and weight relationship of about 100 specimens measuring 19 to 96 mm was calculated for juvenile specimens of *Parastromateus niger* which constitute a good fishery along the inshore waters of Tuticorin. The linear equation was fitted for the juveniles and the regression equation was Log W: 1.5047+3.0420 Log L. The exponent value in juveniles of *P. niger* obeys the cube law relationship maintaining the shape without any change.

2786. **Venkataramani, V.K., N. Ramanathan and K. Venkataramanujam** 1995. Breeding biology of a carangid fish *Selaroides leptolepis* Cuv. (Perciformes) along Tuticorin, southeast coast of India. *Indian J. Mar. Sci.,* 24(4): 207-210.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Studies on ova diameter frequency, seasonal occurrence of maturity stages, gonado-somatic indices and relative condition factor (Kn) revealed that *Selaroids leptolepis* was a prolonged breeder and the individuals spawned once in a year. The spawning period for *S. leptolepis* was from August to March with two peaks, one in January to February and the other in September to October. Length at first maturity in *S. leptolepis* was 113.8 mm (TL) for both the sexes. Fecundity studies showed a direct and significant correlation with total length and body weight. Sex ratio conformed to the expected 1:1 ratio in all the months of the year.

2787. **Venkataramani, V.K., P. Jawahar and T. Vaitheeswaran** 2004. *Training manual on biodiversity and stock assessment of marine ornamental fishes.* 103 pp.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : This training manual deals the commercially important ornamental fish families of Gulf of Mannar, methods for assessment of biodiversity of ornamental fishes and assessing maturation and spawning.

2788. **Venkataramanujam, K., N. Ramanathan and G. Sanjeeviraj** 1978. A redescription of *Cirrhitichthys aprinus* (Pisces: Cirrhitidae) from Tuticorin, South India. *J. Mar. Biol. Assoc. India*, 20(1&2): 171-172.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The redescription of the little known perch *C. aprinus* (Cuvier and Valenciennes, 1829) based on fresh material from Tuticorin, South India is given here.

2789. **Venkataramanujam, K and K. Ramamoorthi** 1981. Developmental studies through laboratory rearing of *Ambassis commersoni*. *The early life history of fish: Recent studies*. (*eds*) R. Lasker, K. Sherman. 178: 578-579.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The author describes stages of the early development of the glassy perchlet *Ambassis commersoni*; (a) just hatched larva; (b) larva 24 h after hatching; (c) larva 120 h after hatching; (d) post larvae of 5.0-7.5 mm size; (e) post larvae of 8.0-12.2 mm size; (f) juvenile.

2790. **Venkataramanujam, K., R. Santhanam and N. Sukumaran** 1981. Coral resources of Tuticorin (S. India) and methods of their conservation. *International Coral Reef Symposium, Manila (Philippines), 18-22 May 1981. The reef and man. Proceedings of the fourth international coral reef symposium, volume (1). (eds) E.D. Gomez, C.E. Birkeland, R.W. Buddemeier, R.E. Johannes, Jr.J.A. Marsh and R.T. Tsuda.* pp. 259-262.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : An investigation on the coral resources of Tuticorin was undertaken for a period of one year (April '79 to March '80). A total of 20 species of corals were found distributed along the reefs and Islands lying off the coast. It is estimated that 10,000 tons of lime is manufactured annually by burning mainly species of *Acropora* in kilns. About 400 people are employed daily in the coral lime industries of this area and a sum of Rs.0.4 to 1.0 million is being generated annually. Massive species of corals like *Favia* spp. and *Porites* spp. are also exploited and are used as building blocks and in the construction of roads. The over-exploitation of the corals for the manufacture of lime and as building blocks, and its effects on the local fisheries and Islands of this area are discussed. The probable measures for the conservation of these commercially important resources are also dealt with.

2791. **Venkataramanujam, K and G. Sanjeeviraj** 1982. The gorgonian resources of Tamil Nadu. *Seafood Export J.*, 14(3): 23-26.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The gorgonian potential of the coastal localities of Tamil Nadu is discussed. Methods of exploitation are considered; gorgonians are mainly found in the vicinity of pearl paars and chank beds. Their various uses are outlined: processed ones are exported to European countries for use in interior decoration and pharmaceutical preparation.

2792. **Venkataramanujam, K., V.K. Venkataraman and N. Ramanathan** 1982. A new labrid fish *Xyrichtys rajagopalani* sp. Nov. from Tuticorin bay, South India. *J. Mar. Biol. Assoc. India*, 24(1&2): 47-49.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A new labrid fish *Xyrichtys rajagopalani* sp. nov. collected from Tuticorin Bay is described based on 14 speciemns of both sexes with a comparison of the other two closely related species of the same genus.

2793. **Venkataramanujam, K and V.K. Venkataramani** 1984. The reproductive biology of *Ambassis commersoni* Cuv. and Val. (Pisces: Perciformes) along the Porto Novo coast. 4. *All India Seminar on Ichthyology, Dehra Dun (India), 29 Oct 1983. Int. J. Acad. Ichthyol. Modinagar,* 5(1&2): 103-111.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Reproductive biology of *Ambassis commersoni* has been studied for two years. Seasonal occurrence of maturity stages relative condition factor values, fecundity and spawning season in this species have been investigated. The species has a prolonged breeding season with two peaks one in March to May and the other in August to September.

2794. **Venkataramanujam, K., N. Ramanathan and V.K. Venkataramani.** 1984. Developmental studies through laboratory rearing of the slender lizard fish *Saurida gracilis* (Quoy and Gaimard, 1824) (Pisces: Synodontidae). *J. Mar. Biol. Assoc. India*, 26(1&2): 174-177.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The egg, prolarvae and postlarvae of the slender lizardfish *Saurida gracilis* are described and figured from material reared in the laboratory. Comparisons are made with published descriptions of other lizardfishes.

2795. **Venkataramanujam, K and R. Santhanam** 1985. Coral reef fishery resources of Tuticorin (South India). *Proc. 5th International Coral reef Congress, Talit,* 2: 391.

2796. **Venkataramanujam, K., N. Sukumaran and G. Sanjeeviraj** 1986. Socioeconomic conditions of the chank fishermen community in Tuticorin, South India. *Symp. Ser. Mar. Biol. Assoc. India*, 6: 1475.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A sample survey to study the socioeconomic conditions of the chank fishermen community in Tuticorin was conducted during March-May, 1979 to ascertain the socioeconomic conditions prevailing and the effect of developmental schemes on the socioeconomic conditions at a later date.

2797. **Venkataramanujam, K., G. Jegatheesan and B. Srikrishnadhas** 1988. On a sei whale, *Balaenoptera borealis* stranded at Tuticorin, east coast of India. *Invest. Cetacea*, 21: 247-249.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A description is given of a specimen of *Balaenoptera borealis* found stranded inside the Tuticorin Port Trust wharf, off the east coast of India on 26 February 1988. Morphometric data of the whale are included and details given of stomach contents, which consisted mainly of sardines.

2798. **Venkataramanujam, K., N. Ramanathan and V.K. Venkataramani** 1988. On the egg and larval stages of the zebra sole, *Zebrias quagga* (Kaup) (Pisces: Soleidae) reared in the laboratory. *Matsya*, 14: 41-46.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : The egg, prolarvae, and postlarvae of the zebra sole, *Zebrias quagga* are described and figured from material reared in the laboratory. Comparisons are made with published descriptions of other flat fishes.

2799. **Venkataramanujam, K., V.K. Venkataramani and M. Devaraj** 1993. A new solenostomid fish *Solenostomus tuticoriensis* sp. nov. from Tuticorin Bay, South India. *J. Mar. Biol. Assoc. India*, 35(1&2): 201-204.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : A new solenostomid fish *Solenostomus tuticoriensis* sp. nov. collected from the Tuticorin Bay in the Gulf of Mannar is described and a comparison made with the other three closely related species of the same genus.

2800. **Venkatasamy, G.** 1983. Studies on the culture of *Penaeus indicus* in cages. *Proc. Nat. Sem. Cage and Pen Culture*, 1983, Tuticorin. pp. 99-102.

2801. **Venkataswamy, M and Raghavan** 1988. Polyculture of fishes and prawns in brackishwater of Tuticorin, India. *Seafood Export J.*, 20(7): 23-24.

Address : Fisheries College and Research Institute, Tuticorin - 628 008, Tamilnadu, India.

Abstract : Indian coasts are highly productive and afford vast scope for fish culture. There are about 1.4 million ha of brakishwater area spread throughout the country and to its credit Tamil Nadu shares 2 lakhs ha. Of these 27,000 ha are readily available for brackishwater fish culture but only 12,000 ha. are currently being utilized (Srinivasan *et. al.*, 1980). The polyculture of fishes and prawns if practiced properly can promise manifold increase of yield so far obtained through other culture methods underway in this rich brackish water biotope. Brackishwater prawn culture is more profitable than freshwater fish farming or paddy cultivation in India.

2802. **Venkatesalu, V., P. Sundaramoorthy, M. Anantharaj and M. Chandrasekaran** 2002. Fatty acid composition of some Rhodophycean marine macroalgae. *Phykos,* 41(1&2): 59-62.

Address : Department of Botany, Annamalai University, Chidambaram - 608 002, Tamilnadu, India.

Abstract : The marine red algae viz., *Gracilaria cort. cylindrica, G. corticata, Amphiora* sp., *Hypnea valentiae, G. edulis, Desmia* sp., *Spyridia flementosa, Acanthophora spicifera, G. crassa, Cheilosporum spectabile* and *Gracilaria* sp. collected from Rameshwaram Coast, Tamil Nadu, India were investigated for their fatty acid composition by gas chromatography. Fatty acid composition of red seaweeds showed significant differences among various species. Palmitic acid was found to be the major fatty acid present in these algae.

2803. **Venkatesalu, V., P. Sundaramoorthy, M. Anantharaj and M. Chandrasekaran** 2003. Fatty acid composition of some marine algae. *Seaweed Res. Utiln.,* 25(1&2): 95-98.

Address : Department of Botany, Annamalai University, Chidambaram - 608 002, Tamilnadu, India.

Abstract : Fatty acid composition of nine algal species viz., *Ulva fasciata, U. reticulata, Caulerpa veraveliensis, C. scalpelliformis, C. chemnitzia, C. racemosa, Chaetomorpha aerea, Valoniopsis pachynema* and *Halimeda macroloba* belonging to the class Chlorophyceae collected from Gulf of Mannar was determined. The analysis of fatty acids methyl esters by gas chromatography revealed the presence of higher amount of saturated fatty acids than unsaturated ones except in *Halimeda macroloba* and *Valoniopsis pachynema*. Among saturated fatty acids, the amount of palmitic acid was higher in all the species studied. Linoleic and linoleinic acid contents were high among unsaturated fatty acids except in *Caulerpa chemnitzia*.

2804. **Venkatesalu, V., P. Sundaramoorthy, M. Anantharaj, M. Gopalakrishnan and M. Chandrasekaran** 2004. Studies on the fatty acid composition of marine algae of Rameswaram coast. *Seaweed Res. Utiln.,* 26(1&2): 83-86.

Address : Department of Botany, Annamalai University, Chidambaram - 608 002, Tamilnadu, India.

Abstract : *Ulva lactuca, Caulerpa chemnitzia, Padina tetrastromatica, Sargassum longifolium, Acanthophora spicifera* and *Gelidium micropterum* collected from Rameswaram coast, Tamil Nadu, India were investigated for their fatty acid composition. The analysis of fatty acids (as methyl esters) by gas chromatography revealed the presence of lauric acid, tridecanoic acid, myristic acid, pentadecanoic acid, palmitic acid, heptadecanoic acid, stearic acid, nonadecanoic acid, arachidic acid, heneicosanoic acid, behinic acid, oleic acid, linoleic acid and linolenic acid. Among the fatty acids, palmitic acid was predominant in all the seaweeds studied.

2805. **Venkatesalu, V., P. Sundaramoorthy, M. Anantharaj and M. Gopalakrishnan** 2005. Studies on the fatty acid composition of some brown macroalgae. *Seaweed Res. Utiln.,* 27(1&2): 45-48.

Address : Department of Botany, Annamalai University, Chidambaram - 608 002, Tamilnadu, India.

Abstract : Ten species of brown macro algae collected from Gulf of Mannar Marine Biosphere Reserve were investigated for their fatty acid composition. The analysis of Fatty Acid Methyl Esters by Gas Chromatography revealed the presence of lauric, myristic, palmitic, stearic, oleic, linoleic and linolenic acids. Higher amount of saturated fatty acids have been recorded than the unsaturated fatty acids. Among the saturated fatty acids, the amount of palmitic acid was higher in all the species studied.

2806. **Venkatesan, I., C. Kasinathan and A. Shanmugavelu** 2006. On the first record of a rare marine ornamental fish from the Gulf of Mannar. *Mar. Fish. 1nfor. Serv. T&E Ser.,* 187: 17.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A single specimen of reef associated sand tile fish *Malacanthus latovittatus* was landed at the Pamban landing center of Gulf of Mannar on 21-2-06. 1t is one of the commercially important rare ornamental fishes.

2807. **Venkatesan, P., A. Rajendran, S. Srinivasan and S. Kannan** 2003. Corrosion of Reinforced Concrete Exposed to Marine Atmosphere. *Transactions of the SAEST,* Society for Advancement of Electrochemical Science and Technology. 38(2): 53-56.

Address : Offshore Platform, Central Electro Chemical Research Institute, Tuticorin, Tamilnadu, India.

Abstract : The reinforced concrete exposed to marine atmosphere deteriorates very fast resulting in the corrosion of reinforcement. Corrosion of reinforcement reduces the life of the structure. It is impossible to estimate accurately the loss resulting from corrosion. In 1925, Franklin Speller estimated roughly that the renewal of iron and steel products such as roofing, wire, tubes and pipe, oil-well equipment, steel coal cars and many other steel or iron structures subject to corrosion because of inadequate or no protection amounted annually to about 2 percent of the total tonnage of such products in use. In this paper the corrosion, the facts established with respect to corrosion, the nature and mechanism of corrosion, typical chemical reactions of the corrosion process; corrosion measurements, corrosion control, cathodic protection methods, protective coatings, admixtures and incubations,

and the corrosion measurement techniques are presented. Wherever possible examples are given. The corrosion in the Tuticorin marine environment is presented.

2808. **Venkatesan, P., N. Palaniswamy and K. Rajagopal** 2006. Corrosion performance of coated reinforcing bars embedded in concrete and exposed to natural marine environment. *J. Progcoat,* 56(1): 8-12.

Address : Central Electrochemical Research Institute, Karaikudi - 630 006, Tamilnadu, India.

Abstract : Corrosion behavior of mild steel plain bar embedded in concrete with 28 days compressive strength of 40 N/mm^2 exposed to natural marine environment at a location in the Gulf of Mannar was studied. This paper reports the results of I-year study conducted on the reinforced concrete specimens exposed to three different levels. The performance of three different types of corrosion protection by speciality coatings to rebars, namely cement polymer composite, interpenetrating polymer network coating and epoxy coating was also evaluated periodically by measuring open circuit potential measurements and the results are discussed. Biofouling was predominant on completion of 3 months immersion.

2809. **Venkatesh, K.V and I. Ray** 1981. Grain size variation in the sediments off Tuticorin Harbour, Tamil Nadu. *J. Geol. Soc. India,* 22(4): 181-189.

Address : Punja Building, Lalbagh, Mangalore - 575 003, Karnataka, India.

Abstract : The size parametes of the near shore sediments off Tuticorin vary as follows: inclusive graphic mean from 1.41 to 2.22 phi; standard deviation 0.58 to 0.91 phi; skewness 0.07 to 0.37 and kurtosis 0.91 to 1.15. Decrease in the values of mean size towards southwest indicates the movement of sand in that direction which is largely aided by the wind induced currents. A close correlation between mean grain size and sorting is inferred. Sporadic occurrence of coarser sand nestled by finer ones noticed closer to the site of breakwaters speaks of the low transporting ability of the back wash. The important mode of transport is through siltation and traction.

2810. **Venkatesh, R., V. Mathews and J. K. Patterson Edward** 2003. Feasibility of enhancing coral biomass by transplanting branching and non-branching corals. *Nat. Sem. Reef Ecosystem Remediation,* 24th –26th Sep'03, SDMRI, Tuticorin, India. p. 24.

Address : Suganthi Devadason Marine Research Institute, 44 - Beach Road, Tuticorin - 628 001, Tamil Nadu, India.

Abstract : Coral fragments of branching and non-branching were transplanted on ferro cement concrete slabs, which were fixed on concrete frames (1 x 1 m^2) and deployed in coral degraded areas of 1.8 and 5.5m depth. Survival and growth rate were monitored over a period of 8 months by SCUBA diving. The overall survival after 8 months was 89.322 %. The remaining 10.67 % loss of transplants occurred mainly because of the detachment of the slabs from the main frames due to wave action. The stable secondary basal disc formation in branching coral fragments occurred within a short period of 10 to 15 days while in non-branching coral fragments the time taken was more than 30 days. Branching corals showed multiple polyps around the axial polyps after two weeks and had a growth of 3.531 cm after 8 months. *Turbinaria* sp., *Favia* sp. and *Favites* sp. showed poorest response to transplantation and took more time to attach with the substrate. Larger colonies of non-branching corals with more than 30 cm diameter are suitable than small pieces. The branching corals are the ideal ones for transplantation than the non-branching corals but both can be used for coral biomass enhancement in the degraded areas.

2811. **Venkateswara Rao, J., P. Kavitha, N. Chakra Reddy and T. Gnaneshwar Rao** 2006. *Petrosia testudinaria* as a biomarker for metal contamination at Gulf of Mannar, southeast coast of India. *J. Chemosphere* (In press).

Address : Toxicology unit, Biology Division, Indian Institute of Chemical Technology, Hydrabad-500 007, Andhrapradesh, India.

Abstract : Coastal marine ecosystems in many parts of the world are under unrelenting stress caused by urban development, pollutants and other ecological impacts such as building of infrastructure, land reclamation for port and industrial development, habitat modification, tourism and recreational activities. The present work is a first extensive field study using the marine sponge, *Petrosia testudinaria* as a biomarker to detect heavy metal pollution between near and off shore environment of Gulf of Mannar, India. Sponges were collected from near shore (0.5-1 km) and offshore (5-7 km), locations and their metal concentrations were determined by inductively coupled plasma-mass spectrometry (ICPMS). Our results show that the near shore sponge accumulated greater concentrations of heavy metals (AI, Fe, Mn, As, Ni, Co, Cu, Se) ranging from 0.13 to 64 times higher concentration than the sponges located away from the shore. The results indicate that the accumulated metals alter the macromolecule composition (sugars, proteins and lipids) in near shore sponges. Frequent monitoring is necessary

to assess the eco-health of the marine environment by choosing bioindicator species like sponges, which provide accurate, reliable measurement of environmental quality.

2812. **Venkateswaralu, Y and M.A. Farooq Biabani** 1995. A spatane diterpene from the brown alga *Stoechospermum marginatum*. *Phytochemistry*, 40(1): 331-333.

Address : Organic Chemistry Division, Indian Institute of Chemical Technology, Hyderabad-500 007, India.

Abstract : A new spatane diterpene, 17,18-epoxy, 5(R),16-dihydroxyspat 13(14)-ene, has been isolated from a brown alga *Stoechospermum marginatum* and characterized by interpretation of spectral data and confirmed by synthesis.

2813. **Venkateswaralu, Y and R. Chavakula** 1995. Brominated benzene acetonitriles, the dibromo tyrosine metabolites from the sponge *Psammaplysilla purpurea. J. Nat. Prod.*, 58(7): 1087-1088.

Address : Organic Chemistry Division-I, Indian Institute of Chemical Technology, Hyderabad - 500 007, India.

Abstract : Three compounds, 3, 5-dibromo- 4-methoxyphenylacetonitrile[1], 3 - bromo - 4 - methoxyphenylacetonitrile [2], and 3,5-dibromo-4-methoxybenzoic acid [3], have been isolated from the sponge *Psammaplysilla purpurea* and characterized by spectral methods

2814. **Venkateswaralu, Y., M.A. Farooq Biabani and J.V. Rao** 1995. Phycopsisenone, a new phenolic secondary metabolite from the sponge *Phycopsis* sp. *J. Nat. Prod. Lloydia*, 58(2): 269-270.

Address : Organic Chemistry Division-I, Indian Institute of Chemical Technology, Hyderabad - 500 007, India.

Abstract : Crotonic acid, phenylacetic acid, 4-hydroxyphenylacetic acid, methyl 4-hydroxyphenylacetic, 4-hydroxybenzaldehyde, 4-isobutyl- alpha -methylbenzyl alcohol [1], and a new phenolic derivative, phycopsisenone [2], have been isolated from the sponge *Phycopsis* sp., and characterized by interpretation of spectral data.

2815. **Venkateswaralu, Y.** 1998. New ceramides from the sponges of Gulf of Mannar. *Indian J. Chem. Sec. B Org. Med. Chem.*, 37(12): 1264-1268.

Address : Natural Products Laboratory, Organic Chemistry Division-I, Indian Inst. of Chemical Technology, Hyderabad - 500 007, Andhrapradesh, India.

Abstract : The chemical examination of the sponges *Haliclona tenuiramosa, Tedania annhelans, Zygomycale parishii* and *Sigmadocia pumila* reveals the presence of steroids and new ceramides 1-4 and they have been characterized by spectral data. Further *Zygomycale parish*ii and *Sigmadocia pumila* afford floridoside 5 and benzaldehyde 4-(3-phenyl propionate) 6 respectively.

2816. **Venkateswaralu, Y., N.S. Reddy and P. Ramesh** 1998. A new oxygenated furano sesquiterpene from the sponge *Dysidea fragilis*. *Nat. Prod. Sci.*, 4(3): 158-160.

Address : Natural Products Laboratory, Organic Division-I, Indian Inst. of Chemical Technology, Hyderabad 500 007, Andhrapradesh, India.

Abstract : A new oxygenated furano sesquiterpene [1] has been isolated from the sponge *Dysidea fragilis* collected from Mandapam coast, Tamilnadu, India and its structure was determined by analysis of spectral data.

2817. **Verduijn, J.C.** 2000. Basic needs of 39 coastal fishing communities in Kannyakumari District, Tamil Nadu, India; A survey to investigate and prioritise problems regarding services and infrastructure. *BOBP/MM/1*. pp.1-14.

Address : Bay of Bengal Programme, Development of Small-Scale Fisheries, Madras, Tamilnadu, India.

Abstract : This document describes a survey of the basic needs of 39 coastal fishing communities of Kanyakumari district, Tamil Nadu, India, as perceived by the communities. The survey investigated and prioritized the communities needs for basic services such as water, education and health care. The survey was a co-operative effort of the Tamil Nadu Department of Fisheries, the Coastal Peace and Development Committee of the Kottar Diocese, and the Bay of Bengal Programme (*FAO/UN*). The survey was carried out during the first half of 1998 by two local enumerators in each village selected by the Coastal Peace and Development Committee.

2818. **Victor, A.C.C.** 1978. Length-weight relationship in the Malabar sole, *Cynoglossus macrostomus* Norman. *Indian J. Fish.*, 25(1&2): 259-262.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628001, Tamilnadu, India.

Abstract : The length-weight relationship of the Malabar sole, *C. macrostomus* Norman was studied. The difference between the regression coefficients of males and females was not significant at 5% level. Hence a pooled estimate was made for males and females and the length-weight relationship is described by the formula $W = 0.000007872\ L^{(2.9145)}$.

2819. **Victor, A.C.C.** 1983. Ecological conditions of the pearl culture farm at Veppalodai in the Gulf of Manner. *Symp. Ser. Mar. Biol. Assoc. India*, 6: 619-626.

Address: Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamil Nadu, India.

Abstract: The seasonal changes in atmospheric temperature, surface water temperature, salinity, dissolved oxygen, pH, turbidity and silt deposition at and in the vicinity of the pearl culture farm located off Veppalodai in the Gulf of Mannar were studied during the period from January, 1974 to December 1978. The surface exhibited a clear double oscillation every year and the atmospheric temperature, which was invariably higher, also registered two maxima and two minima. The salinity was high during the period of the southwest monsoon and low during the northeast monsoon. There was not much variation in pH values and dissolved oxygen content. The water was studied during the most part of the year, with higher dissolved oxygen content. Silt deposition was observed to be high during December. The values of primary production were high in September.

2820. **Victor, A.C.C., A. Chellam and S. Dharmaraj** 1987. Pearl oyster spat collection. *CMFRI Bulletin*, 39: 49-53.

Address : Central Marine Fisheries Research Institute,Tuticorin-628 001, Tamilnadu, India.

Abstract : The results are presented of experiments conducted using various types of spat collectors for collecting pearl oyster (*Pinctada* species) spat at Veppalodai and Tuticorin Harbour farms during November 1975-March 1981. Five different types of collectors were investigated: 1) pearl oyster shell collectors; 2) rope collectors; 3) synthetic filamentous spindle; 4) split bamboo collectors; and 5) coconut shell collectors. Findings show oyster growing baskets and cages to be the most suitable method.

2821. **Victor, A.C.C and T.S. Velayudhan** 1987. Ecology of pearl culture grounds. *CMFRI Bulletin*, 39: 78-86.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : An account is given of ecological parameters of the pearl culture farms at Veppalodai and Tuticorin Harbour. Wind, waves, currents, tides, turbidity, temperature, salinity, dissolved oxygen, pH and nutrients are described. Growth of the pearl oyster under culture conditions at the 2 farms is examined.

2822. **Victor, A.C.C., A. Chellam, S. Dharmaraj, T.S. Velayudham, K. Srinivasagam, A.D. Fernando, F. Soosai, V. Rajan, N. Jesuraj and K. Shanmugasundaram** 1993. Sea ranching of pearl oyster. *Mar. Fish. Infor. Serv. T & E Ser.*, 124: 8-13.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract In order to study the effect of ranching on the revival of pearl oyster population, several sea trips were made to different pearl beds and collected data on the population density of oysters by direct underwater observations utilizing the facilities of SCUBA diving. On several occasions the ranched spat could not be traced at the sea bottom. Unless a scientific method is devised to locate the site, it would be impossible to make further observations on the survival and growth of ranched spat. From 1975 onwards, the pearl oyster beds of Gulf of Mannar were inspected at regular intervals and oysters from the paars were collected for mother oyster culture and seeding operations. When the technology for mass production of pearl oyster spat in the hatchery laboratory was perfected, the collection of oysters from the natural beds for farming purposes came to a stand still in 1986. Thereafter from 1986 onwards the number of trips to the various oyster beds have been reduced. Between the years 1986 and 1993, Only 39 sea trips were made and as a result many paars were not surveyed. However, some data on the pearl oyster population could be obtained from M/S TNFDC, Tamil Nadu through personal communication. Dense population of pearl oysters were recorded both in the southern as well as northern group of paars.

2823. **Victor, A.C.C., A. Chellam, S. Dharmaraj and T.S. Velayudhan** 1994. Recent developments in pearl oyster research in India. *J. Shellfish Res.*, 13(1): 353.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : The occurrence of pearl oysters in the beds of Gulf of Mannar is known from time immemorial. The oysters were fished for their pearls whenever they were found to bear pearls and the fishing operations found to

be economically viable. Research on such aspects of pearl oysters as farming, production of cultured pearls and pearl oyster seed, are of recent origin and in a period of 20 years, much information particular to Indian conditions has been collected and published in various journals. Pearl oyster seed are produced in the hatchery. The scaling up of the seed production in the hatchery of the Central Marine Fisheries Research Institute at Tuticorin is achieved through investigations on oyster breeding, larval rearing, larval food production, spat-setting and in the rearing of juveniles. The inshore waters in the southeast coast of India bordering the Gulf of Mannar are shallow and unprotected to a large extent from the vagaries of nature. A farming technology to suit local conditions has been developed and the juveniles and mother oysters farmed. The formation of the nacreous coating on the implanted nuclei is rapid in the tropical Gulf of Mannar waters. Even though seasonal variation is not greatly pronounced here, experimental production of pearls during different periods has shown differential nacre growth and pearl quality. Unlike in temperate waters, all gonadial developmental stages can be encountered in the oysters throughout the year. Many of these research and development efforts carried out on the pearl oysters at Tuticorin have streamlined cultured pearl production to develop into an industry in India.

2824. **Victor, A.C.C and T.S. Velayudham** 1996. Pearl oyster farming and pearl production. *CMFRI Bulletin,*48:56-63.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Natural pearls were the oldest gems known to mankind. Long before man discovered the diamond and other precious stones, pearls were considered to be the first precious gem. The Vedas of India, the Bible and the Quran make several references to pearls as objects of adoration and worship. The natural pearls of the Gulf of Mannar and the Persian Gulf enjoyed very good reputation in the world trade from time immemorial. The Gulf of Mannar pearls are famous throughout the world as 'Orient Pearls'.

2825. **Victor, A.C.C and K. Jayabalan** 1998. On the catch of a giant octopus from Gulf of Mannar off Rameswaram. *Mar. Fish. Infor. Serv. T & E Ser.,* 157: 23.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : A female giant octopus caught at 18 m depth off Rameswaram coast measured 150 cm of total length and the dorsal mantle length of 52 cm.

2826. **Victor, A.C.C., D. Kandasami and N. Ramamurthy** 1998. On a large Sunfish landed near Mandapam. *Mar. Fish. Infor. Serv. T & E Ser.,* 157: 26.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The morphometric measurements of Sunfish landed at Mandapam is given in detail.

2827. **Victor, A.C.C.** 2000. Mandapam Regional Centre of CMFRI, Mandapam Camp: Its Research activities and achievements. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp.* pp. 1-5.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The Mandapam Regional Center of Central Marine Fisheries Research Institute at Mandapam Camp is one of the Premier Institutions for R&D in the field of Marine Fisheries Research and is an advanced center of its kind among the subordinate establishment of Central Marine Fisheries Research Institute. It is located on an impressive and picturesque elevated sand dune spread over 84 acres overseeing the Palk Bay in the north and Gulf of Mannar in the south. The history of the center dates back to 1943. The proposal for establishing various Central Fisheries Research Institutes, under the Union Government, was first made in 1943. The Fish Sub Committee of the Policy Committee on Agriculture and Fisheries in its report in 1945 endorsed this proposal. Subsequently on the basis of the "Memorandum on the proposed Fishery Research Institute" submitted by Lt. Col. RB. Seymour Sewell in 1946, the Central Marine Fisheries Research Institute (CMFRI) came into existence on the 3rd February 1947 at the Zoology Laboratory building of the Madras University. The establishment was later shifted to Mandapam Camp in 1949 where it was housed in the Naval Building Complex, which was acquired in 1946 and modified into laboratories, administrative wings and temporary residential accommodation.

2828. **Victor, A.C.C.** 2000. Sethusamudram ship canal project in the Gulf of Mannar Marine Biosphere Reserve - Its impact on environment. *Golden Jubilee Celebrations Souvenir 2000, Mandapam Regional Centre of CMFRI, Mandapam Camp,* pp. 25-27.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : The Gulf of Mannar is located on the southeastern tip of India in the State of Tamil Nadu. It is in this region India's first and foremost Marine Biosphere Reserve is located. Popularly known as the Biologists paradise, this region harbours more than 3,600 species of plants and animals, making it one of the world's richest marine biosphere reserves. Owing to its shallowness, semi enclosed nature, less fluctuating temperature regimen, biophysical and ecological uniqueness, nutrient enrichment etc., it has acquired special status in the bio-diversity map of the Indo-Pacific oceanic realm. In recent years, the Government of India has been taking steps to initiate the excavation of the Sethu Samudram ship canal in the Rameswaram Island to connect the Palk Bay with Gulf of Mannar to facilitate the passage of ships without touching Colombo and circumnavigating Sri Lanka. In the budget for the year 2000-2001, the Government of India has sanctioned funds of Rs.4.8 crores for a detailed feasibility study and environmental impact assessment of the project. While the Government of Tamilnadu has expressed its happiness over the undertaking of the project, some environmentalists have raised questions on the positive and negative impacts of the project. The primary objective of this article is to analyse the positive and adverse aspect of the project.

2829. **Victor, A.C.C., A. Chellam and S. Dharmaraj** 2000. Pearl culture, ***In***: *Marine Fisheries Research and Management,* (eds.). V.N. Pillai and N.G. Menon, CMFRI pp. 775-785.

Address : Central Marine Fisheries Research Institute, Tuticorin-628 001, Tamilnadu, India.

Abstract : Pearl culture gives the highest gross income for unit area among aquaculture systems. The techniques developed by CMFRI to suit Indian conditions have attracted the entrepreneurs to enter into the venture of pearl culture. The rate of return works out to more than 50%. The recent line of research on the onshore pearl oyster farming and pearl culture can easily revolutionize the concept and this can be profitably taken up in the east and west coasts of India where prawn farming was successfully conducted. In this paper the cost of seed production and economics of pearl production is dealt with. The possibilities of taking up production of seed of desired qualities through selective breeding, manipulation of conditions in the onshore tanks culture are counted as priorities. Black pearl production and forming and pearl culture in the natural beds are the other priorities.

2830. **Victor, A.C.C., D. Kandasamy, I. Jagadis, Boby Ignatius, A. Chellam, G. Chitra, P. Villan and M. Rajkumar** 2001. Hatchery seed production and nursery rearing of Indian pearl oyster *Pinctada fucata* (Could) under onshore and offshore conditions at Mandapam, Tamilnadu, ***In***: *Perspectives in Mariculture,* (eds.). N.G.Menon and P.P. Pillai, MBAI, Cochin. pp. 241-250.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : A full fledged pearl oyster hatchery was established at R.C. of CMFRI, Mandapam Camp along with a temperature controlled micro algal culture laboratory. The hatchery house four 5 ton capacity circular FRP tanks for storage of filtered seawater and 28 nos of 1.5 ton rectangular FRP tanks for larval rearing. A central drain of 80 m length connects the hatchery to the sea. Sea water supply is effected through 7.5 and 10 HP pumps connected to sedimentation tanks, ground level sumps and to overhead tank. Two sand filters were erected for effective filtering of seawater. Aeration is provided with air blowers and air compressors. The annual production capacity is estimated to be 2.8 million spats. Induced spawning and larval rearing gave encouraging results and 0.7 million spats were produced during June-August 1997. The temperature controlled micro algae laboratory holds stock culture of 5 important species. The laboratory can supply monoculture of micro algae to the tune of 500 l per day with cell concentration of l million/ml, along with a stock of 1000 l for subsequent harvest. Unialgal culture of *Isochrysis galbana, Nanochloropsis* sp and mixed culture of *Chaetoceros* sp were attempted and the results discussed. Observation on the growth performance of laboratory produced spats was made under onshore and offshore conditions and the results and short comings are discussed.

2831. **Victor, A.C.C., D. Kandasami, I. Jagadis, Boby Ignatius, A. Chellam, G. Chitra, P. Villan and M. Rajkumar** 2001. Results of the mother oyster culture and pearl production in *Pinctada fucata* (Gould) in the inshore waters of the Gulf of Mannar and Palk Bay. *Perspectives in Mariculture. (eds.)* N.G. Menon and P.P. Pillai, Cochin-India. MBAI. pp. 251-258.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : It is established experimentally that the inshore areas of the Gulf of Mannar and Palk Bay bordering Mandapam Camp, Tamil Nadu, India can profitably be used for mother oyster culture and cultured pearl production. The depth of the inshore waters of the Gulf of Mannar is comparatively deeper where the raft culture can be adopted from November to May, the near shore waters of Palk Bay is shallow where rack can be used to farm the oysters from June to October, thus a continued farming is possible in all months in a calendar year.

Though the hydrological and environmental conditions of both the seas are almost same, it is found that Gulf of Mannar is better suited for mother oyster culture as indicated by the better growth rates of spat and oysters. If farming is done properly, high survival rates of spat, mother oysters and implanted oysters can be achieved with an enhanced rate of production of better quality-cultured pearls.

2832. **Victor, A.C.C., Boby Ignatius and I. Jagadis** 2001. Experimental production of half pearls from tropical abalone *Haliotis varia* (Linn.) at Mandapam coast. *Mar. Infor. Serv. T&E Ser.*, 170: 9-10.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Abalones are one among the few molluscs known for producing gem quality pearls and highly priced meat. The nacre of abalone shell is often multihued in tunes of silver, orange, pink, green, blue and lavender. The abalone pearls are superior to pearls produced from freshwater mussels and comparable to best marine pearls. History of abalone pearls dates back to 5000 BC. The first recorded reference occurs in one of the Japanese oldest historical writing, the Kojiki. (ca 800 AD).

2833. **Victor, A.C.C., I. Jagadis, Boby Ignatius and A. Chellam** 2003. Perspectives and Problems of Commercial Scale Pearl Culture - An Indicative Study at Mandapam Camp, Gulf of Mannar. *1st Indian Pearl Congress & Exposition*, 5th to 8th February, 2003. pp. 73-75.

Address: Central Marine Fisheries Research Institute, Tuticorin- 628 001, Tamilnadu, India.

Abstract : Commercial scale production of cultured marine pearls was started in 1997 at Mandapam Regional Centre of Central Marine Fisheries Research Institute at the instance of the Indian Council of Agricultural Research with a sanctioned amount of Rupees thirty lakhs. The Project apart from the scientific personnel had manpower of two technicians and 10 skilled contract labourers inclusive of three nucleating technicians. The experience gained in the conduct of the Revolving Fund Project formed the basis for this study. The project had three components namely hatchery, farm and nucleation unit. A marine pearl oyster hatchery (40x6.5m) with a capacity to produce 2.0 million spats/ year was established along with a microalgal laboratory with a supply capacity of 500 l of pure culture of desired algae. A year-round production of spat could be achieved through the hatchery. A pearl oyster farm of 1000 sqm area comprising two types of culture systems, the fixed rack and the raft was established. The farm could hold one million oysters of different sizes ranging from spat to mother and implanted oysters. The rack was constructed in the near shore area with a depth of 3m on an average and the raft was floated where the depth was above 3 m. The nucleation unit was housed in a temperature controlled, dust free room (6x6.5m) with three operating tables and one conditioning/handling table in addition to a postoperative convalescence facility. On an average each technician implanted 150 oysters/day. In a period of 6 years, the production of the spat of 5mm (in DVM) amounted to 2.58 million. The duration for mother oyster production from spat ranged from 12-15 months in these waters. On an average, the mother oysters grown from the hatchery produced transplanted seeds formed 25 -30 % of the total number of oysters in this farm.

2834. **Victor, A.C.C.** 2004. Natural resources management - Coral reef ecosystem. Central Marine Fisheries Research Institute (CMFRI) Annual Report, 2003-2004: 92.

Address: Central Marine Fisheries Research Institute, Cochin-682 018, India.

2835. **Victor, A.C.C.** 2005. Abalone culture. *Proc. Ocean life food and Med. Expo.*, Aquaculture Foundation of India, Chennai, p. 284.

Address : Central Marine Fisheries Research Institute, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Considering the economic importance of the Indian abalone, *Haliotis varia* the Central Marine Fisheries Research Institute initiated experiments on its culture at the Research Centres, Tuticorin and Mandapam in 1996. A breakthrough was achieved in the larval rearing and juvenile production of this species in 1998 at Mandapam. The larva obtained from the spawning of *H. varia* passes through various stages of development namely the motile trochophore, veliger, gliding stage before settling as juvenile on the 26th day. The technology has been tested repeatedly in the hatchery and standardized. In 1999, experiments were initiated to rear juvenile *H. varia* to adult under controlled condition adopting tank culture, cage culture and barrel culture methods. Among them, cage culture was found to be the most suitable method when compared with the other methods. The juveniles were fed with different types of algal food namely, *Ulva lactuca*, *Gracilaria edulis* and *G. crassa*. Of these, *U. lactuca* was found to be the most ideal food. In 1999, efforts were made to produce half pearls in *H. varia* at Mandapam. Success came immediately when the first set of half pearls were produced at Mandapam in the year 2000 heralding the development of half pearl production technology in India indigenously.

2836. **Victor Jerald Leo, S.** 2000. Antimicrobial activity of crude extracts of some stony corals in the Gulf of Mannar and Palk Bay. *M.Phil., Dissertation* Madurai Kamaraj University. 55 pp.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625021, India.

Abstract : Majority of synthetic antibiotics are considered to be safe, because of their ability to kill the target microorganisms at extremely low concentrations. So, they can be used as therapeutic agents to treat various diseases. But some pathogenic bacteria have gained resistance to these synthetic antibiotics and also the overuse of antibiotics has contributed to a profoundly dangerous medical threat to modern health care. Hence, many chemical alternatives are being tried in recent years for combating this threat. Antimicrobial compounds from marine flora and fauna are well known for their profound physiological and pharmacological properties and thus form the basis of potent bioactive compounds. Eventhough, many bioactive compounds from marine flora and fauna have been used as drugs, not much attention has been paid for exploring the possibilities of making antibiotics out of them. Gulf of Mannar and Palk Bay contain the habitats of many corals, coral reefs and shelter a variety of flora and fauna. However, studies on the extraction of bioactive compounds from marine stony corals from this area with potential antibacterial activity are very few. Hence, in the present study, the crude extracts from stony corals were tested for antibacterial properties against *E. coli* cultures. The stony corals in this study were collected from the intertidal areas of Gulf of Mannar and Palk Bay. There are quite a number of assays used to study the inhibition growth of test organism (*E. coli*) by an antibiotic.

2837. **Victor Rajamanickam, G and V.J. Loveson** 1990. Results of Radiocarbon dating from some beach terraces around Rameshwaram Island, Tamil Nadu. ***In***: *Sea level variation and its impact on Coastal Environment.* (ed) G. Victor Rajamanickam. pp. 389-396.

Address : SASTRA University, Tanjore, Tamilnadu, India.

Abstract : Various kinds of terraces and beach ridges were observed along the Tamil Nadu coast of India between Mandapam and Kanyakumari. Terraces at Pamban area are composed of 5 small beds each averaging 0.75 to 1.5 m and consisting of fossiliferous beds, but alternatively, around Rameshwaram Island, northwest of Pamban, enormous coral stags were found. They are still seen at low tide level, having a height from 1.5 to 3 m. To demarcate and correlate the terraces with the different stages of sea level stand, 5 samples from coralline terraces were selected and their age determined by using the ^{14}C method. Their ages varied from 5440 yrs. B.P. to 140 yrs. B.P. The ages suggest the formation of coral terraces in this area during the marine transgression Mid-Holocene period.

2838. **Vijayakumar, S.** 2002. First National Marine Park in Gulf of Mannar. *The Hindu,* 23rd *April* 2002.

Address : The Collectorate, Ramanathapuram, Tamilnadu, India.

Abstract : The Government proposes to launch a Rs 110 crore, Seven year project for setting up India's first Marine National Park in Gulf of Mannar to protect the breeding and feeding grounds of endangered fauna and flora and to eliminate factors which adversely affect the ecosystem.

2839. **Vijayakumar, S.** 2003. Facelift for Pamban to Promote Eco-tourism. *The Hindu* 22nd *September,* 2003.

Address: The Collectorate, Ramanathapuram, Tamilnadu, India.

Abstract: The Balanoglossus, a unique living fossil connecting invertebrates and vertebrates, is found only around this island. Due to its biological and ecological significance, the district administration plans to develop eco-tourism on the Kurusadai Island.

2840. **Vijayaraghavan, B.** 1970. Marine fisheries in Tamil Nadu. *Seafood Export J.*, 2(1): 11-15.

Address : Fisheries Department, Tamil Nadu, India.

Abstract : The Government of Tamil Nadu has been engaged in the development of marine fisheries and fish-based industries since 1907 when the Madras Fisheries Department was established. However, concerted measures for the development of fisheries were initiated only subsequent to 1950 under the successive Five Year Plans. During this period, the State Government launched a bold and ambitious programme for the mechanisation of fishing crafts, construction of boat building yards, erection of lee plants and cold storages, establishment of freezing, canning and provision of fisheries training centres in addition to the strengthening of the co-operative organization for fishermen through the supply of loans and advances, quick transport vehicles etc., The bulk of the expenditure under the Plan Schemes has been towards the construction of mechanized fishing boats of sizes up to 32 feet and their distribution to groups of fishermen on a loan-cum-subsidy basis and on hire purchase terms.

2841. **Vijayarajan, P.K., K. Ramanathan and G. Sanjeeviraj** 1976. Seasonal wave characteristics of the Arabian Sea and the Bay of Bengal. *J. Mar. Biol. Assoc. India,* 18(1): 99-109.

Address : Naval Physical and Oceanographic Laboratory, Cochin, Kerala, India.

Abstract : Wave data reported in the Indian Daily Weather Reports for the period 1960-64 have been used to evaluate seasonal wave characteristics for each 2^o square area of the Arabian Sea and the Bay of Bengal. These results are presented in the form of charts. The maxima of the average heights in both the Arabian Sea and the Bay of Bengal (3.2 m and 3.1 m) have been observed during the monsoon season even though the number of cyclone and depression days were maximum in May and November, respectively in the Arabian Sea and Bay of Bengal. The most prominent period of waves in all seasons in both the regions was 5 or less than 5 seconds.

2842. **Vimalabai, C.P.M., S. Sudhadevarani and R. Nalina Devi** 2003. Carbohydrate and Vitamin-C contents of some macro algae of Tuticorin, Southeast coast of India. *Seaweed Res. Utiln.,* 25(1&2): 47-53.

Address : Research Centre for Plant Sciences, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Carbohydrate and Vitamin-C contents were analysed from monthly samples of 26 species of macroalgae collected during October 2001 to July 2002 from the intertidal habitats of Tuticorin coast. In general, the algae belonging to Rhodophyceae have higher annual mean content of vitamin-C (212.36µg g^{-1}) than Phaeophyceae (177.95 µg g^{-1}) and Chlorophyceae (135.74µg g^{-1}). The species which were rich in vitamin-C content are *Hypnea valentine* (670 µg g^{-1}), *Enteromorpha intestinalis* (396 µg g^{-1}) and *Stoechospermum marginatum* (336µg g^{-1}). Vitamin-C showed positive relationship with carbohydrate content in Chlorophyceae. The distribution of vitamin-C is associated with the morphogenetically important vegetative and reproductive phases indicating its key role in metabolic function.

2843. **Vimalabai, C.P.M., R. Nalina Devi and S. Sudhadevarani** 2003. Studies on agar content in Gracilaria species of Tuticorin, southeast coast of India. *Seaweed Res. Utiln.,* 25(1&2): 55-61.

Address : Research Centre for Plant Sciences, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Studies on the yield and physical properties of agar was made from October, 2001 to July, 2002 in *Gracilaria crassa, G. corticata* var. *cylindrica* and *G. folifera* growing along the red gate area of Tuticorin Coast, Tamil Nadu, India. The ash content in these three algae ranged from 13.4% to 69.7% and minimum values were recorded during December and January. Maximum agar content (59%) was found in *G. folifera* during premonsoon season. It was followed by *G. corticata* var. *cylindrica* (48.6%) in the southwest monsoon season and *G. crassa* (40%) in the postmonsoon season. Gel strength of agar varied from 19 to 105, 46 to 120 and 29 to 140 g/cm^2 in *G. crassa, G. corticata* var. *cylindrica* and *G. folifera* respectively. Seasonal variations were observed in the gelling and melting temperatures of agar in these three red algae.

2844. **Vimalabai, C.P.M and M.M. Phoebe** 2003. Distribution of trace metals in red algae, seawater and sediment of Tuticorin coast. *Seaweed Res. Utiln.,* 25(1&2): 63-68.

Address : Research Centre for Plant Sciences, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Levels of trace metals (Fe, Mn, Zn and Cu) in water, sediment and seven species of red seaweeds of Tuticorin Coast, Tamil Nadu, India were studied. The order of accumulation of trace metals was the same in water and sediment (Fe>Mn>Zn>Cu). Both interspecific and intraspecific differences were found with in the levels of each of these four trace metals in the algal species studied. *Gracilaria corticata* accumulated more of Fe and Mn, while *G. crassa* accumulated more of Zn. The concentration factors are the highest in Cu.

2845. **Vimalabai, C.P.M., P. Sumithra and R.A. Prathiba** 2004. Carrageenan content in *Hypnea* species from Tuticorin, southeast coast of India. *Seaweed Res. Utiln.,* 26(1&2): 55-61.

Address : Research Centre for Plant Sciences, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Studies on the yield and constituents of carrageenan were made from July 2002 to June 2003 in *Hypnea musciformis* and *H. valentiae* growing along the Tuticorin coast, Tamil Nadu, India. The yield of carrageenan ranged from 13.20% (August) to 52.8% (May) in *H. musciformis* and from 20.4% (January) to 59.2% (March) in *H. valentiae*. Carrageenan content as annual mean was higher in *H. valentiae* (38.3 plus or minus 10.73) than in *H. musciformis* (35 ± 11.67). Maximum amount of Gal and 3.6 A.G. and minimum amount of SO_4 were observed in February in both the species.

2846. **Vimalabai, C.P.M., R.A. Prathiba and P. Sumithra** 2004. Phenolic compounds in brown seaweeds from Tuticorin, southeast coast of India. *Seaweed Res. Utiln.,* 26(1&2): 93-98.

Address : Research Centre for Plant Sciences, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Studies on the content of total phenols and tannin were made from August 2002 to July 2003 in four species of brown algae growing along the Tuticorin Coast, Tamil Nadu, India. The total phenols content ranged from 8.3% (October) to 86.7% (July) in *Padina tetrastromatica* and from 13.3% (April) to 65.3% (September) in *Stoechospermum marginatum*. Phlorotannin content ranged from 1.8% (June) to 15.0% (April) in *P. tetrastromatica* and from 2.6 (June) to 14.6% (May) in *S. marginatum*. Total phenol content as annual mean was slightly higher in *P. tetrastromatica* (38.8 ± 24.8) than in *S. marginatum* (35.5 ± 21.1). Phlorotannin content as annual mean was higher in *S. marginatum* (7.2 ± 3.4) than in *P. tetrastromatica* (5.6 ± 3.7). These compounds from the algae exhibited antibacterial activity against *Escherichia coli*, *Pseudomonas fluorescens* and *Bacillus subtilis* but no activity against *Staphylococcus aureus.*

2847. **Vimalabai, C.P.M and S. Sudhadevarani** 2005. Seasonal studies on the carbohydrate content of some macroalgae of the Tuticorin, south east coast of India. *J. Ecobiology*. 17(1): 55-59.

Address : Research Centre for Plant Sciences, St. Mary's College, Tuticorin - 628 001, Tamilnadu, India.

Abstract : Carbohydrates were analysed in 26 species of marine algae belonging to three classes collected at monthly intervals between October 2001 and July 2002 from the intertidal habitats of Tuticorin coast. The selected algae showed species specific and seasonal variations in their carbohydrate content rhodophyceae and phaeophyceae contained 45 to 48% of carbohydrates, but chlorophyceae contained only 35%. The highest carbohydrate value was obtained in the green alga (*Ulva reticulata*) (59%) and the brown alga (*Padina tetrastromatica*) (79%) in October and in the red alga (*Hypnea musciformis*) (77%) during February. The annual mean carbohydrate was 35.3% in chlorophyceae, 45.6% in phaeophyceae and 48.1% in rhodophyceae.

2848. **Vinithkumar, N.V., S. Kumaresan, M. Manjusha and T. Balasubramanian** 1999. Organic matter, nutrients and major ions in the sediments of coral reefs and seagrass beds of Gulf of Mannar Biosphere Reserve, southeast coast of India. *Indian J. Mar. Sci*., 28(4): 383-393.

Address : Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai-608 502, Tami Nadu, India.

Abstract : Comparative investigations have been made to study the distribution pattern of organic matter, nutrients and major ions in the Gulf of Mannar biosphere reserve ecosystem. Sediment samples have been collected during January 1996 from six Islands (Shingle, Kurusadai, Kori, Pumarichan, Manauli and Hare) of this region covering coral reef zone, seagrass bed and adjacent areas. Although textural composition of sediment samples showed predominantly sandy, coral bed areas were found to have greater percentage of coral stones and shell fragments and with very low silt and clay fractions. About 0.5 to 40 % by dry weight of the sediments were made up of Ca derived from the coral and molluscan organisms, due to weathering processes. The coral reef sediments recorded low salinity and higher pH compared to seagrass bed and adjacent areas. Total organic carbon (TOC) content (1.38 to 9.11 mg/g) of the reef sediments were low when compared to the seagrass bed and adjacent areas. Higher concentrations of total nitrogen and total phosphorus were found in the coral reef zone and seagrass bed revealed that these areas may be viewed as a sink for nutrients, whereas the adjacent areas act as reservoir for nutrients. The contribution of seagrass and reef associated organisms play an important role in the recycling of nutrients in these environments. The seagrass bed sediments recorded higher Na and K concentrations than the coral reef zone and adjacent areas could be due to the utilization and trapping of these ions by seagrass and associated organisms.

2849. **Virabhadra Rao, K.** 1951. Observations on the probable effects of salinity on the spawning, development and setting of the Indian backwater oyster, *Ostrea madrasensis*. *Proc. Indian Acad. Sci*., 53B: 233-256.

2850. **Virabhadra Rao, K and K. Alagarswamy** 1960. An account of the structure and early development of a new species of a nudibranchiate Gastropod, *Eolidina mannarensis*. *J. Mar. Biol. Assoc. India,* 2(1): 6-16.

Address : Central Marine Fisheries Research Institute, Mandapam camp, Mandapam, India.

Abstract : A small nudibranch of the family Aeolidiidae was at first obtained in the month of March 1960 from a collection of squid eggs attached to weeds in a shallow water region of the Gulf of Mannar in the vicinity of the Central Marine Fisheries Research Station at Mandapam. Subsequently the same form was found to occur in fairly large numbers creeping over the sides of some large aquaria with circulating seawater in the Research Station. The glass panes of the aquaria were kept not cleaned thereafter which promoted a vigorous growth of a few sedentary organisms like the hydroids, colonial ascidians and polychaetes amidst which the nudibranchs thrived well depositing strings of their spawn. This form has been referred to the genus *Eolidina* Quatrefages,

sub-genus *Eolidina* and described as *E. (E.) mannarensis*, a species new to science. The opportunity presented by the availability of freshly laid spawn in the aquaria has enabled studying some aspects of the life history of the species.

2851. **Virabhadra Rao, K.** 1961. On two opisthobranchiate Molluscs, *Placobranchus ocellatus* and *Discodoris boholiensis* from Indian waters not hitherto been recorded. *J. Mar. Biol. Assoc. India,* 3(1&2): 253-256.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : *Placobranchus ocellatus* Hasselt 1824.- In the month of July 1960 a small sea slug from among the Sea Weeds found on dead coral in the shallow water region of the Palk Bay in front of the fish farm was collected by Dr. S. Jones. Subsequently in October 1960 two more numbers of this form were obtained by him from the same locality. These were later identified as *Placobranchus ocellatus* van Hasselt under Family Elysiidae and Order Sacoglossa (Thiele 1931a).

2852. **Virabhadra Rao, K and K. Alagarswamy** 1961. External Morphology and early development of *Pleurobranchus* sp. from Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 3(1&2): 256-259.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, India.

Abstract : In a dredge collection from the Gulf of Mannar at one and a half fathoms depth near the Central Marine Fisheries Research Institute at Mandapam Camp four numbers of a species of Sea-Slug under the genus *Pleurobranchus* Cuvier and subgenus *Oscanius* (Leach) (*vide* Thiele 1931) along with their egg ribbons were obtained on 25th December, 1960. To the best of our knowledge the form obtained has not so far been described, although Bergh (1905) in his Report on *Opisthobranchiata* of Siboga Expedition in Tabel II, gives an almost identical form as *Oscanius* sp. Unfortunately the original specimen of the Siboga Expedition as also the notes thereof were lost as stated under the legend to the figure referred to above.

2853. **Virabhadra Rao, K and K. Prabhakara Rao** 1963. *Stiliger wigrovittatus* sp. Nov. A Sacoglossan Mollusc from the Gulf of Mannar. *J. Mar. Biol. Assoc. India,* 5(2): 232-238.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : The species under the genus *Stiliger* Ehrenberg 1831 known hitherto from the coastal waters or backwaters and estuaries of India are very few. *S. pica* Annandale and Prashad (Sewell & Annandale, 1922) from Chilka Lake and S. gopalai Rao (1937) from Madras backwaters are the only species on record. *Stiliger viridis* (Kelaart) as described by Eliot (1906a) from the Ceylon coast of Gulf of Mannar and S. tentaculatus Eliot (1916) from Siam are two other species known from regions very close to Indian coasts. *S. nigrovittatus* described here is one of the few species collected by the present writers from the Palk Bay and the Gulf of Mannar in the vicinity of Mandapam. It has been experienced that a careful search among the members of filamentous algae like Chaetamorpha revealed one or the other species of the *sacoglossan, Opisthobranchs* which feed on those algae. A few individuals of *S. nigrovittatus* were obtained from the Gulf of Mannar close to the Central Marine Fisheries Research Institute, Mandapam Camp, on November 29, 1962, for the first time. Subsequently they were collected from the same locality and also from Kundagal Point near Pamban in all months upto March 1963. They were observed on algal growths of *Cladophoropsis zoolingeri* (Kuetz.) Boergs., covering the rocks in the intertidal region. In captivity they were found feeding on this alga as also on Chaetomorpha sp.

2854. **Virabhadra Rao, K.** 1967. Exploratory Fishing. *Souvenir 20th Anniversary CMFRI.* pp. 25-36.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : While the exploitation of the inshore fisheries with the help of indigenous non-mechanized craft and gear is being carried out fairly intensively from very ancient times, combing of the depths of the high seas in India using power driven vessels operating trawls and other types of gear has come into vogue only within the last few decades. Different organizations at present are conducting large scale exploratory and commercial offshore fishing operations from different bases viz., Bombay (Government of India Deep Sea Fishing Station, Directorate of Fisheries of Maharashtra State and the New India Fisheries Company Ltd.), Goa (Directorate of Fisheries, Government of Goa), Karwar (Indo-Norwegian Project), Cannanore (Indo-Norwegian Project), Cochin (Government of India Offshore-Fishing Station, Indo-Norwegian Project, The Cochin Company. New India Fisheries Ltd., Island Seafood Private Ltd.), Tuticorin (Government of India Offshore Fishing Station, Mandapam (Indo-Norwegian Project) and Visakhapatnam (Government of India Offshore Fishing Station).

2855. **Virabhadra Rao, K.** 1968. Pearl Oysters of the Indian Region. *Proc. Symp. Mollusca. MBAI,* 3: 1017-1028.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : An account of the distribution of the peral oyster species under the Genus *Pinctada* Roding in the Indian region has been given. The synonymy of *P. fucata* (Gould) and *P. vulgaris* (Schumacher) is discussed. In addition to *P. margaritifera*, *P. fucata* (Syn. P. vulgaris), *P. chemnitzi*, *P. anomiodides* and *P. atropurpurea* hitherto known form the Indian coasts, a sixth species, viz., *P. sugillata* (Reeve) collected for the first time from the pearl beds of Tuticorin and subsequently from the Madras harbour has been described.

2856. **Virabhadra Rao, K.** 1973. Distribution pattern of the major exploited marine fishery resources of India. *Proc. Symp. Living Resources of Seas around India.* pp. 18-101.

Address : Central Marine Fisheries Research Institute, Vizhinjam, Kerala, India.

Abstract : The annual estimated total marine fish catch in India for the period 1951-65 is 0.68786 million metric tons. The marine fish production of the countries bordering the Indian Ocean in 1966 was 2.2 million metric tons, of which 40.5% was from India. In the annual average catches for 15-year period in the states, Kerala has ranked first (31.47%), followed by Maharashtra (22.4%), Madras (14.91%), Gujarat (16.9%), Mysore (8.3%) and Andhra (7.57%). The contribution to marine fisheries from West Bengal, Orissa, Goa, South Andamans and Laccadive Islands is about 1% from each or even less. State wise distribution pattern of the major fish groups, the component species, their life habits in relation to seasonal fluctuations in the fisheries have been discussed. A series of illustrations has been made to show the fishing craft and gear commonly used in different States, the fish species obtained and their fluctuations in the landings from quarter to quarter. The landings by the exploratory and commercial fishing trawlers form about 1% of the total marine fish landings. The vessels operating from different bases, the common types of gear used and the catch per hour returns obtained in respect of different categories of vessels are discussed. Productive areas have been charted in the regions covered by vessels operating from Bombay, Karwar, Mangalore, Cannanore, Cochin, Tuticorin, Mandapam and Visakhapatnam. The species abundance in each region and depth wise distribution as revealed by trawler landings have been recorded. Indian Ocean contours, currents, regional upwelling, hydrology and plankton intensities have been shown in charts from the available information, to enable understanding their relation to fluctuation in the fisheries.

2857. **Virabhadra Rao, K and K. Dorairaj** 1973. Shrimp resources on the continental shelf as revealed by trawler landings from offshore waters of India. *Proc. Symp. Living Resources of seas around India.* pp. 596-613.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : An account of the region-wise shrimp landings by the trawlers operating from Bombay, Karwar, Mangalore, Cannanore, Cochin, Mandapam, Tuticorin, Visakhapatnam and Calcutta bases is given. The catch per hour of shrimp returns by the trawlers is taken as the basis for determining the area-wise and regional abundance. Productive areas, which have fairly constantly given high catch rates in different regions, have been charted. In the west coast the catch rates have been found to increase north to south, from Kutch to Cochin. Productive areas occur on the continental shelf in the Gulf of Cambay, off Bombay, Ratnagiri, Vengurla-Dabhol, Karwar, Mangalore, Cannanore, Cochin and Alleppey. On the east coast the shrimp catches are comparatively less. However some productive prawn grounds have been located off Tuticorin, Mandapam, Kakinada and Visakhapatnam. In West Bengal also fairly productive grounds have been recorded from the Eastern Channel, off Debi-Prachi rivers and the Western Channel. The seasonal and depth-wise abundance of shrimp species in different regions has been investigated.

2858. **Virabhadra Rao, K.** 1973. On Dendronotacean Nudibranch Gastropods of the Genera *Hancockia* and *Doto* from the Gulf of Mannar. *MBAI Spl. Publ.*, 321-332.

Address : National Institute of Oceanography, Panaji, Goa, India.

Abstract : *Hancockia papillata* (O' Donoghue) has been redescribed, based on an examination of living material obtained from the Gulf of Mannar along the Indian coast. As compared with other species under the genus, *H. papillata*, is devoid of jaws. Tubercles and branched papi1lary processes over the surface of the Rhinophores and the dorsum are very characteristic of this species. The radula is triseriate as in other members under the genus. The spawn and early developmental stages have been described. The larva has an elongated spirally coiled shell and the excretory organ is reddish brown. The larval shell bears a pair of small denticulations at the base of the aperture. The general structure and early development of a dotonid species, also obtained from the Gulf of Mannar, have been described and compared with some of the known species under the genus *Doto.* This species is characterized by the presence of an abbreviated oral veil, nonbranchiate cerata with tubercles in 3 to

4 circlets and rhinophore sheath with spoon-shaped extension in the anterior margin. The dorsum and the sides are without papillary processes. The larval shell is a short spire. The veliger when hatched is without the pigmented eyespots and the excretory organ is colourless.

2859. **Virabhadra Rao, K and K.S. Rao** 1974. Pearl Oysters. *CMFRI Bulletin*, 25: 84-105.

Address : Central Marine Fisheries Research Institute, Cochin - 682 018, India.

Abstract : Pearls are formed in a number of species of molluscs *viz.*, the pearl oysters, window-pane oysters, edible oysters, freshwater mussels, abalones, chanks, topshells, turban shells etc., Pearls formed in some of the pearl oyster species are valued very highly as Gems because of their excellent shape, quality and lustre. Pearl oysters enjoy a world-wide distribution occurring in almost all the seas of the tropical belt. Six species of pearl oysters are known from the Indian coasts viz. *Pinctada fucata* (Gould), *P. margaritifera* (Linnaeus). *P. chemnitzii* (Philippi), *P. sugillata* (Reeve), *P anomioides* (Reeve) and *P. atropurpurea* (Dunker). Of these, *P. fucata* which occurs in extensive beds in the Gulf of Mannar and to a much less extent in the Gulf of Kutch is commercially very important being the source of the 'Oriental pearls' or Lingah pearls of great renown. *P. fucata* occurring in the Persian Gulf and off the coasts of Ceylon also supports excellent fisheries for natural pearls. The Indian pearl fisheries have been famous since ancient times for the most beautiful pearls they yield. The other five species of pearl oysters on the Indian coasts are not of any importance as their pearl yield is low or the pearls produced by them are not of high quality.

2860. **Virabhadra Rao, K and L. Krishna Kumari** 1974. On some aspects of Taxonomy, structure and early development of the nudibranchiate Gastropod *Discodoris fragilis. J. Mar. Biol. Assoc. India*, 16(3): 689-699.

Address : National Institute of Oceanography, Panaji, Goa, India.

Abstract : The present paper deals with observations on specimens of a doridacean nudibranch, *Discodorisfragilis* (Alder & Hancock) found among the sea grass *Cymodocea ciliata* in the Palk Bay lagoons along the south eastern coast of India. *D. fragilis* is a widely distributed species in the Indo-Pacific. The species has often been confused by same workers with other species having certain outward resemblances. With the help of photographic representations the taxonomic characters of the species have clearly been described. The morphological characters of this species with related species have been compared. The nature of the dorsal tubercles which are low conical spiculate and with blunt white tips, the foot with a frontal groove but without a median notch, the rhinophores each with a write line on its posterior face, the labial disc having paired elongated triangular patches of close-set rodlets, the radula with a varying number of lateral hamate teeth in numerous transverse rows but without the rachidial teeth, an enlarged prostate in two distinct lobes and a conical penis without armature among the reproductive organs are good taxonomic characters when taken along with the distinct pattern of coloration of the mantle and the foot. The mantle is very fragile and the animal often autotamizes it in portions. The mating habits, spawn and early developmental stages have been described. The just hatched veliger measured about, 180 p. on its long axis, having rather a broad spiral shell of a pale pinkish hue.

2861. **Virabhadra Rao, K and N.S. Rao** 2003. Assessment of quality of Harbour waters in major ports of India: Part III - Madras (Chennai) and Tuticorin ports. *Indian J. Environ. Prot*., 23(9): 1025-1032.

Address : Shiva Analyticals (India) Limited, KIADB Industrial Area, Plots 24 D (P) and 34 D, Bangalore Rural North, India; Chemistry and Catalyst - Analytical, G.E. Indian Technol. Ctr. Pvt. Ltd., Hoodi Village, Whitefield Road, Bangalore - 560 066, India; Analytical Chemistry Laboratory, School of Chemistry, Andhra University, Visakhapatnam - 530 003, Andhrapradesh, India.

Abstract : The harbour waters of Madras and Tuticorin ports were assessed for their quality. The polluted conditions in the harbour waters of Madras port was found to be mainly due to the Coom river waters, which brings the industrial effluents, city's sewage, entering the open sea very close to the harbour. Significant positive correlations between zinc, copper and cadmium and also between manganese and iron for the harbour waters of Madras port suggested the existence of common sources for these pollutants. The harbour waters of Tuticorin port are less polluted compared to that of Madras port. The influence of industrial effluents and the polluted fishing harbour waters on the harbour water quality of Tuticorin port is less because of the unfavorable average littoral drift at Tuticorin port.

2862. **Visvanathan, M.A and V. Krishnamurthy** 2005. Hydrophycology of the salterns in Kanyakumari and Tuticorin districts. *Nat. Symp. Marine Plants, Their Chemistry and Utilization*. Seaweed Research and Utilization Association, Mandapam Camp and Suganthi Devadason Marine Research Institute, Tuticorin, 23-25 June 2005. p 66.

Address : Krishnamurthy Institute of Algology, Mahalingapuram, Chennai- 600 034, Tamilnadu, India.

Abstract : Salterns are the places where commercial salt *i.e.*, sodium chloride is prepared by solar evaporation. Salterns are also the habitats of several microorganisms like Bacteria, Fungi, Algae and Protozoan and macro organisms like *Artemia* and water insects. These organisms exhibit extreme characters suited to the extreme environment in which they are living. This type of habitat is interesting and has to be explored for its effect on microorganisms. In this work, the hydrophycology of two salterns from Kanyakumari and Tuticorin have been dealt with. The water and soil samples were collected from the two salterns. The algal diversity has been identified for each water and soil samples. Physical parameters of the water were recorded and determined by analysis.

2863. **Viswanathan, R.** 1959. Characteristics of seawater off Mandapam, 1950-1954. *J. Mar. Biol. Assoc. India*, 1(1): 85-88.

Address : Central Marine Fisheries Research Institute, Mandapam Camp, Tamilnadu, India.

Abstract : Some of the chemical and biological characteristics of sea water off Mandapam have been analyzed for trends. Salinity and dissolved oxygen were lower in Palk Bay than in the Gulf of Mannar. Oxygen-phosphate relationship and likewise trends in phytoplankton were different; it is considered likely that this association is of some significance.

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2864. **Wafar, M.V.M.** 1974. Nematocysts in four species of corals. *Mahasagar,* 7(1&2) : 119-123.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : The types and distribution of nematocysts in four coral species were studied. Of the 20 major categories of nematocysts recognized in the phylum Cnidaria, five types were encountered in these four corals. They were *Holotrichous isorhizas, Atrichous isorhizas*, *Microbais mastigophore*. The type of nematocysts and their abundance varied from coral to coral and even within a single species, the relative distribution of a given type of nematocyst varied in different parts of a polyp. It is suggested that the differences in the nematocysts could be used in the classification of corals.

2865. **Wafar, M.V.M.** 1986. Corals and Coral reefs of India. *Proc. Indian Acad. Sci. (Anim. Sci./Plant Sci.) Suppl., November* 1986: 19-43.

Address : Biological Oceanography Division, National Institute of Oceanography, Dona Paula, Goa, India.

Abstract : This paper summarises the present state of knowledge on the ecology, productivity and resources of Indian coral reefs. In Indian waters, reef-building corals occur at, Palk Bay, Gulf of Mannar, Gulf of Kutch and central west coast along the mainland India, Andaman and Nicobar islands in the Bay of Bengal, and Lakshadweep Islands and Gaveshani Bank in the Arabian Sea. Coral formations at Palk Bay, Gulf of Mannar, Andaman and Nicobar islands are of fringing type. Patch reefs occur along the central west coast, on the Gaveshani Bank and around Gulf of Kutch islands. Lakshadweep islands are well developed atoll reefs. Diversity of coral genera is the greatest in the Nicobar Islands, with 42 genera followed by Lakshadwecp islands (28), Gulf of Mannar (26), Andaman Islands (25), Palk Bay (21), Gulf of Kutch (20), central west coast (9) and Gavcshani Bank (5). *Acropora* is the most diverse genus in Indian reefs whereas *Porites* is the most important reef builder. Gross primary production of Indian reefs vary from 2 - 4 to 9.1 g $Cm^{-2}d^{-1}$ which are in the range known for world reefs. All reefs studied are autotrophic with the exception of one reef in the Andaman Islands. Bulk of the primary production is contributed to by benthic autotrophs, and phytoplankton production is negligible. Nannoplartkton is an important fraction of phytoplankton in reef waters. The corals recycle and conserve nitrogen very efficiently accounting for the high primary productivity of the reefs located in oligotrophic waters. Production of particulate organic aggregates is an important pathway of energy transfer in coral reefs and can be as high as 20% of gross production. Food fishes and aquarium fishes constitute the pelagic resources of coral reefs. The potential food fish yield from all Indian reefs is about 0.2 million tons yr^{-1}. Potential yield and export value of aquarium fishes, however, are not known. Corals are the most important of benthic resources and are exploited in commercial quantities from the Gulf of Mannar reefs. Coral sands to the extent of about a million tonnes are dredged annually from the Gulf of Kutch. Pearl oyster and chank constitute the major molluscan fisheries in Gulf of Mannar reefs. Trade for ornamental shells is also an important industry in many of the Indian reef areas. Overexploitation of coral resources is a serious threat to Indian reefs. Calcareous sand mining in the Gulf of Kutch has led to the destruction of more than 50% of coral life. In Gulf of Mannar, selective overexploitation of massive corals has adversely affected several reefs. Coral mining also leads to shore erosion, as in the Lakshadweep islands. The increasing trade in corals for ornamental purposes is also a contributing factor to the decline in coral resources. Present management and conservation measures for Indian coral reefs are inadequate. So far, only Gulf of Kutch reefs have been declared as Marine Sanctuary and Marine National Park, and thus enjoy legal protection. Proposals to declare other reef areas as Marine National Parks are yet to be implemented. In certain reef areas, protection for overexploited species exists; however, its enforcement is not strict. Proper management of space and species of coral reefs, and creation of an awareness among the public of the importance of the coral reef ecosystem, are the measures urgently needed for the conservation of our coral reefs.

2866. **Wafar, M.V.M.** 1990. Global warming and coral reefs. *Sea level variation & its impact on Coastal Environment,* pp. 411-437.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamil Nadu, India.

Abstract : Ever increasing global warming trend is predicted to cause within the next 100 years an accelerated sea level rise, increase in sea surface temperature and enhanced ultraviolet radiation to be significant enough extent to drastically affect marine communities. Among the latter, the coral reefs are the most vulnerable because of their occurrence near the shoreline and close to the sea surface, and also because of their sessile nature. Besides, coral reefs respond quantitatively and qualitatively to sea level changes, and the reef structures thus preserve environmental signatures to reconstruct past sea level changes. This review summarizes the present

state of knowledge on inferred Holocene sea level changes and reef structures in the Indian seas, and presents predictions of the possible deleterious effects the global warming can have on coral reefs in general, and the Indian reefs in particular.

2867. **Westheide, W.** 1992. New interstitial Polychaeta (Hesionidae, Dorvilleidae) from the littoral of the Bay of Bengal. *Microfauna Mar.*, 7: 147-157.

Address : Spez. Zool., Fachber. Biol./Chem., Univ. Osnabrueck, Postfach 44 69, D-W 4500 Osnabrueck, FRG.

Abstract : Three species of interstitial meiofauna polychaetes new to science are described from and shallow subtidal sandy sediments. *Hesionides bengalensis* n. sp. (Hesionidae) was found in sandy beaches of the Island of Phuket (Thailand); some specimens from South Andaman formerly considered to belong to *Hesionides indooceanica* were included into the new species. The dorvilleid *Parapodrilus indicus* n. sp. was discovered in a beach at Mandapam, Gulf of Mannar it shows close relationship to the European *Parapodrilus psammophilus*, which was the only species of this genus hitherto known *Microdorvillea phuketensis* n. sp. from sandy patches between coral reefs on Phuket and South Andaman is another dorvilleid of a hitherto monotypic genus.

2868. **Whitaker, R.** 1985. National use of estuarine and marine reptiles. *Proc. Symp. Endangered Marine Animals and Marine Park, MBAI,* 1: 298-303.

2869. **Whitehead, H**. 1985. Humpback whale songs from the North Indian Ocean. *Invest. Cetacea*, 17: 157-162.

Address: Newfoundland Institute of Cold Ocean Science, Memorial University, Newfoundland, St. John's, Newfoundland, A1B 3X7, Canada.

Abstract: Humpback whale songs were heard off Oman in January 1982, and in the Gulf of Mannar, Sri Lanka, during February and March 1982. The songs recorded in these two locations were similar to one another, but different to those from the North Atlantic or North Pacific. This, and other evidence, suggests that there is a small population of humpbacks, which spends the whole year within the N. Indian Ocean.

2870. **Wilhelmsson, Dan., J.K. Patterson Edward, Arjan Rajasuriya, Jerker Tamelander and Nishanthi Perera** 2006. Assessing the status and improving management of coral reef resources: Experiences and achievements in south asia. pp. 66-82. ***In*: *Coral reef degradation in the Indian Ocean.*** CORDIO, Sweden. 285 pp.

Address : CORDIO South Asia, Colombo, Sri Lanka.

Abstract : Close to half of the world's poor people live in South Asia (UNICEF, 2001; Samarakoon, 2004). Ramachandran (2002) identified population growth, insufficient food production, and underdevelopment as the major problems in the region. Open access to the sea, poverty, and an increasing demand for fishery products has escalated pressure on coastal resources (e.g. James, 1994; Devaraj & Vivekanandan, 1999; Bhattacharya & Sarkar, 2003; Perera *et. al.*, this volume). For example, in India, the number of fishermen in coastal villages increased from two million to six million between 1980 and 1997 (Meenakumari, 2002). Moreover, growing commercial fleets operating in near-shore waters to supply expanding export markets cause habitat destruction and deprive local communities of fish products and a cheap source of nutrition (Jayashree & Arunachalam, 2000; Bavinck, 2003; Bhattacharya & Sarkar, 2003). About 10% and 15% of the total fish catches in India and Sri Lanka respectively are derived from coral reefs by small-scale fishermen (Wafar, 1986; Rajasuriya *et. al.*, 1995). Although this is a considerable proportion of the national fish catches, these statistics do not adequately illustrate the actual situation in many areas in the region where hundreds of thousands of poor people depend solely on the products of coral reefs for food and livelihood.

2871. **Williams, G.P and S. Ravikumar** 2004. Lipid biomarkers for Halobacterial chemotaxonomy. *Seshaiyana*, 12(2): 8.

Address : Centre for Marine Science and Technology, Manonmaniam Sundaranar University, Rajakkamangalam-629 502, Kanyakumari, Tamilnadu, India.

Abstract : Identification of fresh isolates from microbes is a continuing task for marine microbiologists. Identification of marine bacteria is commonly based on a wide range of biochemical and physiological tests and it takes time. It is also problematic due to lack of agreement between the results of biochemical tests. The reason stems from the differences in the biochemical features of fresh and stored isolates (Akagawa - Matsushita *et. al.*, 1992). In fact, plasmid DNA is lost during storage. Recent advances in the biochemistry of microorganisms have shown that analysis of cell components such as proteins and fatty acids provides the basis for chemotaxonomy, which can be effectively used in bacterial identification (Goodfellow and Minnikin, 1985).

2872. **Wilson, J.J.** 2000. Studies on the taxonomic status of two undescribed species of Chicoreus (Class : Gastropoda; Family : Muricidae) collected from Gulf of Mannar, Southeast Coast of India. *M.Sc., Dissertation*, Alagappa University, Karaikudi, Tamilnadu, India. 26 pp.

Address : Department of Oceanography and Coastal Area Studies, Thondi Campus, Alagappa University, Karaikudi - 630 001, Tamilnadu, India. E-mail: jjeraldwilson@hotmail.com

Abstract : The present study reveals the description of two unknown species and taxonomy of presumed species of Chicoreus (No. 4) and presumed subspecies of Chicoreus (No. 5) collected from Mandapam waters, southeast coast of India. In the course of continuing the study on the Muricidae of the southeast coast of India, we frequently encountered an undescribed species from Mandapam waters. Many species have been made available for examination. I have recently recognized two presumed new and subspecies of Chicoreus (No. 4) and (No. 5) placed under the genus Chicoreus. The identification is mainly based on external morphology viz., variation of the shell, varice, siphon canal, shape and size of the aperture. In presumed species Chicoreus (No. 4) and subspecies of Chicoreus (No. 5) differ from one another having weak varix, heavy node, deep narrow space and shape of the aperture and edge of the outer lip.

2873. **Wilson, J.J., N. Marimuthu and A.K. Kumaraguru** 2004. Sedimentation of Sceleractinian corals of Palk Bay in the southeast coast of India. *Nat. Sem. Ecological Balance and Sethusamudram Canal*; Department of Oceanography and Coastal Area Studies, Alagappa University, Thondi- 623 409, 1st to 3rd Oct'2004. p. 54.

Address : Centre for Marine and Coastal Studies, Madurai Kamaraj University, Madurai- 625 021, Tamilnadu, India. E-mail: jjeraldwilson@hotmail.com

Abstract : The corals of Palk Bay are fringing and patchy type distributed from Rameswaram to Vedhalai (North). The northeast monsoon brings large quantities of sediments to the Palk Bay compared to southwest monsoon. The 2002 bleaching event caused severe mortality among the corals of Palk Bay reefs. Abnormal atmospheric depression which occurred in June- 2004 resulted in high accumulation of sediments in the Palk Bay region. A study was conducted to assess the biophysical status of corals of Palk Bay using Line Intercept Transects, Sediment traps and SCUBA diving techniques. The coral reefs of Palk Bay were divided into three zones and each zone was repeatedly observed from June-2004 to Sep-2004. The Live-Coral and Sedimentation rates were monitored in this study and the results are discussed.

2874. **Wilson, J.J., N. Marimuthu and A.K. Kumaraguru** 2005. Sedimentation of silt in the coral reef environment of Palk Bay. *J. Mar. Biol. Assoc. India*, 47(1): 83-87.

Address : Centre for Marine and Coastal Studies, School of Energy Sciences, Madurai Kamaraj University, Madurai - 625021, Tamilnadu, India. Email: jjeraldwilson@hotmail.com

Abstract : The sedimentation of silt in five locations in the coral reef environment of Palk Bay was studied for a period of six months form May to October 2004 for a rapid assessment. The rate of sedimentation was in the range 1mg/cm^2/d to 42 mg/cm^2/d. The sedimentation was greater during June 2004 coinciding with the onset of southwest monsoon season. An assessment of live coral cover indicated that there was less coral cover in the location where there was greater sedimentation. Corals of the family Acroporidae were found to be severely affected.

2875. **Winckworth, R.** 1927. Marine Mollusca from India and Ceylon. 1. Dentalium. *Proc. Malac. Soc. Lond.*, 17: 167-169.

2876. **Winckworth, R.** 1928. Marine mollusca from India and Ceylon. II. Limpets. *Proc. Malac. Soc. London*, 18: 133-136.

2877. **Winckworth, R.** 1929. Marine mollusca from India and Ceylon III. Pinna with an index to the recent species of Pinna. *Proc. Malac. Soc. Lond.*, 18: 206-208.

2878. **Wolstenholme, J and K. Venkataraman** 2003. Identification of Scleractinian corals. *Coral Taxonomy Training Workshop, India-Australia Training and Capacity Building Project, MoEF, Delhi*. 265 pp.

Address : Museum of Tropical Queensland, Australia & Zoological Survey of India, Chennai, India.

Abstract : The Gulf of Mannar reefs are developed around a chain of 21 islands that lie along the 140 km stretch between Tuticorin and Rameswaram. These islands are located between latitude 8° 47' N and 9° 15'N and longitude 78° 12'E and 79° 14' E. The islands lie at an average distance of 8 km from the mainland. They are a

part of the Mannar Barrier reef, which are 140 km long and 25 km wide between Pamban and Tuticorin. Different types of reef forms such as shore, platform, patch and fringing type are also observed in the Gulf of Mannar. The islands have fringing coral reefs and patch reefs around them. Narrow fringing reefs are located mostly at a distance of 50 to 100 m from the islands. On the other hand, patch reefs rise from depths of 2 to 9 m and extend to 1 to 2 km in length with width of as much as 50 meters. Reef flat is extensive in almost all the reefs in the Gulf of Mannar. Reef vegetation is richly distributed on these reefs. The total area occupied by reef and its associated features is 94 sq km. Reef flat and reef vegetation including algae occupies 65 and 14 sq km, respectively (DOD and S.A.C., 1997). Usually monsoons, coral mining and high sedimentation load affect the visibility. These reefs are more luxuriant and richer than the reefs of Palk Bay. Pillai (1986) provided a comprehensive account of the coral fauna of this region. There are about 94 species of corals belonging to 32 genera in the Gulf of Mannar. The most commonly occurring genera of corals are *Acropora, Montipora* and *Porites.* Coral associates such as ornamental fishes belonging to the family Chaetodontidae, (butterfly fish); *Amphiprion* spp (clown fish), *Holocentrus* spp (squirrelfish), *Scarus* spp (parrotfish), *Lutjanus* spp (snapper fish) and *Abudefduf saxatilis* (sergeant Major) are found. Extensive seagrass beds are present; green turtles, olive ridley turtles and dugongs are dependent on the seagrasses.

X

2879. **Xavier Ramesh, M., I. Emerson Kakoo, A. Benny and K. Ayyakkannu** 1991. Muricid shell trade in southeast coast of India. *Spec. Publ. Phuket Mar. Biol. Cent.,* 9: 57-58.

Address : Centre for Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : A brief account is given of the exploitation of muricid shells in the southeast coast of India. The major trading centres are Cuddalore, Rameswaram, Madampam, Tuticorin, and Cape Comorin. The collection of shells, shell sales, shell processing and the marketing of processed shell and operculum are discussed.

2880. **Xavier Ramesh, M and K. Ayyakkannu** 1992. Nutritive value of *Chicoreus ramosus*: A status report. *Proc. Second Workshop of the Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent.*, 10: 14.

Address : Centre for Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : A brief account is given of the nutritive value of *Chicoreus ramosus*, a Gastropod which forms a good substitute to other more expensive protein rich food sources. The biochemical composition of the foot, the only suitable part of the gastropod for consumption, is described. At present, the *C. ramosus* foot muscle is exported from the Gulf of Mannar and some parts of the Coromandel Coast of India to Southeast Asian countries.

2881. **Xavier Ramesh, M., J.K. Patterson Edward and K. Ayyakkannu** 1992. Reproductive biology of *Chicoreus ramosus* from Mandapam coastal waters, southeast coast of India. *Proc. Second Workshop of the Tropical Marine Mollusc Programme* (*TMMP*) at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent.*, 10: 80-85.

Address : Centre for Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of a study conducted to obtain information on the reproductive biology of *Chicoreus ramosus* from the Mandapam waters of India. The sex ratio, germ cells, sperm, spawning, egg capsules, fecundity and environmental parameters involved are described.

2882. **Xavier Ramesh, M., A. Murugan and K. Ayyakkannu** 1992. Larval development in *Chicoreus ramosus. Proc. Second Workshop Tropical Marine Mollusc Programme (TMMP)* at Annamalai University, India, 4th to 14th May, 1992. (eds) J. Hylleberg, K. Ayyakkannu and S. Khokiattiwong. *Phuket Marine Biol. Cent*., 10: 86-89.

Address : Centre for Advanced Study in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamilnadu, India.

Abstract : The findings are presented of a study conducted regarding the larval development of *Chicoreus ramosus* from the Gulf of Mannar area off the southeastern coast of India. A description is given of the morphology of the larvae at various stages of development. Juvenile stages were observed after day 45, and even though no special substratum was provided for settlement, most larvae completed metamorphosis. Implications of the information obtained to the feasibility of the culture of this species are considered briefly.

2883. **Xavier Rodrigo, J.** 1986. Islands around Mandapam. *Souvenir, 35th Anniversary, Recreation Club of Regional Centre of CMFRI, Mandapam Camp,* pp. 22-24.

Address : Central Marine Fisheries Research Institute, Mandapam Camp - 623 520, Tamilnadu, India.

Abstract : Islands generally attract the attention of people with different interests. The islands around Mandapam offer the biologists a rich treasure of biological specimens. They also offer various areas of study for biologists. geologists and oceanographers. For common public they can be converted into attractive tourist spots where they can spend their time forgetting their worries in their routine life.

Y

2884. **Yadav, K.P.S.** 2006. Short circuit. *Down to Earth*, 15th March, p. 35.

Abstract : On the face of it, the ambitious Sethusamudram project to bridge the east coast with the west coast of the country seems a great idea. The prospect of not having to circumnavigate Sri Lanka and cutting short travel periods by 30 hours sounds as interesting as it did 150 years ago when a draft plan for the canal was first mooted. A Tamilian dream is now beginning to take shape. The channel across the Palk Straits between India and Sri Lanka is expected to be operational by 2008: it will allow ships sailing between the east and west coasts of India a straight passage through India's territorial waters, instead of circumnavigating Sri Lanka. India doesn't have a continuous navigable route here due to the presence of a shallow ridge (1.5 metre to 3.5 metre deep) called 'Adam's Bridge'. The Palk Bay is also too shallow for navigation. The Rs 2,427-crore Sethusamudram Shipping Canal Project (SSCP) will create a continuous ship channel by dredging Adam's Bridge and the shallow parts of Palk Bay. The channel's total length will be 167.5 km. Of this, about 90 km needs dredging, which will be done for 35 km length in the southern leg at Adam's Bridge and for a length of 54 km in the northern leg at Palk Straits. Intervening stretches of Palk Bay, not requiring dredging, is 78 km long. Dredging will be done to achieve a depth of 12 metres for ships with a draft of 10 metres, those that reach 10 metres into the water. In terms of weight, a fully loaded 30,000 deadweight tonnage ship will sail through. The EIA report is one of the most contentious of issues. The final EIA report was submitted by NEERI to TPT in May 2004. It was paid Rs 1-crore to put together the EIA and the techno-economic feasibility report. About a year earlier, NEERI had submitted a rapid EIA. Many activists and professionals believe that the same was later submitted as the comprehensive report. The Gulf of Mannar region is among the richest marine biological resource regions in the world. The Gulf of Mannar Marine Biosphere Reserve is the first marine biosphere reserve in the southern and Southeast Asian region. The Gulf was chosen as a biosphere reserve primarily because of its biological and ecological uniqueness. The Gulf of Mannar National Park constitutes 21 islands, all surrounded by coral reefs. Both the Gulf of Mannar and Palk Bay have, till date, remained undisturbed by shipping traffic and have nurtured a large number of faunal and floral species. As per the Union ministry of environment and forests (MOEF), the Gulf of Mannar has about 3,600 species of flora and fauna. Of these, 377 are endemic to the region. Ecologists fear that locating such a huge project, which requires large amounts of dredging, so close to a biodiversity hotspot might lead to irreparable damage to its biodiversity. The total amount of dredged material for the entire project stands at a whopping 82.5 million cubic metres (mcm). This amount of mud, if spread on land, will create an 82,500 km long wall of one metre width and one metre height. This is one of the biggest dredging projects ever undertaken. By mid-January, "Dredge-12", a dredger of DC I, had already removed three mcm of seabed material from the Palk Straits region. The ship is currently dredging the sea floor in the Palk Straits, 25 km off the coast from Point Calimere in Nagapattinam district. Project authorities say they have made sure that dredging and dumping will not have any adverse impacts.

2885. **Yadava, Y.S.** 2000. Report of the national workshop on the code of conduct for responsible fisheries, 29-30 September, 2000, Chennai, India, *BOBP Report No. 90* : 1-166.

Address : Bay of Bengal Programme, Chennai, Tamilnadu, India.

Abstract : The Code of Conduct for Responsible Fisheries is one of the most important international instruments devised for wholesale management of the living aquatic resources of our planet. The Code is an outcome of several contemporary global initiatives, which expressed concern about the overexploitation of important fish stocks, damage to the ecosystems, economic losses, and issues affecting the fish trade. As a first step toward promoting implementation of the Code of Conduct for Responsible Fisheries in India, a National Workshop for coastal States and Union Territories was organized by the Bay of Bengal Programme (BOBP) in association with the Government of India at Chennai during 29-30 September 2000. The objectives of the Workshop were to fully familiarise government functionaries with the elements of the Code and the technical guidelines that have been prepared by FAO to assist member-countries in implementing the Code. The National Workshop brought together senior fisheries administrators working with the Union Ministry of Agriculture and the State and Union Territory Governments, scientists and experts from fisheries institutions, and representatives from national and international NGOs. The Workshop, saw an enthusiastic participation by 43 delegates and incidentally, it was the first occasion when senior fisheries administrators from the Union and the coastal States and Union Territories had assembled to discuss the Code and arrive at an implementable plan of action. For many of the participants, the Workshop also marked the first systematic exposure to the Code of Conduct. The two-day Workshop highlighted several problems concerning implementation of the Code in a large country like India. Keeping in view the strengths and weaknesses of national and state governments, the vastness of the country and the diverse and highly complex

demographic and sociopolitical fabric, the planners and experts concluded that massive efforts would be needed to take the Code to the grassroots level quickly in India. The report contains the Plan of Action and the papers presented at the Workshop by the experts and senior officers representing the coastal States and the Union Territories.

2886. **Yapa, K.K.A.S.** 2000. Seasonal variability of sea surface chlorophyll-*a* of waters around Sri Lanka. *Proc. Indian. Acad. Sci. Earth Planet Sci.,* 109(4): 427-432.

Address : Department of Physics, University of Ruhuna Matara, Sri Lanka.

Abstract : Remotely sensed data on ocean colour of waters surrounding Sri Lanka received from the Coastal Zone Colour Scanner (CZCS) are processed and analyzed. Raw data of 1 km resolution on relatively cloud free days during 1978-1986 are processed to produce sea surface chlorophyll maps within latitudes 4.5° N – 11° N and longitudes 78° E – 85° E, a region in the Indian Ocean surrounding Sri Lanka. The processed data include about 110 single day maps and composite averages for each month and season. The months of July, August and September are omitted in the calculation of averages due to insufficient data. The waters in the Gulf of Mannar and Palk Bay areas show high chlorophyll-*a* concentrations throughout the year. However, these high values may represent other suspended particles and dissolved organic matter besides chlorophyll-a as this region is shallow (< 100 m). Regions with high chlorophyll concentrations (> 0.5 mg m^3) along the coast and western ocean region can be seen in the months of October and November, after the southwest monsoon period. As high surface chlorophyll concentrations may indicate high productivity, these regions need extensive measurements of primary production and also continuous monitoring of fish catches, during and after the southwest monsoon. Studies of particle composition in shallow water areas, in particular waters in Palk Bay and Gulf of Mannar, should be carried out in order to elucidate the effect of non-phytogenic.

2887. **Yavari, V.** 2002. Growth of *Crassostrea madrasensis* (Preston) at Tuticorin along the southeast coast of India. *J. Mar. Biol. Assoc. India,* 44(1&2): 46-58.

Address : Shahid Chamran University, Ahwaz, Iran.

Abstract : The growth and mortality of *Crassostrea madrasensis* were monitored at three stations along the Tuticorin coast, Tamil Nadu, India over a 26-month period. Three categories of station-related growth (high, medium and low) were defined by comparisons of growth curves for different body variables. The mortality of the oyster was comparatively very low (5%), moderate (25.6%) and very high (50.7%) at stations 1,2 and 3 respectively. The results of the principal component analysis and analysis of variance applied to the hydrological parameters of the three experimental stations revealed a significant difference in the levels of turbidity, and chlorophyll-*a* concentrations. The variations in growth and mortality between the stations are discussed in terms of difference in the levels of the above parameters. The results of the study indicated that food availability and turbidity might be the principal factors determining the growth and survival of this oyster in its natural environment.

Units of Measurements

bp	Base Pair
$Bq.kg^{-1}$	Becqurels per kilogiram
CF	concentration factor
cfu	Colony forming Unit
cm	Centimeter
fm	Fathom
fwt	Fresh weight
$g.Kg^{-1}$	gram per kilogram
$g.l^{-1}$	gram per liter
gm	Gram
g / m^3	Gram per cubic meter
Kg	Kilogram
Km	Kilometer
Km^2	Square Kilometer
L or l	Liter
lbs	Pound (British)
m	Meter
$mBq.l^{-1}$	milli Becqurels per liter
mcm	million cubic metres
mg	milligram
$mg\ C/m^3/h^1$	milligram Carbon per cubic meter per hour
ml/l	milli litre per litre
mm	millimeter
$mSv.y^{-1}$	milli Sivet per year
mt	Metric tonne
ng	Nanogram
No/l	Number / liter
pg	Picogram
ppm	parts per million
ppt	parts per thousand
RMSE	Root Mean Square Error
rpm	Rotations per minute
t	ton
wt	weight
yr	Year
µ	Micron
µg	Microgram
$µg.g^{-1}$	Microgram per gram
µR/hour	micro Rad per hour

Acronyms

ARDRA	Amplified Ribosomal DNA Restriction Analysis
ASFA	Aquatic Sciences and Fisheries Abstracts
AVHRR	Advance Very High Resolution Radiometer
BIS	Bureau of Indian Standards
BOBN	Bay of Bengal News
BOBP	Bay of Bengal Programme
BOD	Biochemical Oxygen Demand
CAS in MB	Centre of Advanced Study in Marine Biology
CECRI	Central Electrochemical Research Institute
CIBA	Central Institute of Brackishwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFNET	Central Institute of Fishery and Nautical Engineering Training
CIFT	Central Institute of Fishery Technology
CITES	Conservation and International Trade in Endangered Species
CMCS	Centre for Marine and Coastal Studies
CMFRI	Central Marine Fisheries Research Institute
COD	Chemical Oxygen Demand
CORDIO	Coral Reef Degradation in the Indian Ocean
CSMCRI	Central Salt & Marine Chemicals Research Institute
CZCS	Coastal Zone Colour Scanner
CZIS	Costal Zone Information System
CZR	Coastal Zone Regulation
DANIDA	Danish International Development Agency
DCI	Dredging Corporation of India
DDE	Dichloro Diphenyldichloro Ethane
DDT	Dichloro Diphenyl Trichloroethane
DMSO	Dimethyl Sulphoxide
DNA	Deoxyribo Nucleic Acid
DOD	Department of Ocean Development
Dr. T.P.M Library	Dr. T.P. Meenakshi Sundaranar Library
EC_{50}	Median Effective Concentration at 50
ED_{50}	Median Effective Dose
EDTA	Ethylene Diamine Tetra Acetic acid
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENSO	*El Nino* Southern Oscillation
ENVIS	Environmental Information Service
ERTS-1	Earth Resources Technology Satellite-1
ESR	Erythrocyte Sedimentation Rate
EWMA	Exponentially Weighted Moving Average
FAD	Fish Aggregating Device
FAME	Fatty Acid Methyl Ester
FAO	Food and Agricultural Organization
FC & RI	Fisheries College and Research Institute
FFDA	Fish Farmers Development Agencies
FRP	Fiberglass Reinforced Plastic
FSI	Fishery Survey of India
G.O. Ms. No.	Government Order. Madras Number
GATT	General Agreement on Trade and Tariffs
GCRMN	Global Coral Reef Monitoring Network
GDP	Gross Domestic Product
GEF	Global Environment Facility

GFASRI	Gujarat Fisheries and Aquatic Sciences Research Institute
GIS	Geographical Information System
GOM	Gulf of Mannar
GOMBRT	Gulf of Mannar Biosphere Reserve Trust
GOMMNP	Gulf of Mannar Marine National Park
Govt.	Government
GSI	Gonadosomatic Index
Hb	Haemoglobin
HCH	Hexachloro Cyclohexane
HDPE	High Density Polyethylene
HPLC	High Performance Liquid Chromatography
HPTLC	High Performance Thin Layer Chromatography
HRD	Human Resource Development
HRGC	High Resolution Gas Chromatograph
HRMS	High Resolution Mass Spectrometer
Ht	Haematocrit
HTL	High Tide Level
HUFA	Highly Unsaturated Fatty Acid
ICAR	Indian Council of Agricultural Research
ICLARM	International Centre for Living Aquactic Resources Management
ICMAM	Integrated Coastal and Marine Area Management
ICPMS	Inductively Coupled Plasma Mass Spectrometry
ICRMN	Indian Coral Reef Monitoring Network
IGCAR	Indira Gandhi Centre for Atomic Research
IOC	Intergovernmental Oceanographic Commission
IP	Indian Pharmacopia
IR	Infra Red
IRS	Indian Remote Sensing Satellite
ISRO	Indian Space Research Organization
IU	International Units
IUCN	International Union for the Conservation of Nature and Natural Resources
KDFSF	Kanyakumari District Fishermen Sangam Federation
LC_{50}	Median Lethal Concentration
LD_{50}	Median Lethal Dose
LIT	Line Intercept Transect
LSF	Liquid Seaweed Fertilizer
LTL	Low Tide Level
MK University	Madurai Kamaraj University
MNP	Marine National Park
MoEF	Ministry of Environment and Forests
MOEn & F	Ministry Of Environment and Forests
MORD	Ministry of Rural Development
MPEDA	Marine Products Export and Development Authority
MPN	Most Probable Number
MRDF	Marine Research and Development Fund
MS rod	Mild Steel rod
MS University	Manonmaniam Sundaranar University
NABARD	National Bank for Agricultural and Rural Development
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCBI	National Centre for Biotechnology Information
NCEP	National Center for Environmental Prediction
NEERI	National Environmental Engineering Research Institute
NGO	Non-Governmental Organization
NMR	Nuclear Magnetic Resonance
NOAA	National Oceanic and Atmospheric Administration
NPK	Sodium-Phosphorus-Potassium

ODA	Overseas Development Administration
OSTC	Ocean Science and Technology Cell
OTEC	Ocean Thermal Energy Conversion
PA	Protected Area
PAH	Poly Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCV	Packed Cell Volume
POP	Persistent Organic Pollutant
PRA	Participatory Rural Appraisal
PUFA	Poly Unsturated Fatty Acid
PVA	Poly Vinyl Alcohol
PVC	Poly Vinyl chloride
R&D	Research and Development
RAPD	Random Amplified Polymorphic
RBC	Red Blood Corpuscle (Cell)
ROV	Remotely Operated Veichle
RS data	Remotely sensed data
SAC	Space Application Centre
SCUBA	Self Contained Underwater Breathing Apparatus
SEM	Scanning Electron Microscope
SIDA	Swedish International Development Agency
SLF	Seaweed Liquid Fertilizer
sp	Species (Singular)
SPIC	Southern Petrochemical Industries Corporation
SPOT	System Probatorie d'Observation de la terre
spp	Species (Plural)
SRB	Sulfur Resistant Bacteria
SS	Stainless Steel
SSC	Suspended Sediment Concentration
SSCP	Sethu-samudram Ship Canal Project
SSM/I	Special Sensor Microwave Imager
SST	Sea Surface Temperature
STAPCOR	Status and Protection of Coral Reefs
TBMMT	Tributyl Monomethyl Tin
TBT	Tributyltin
TC	Total Coliform
TED	Turtle Excluding Device
TEM	Transmission Electron Microscope
TMA-N	Trimethylamine -Nitrogen
TMMP	Tropical Marine Molusc Programme
TNAU	Tamil Nadu Agricultural University
TNFDC	Tamil Nadu Fisheries Development Corporation
TOC	Total Organic Content
TOT	Tri Octyltin
TPC	Total Plate Count
TPT	Tuticorin Port Trust
TVB-N	Total Volatile Basic - Nitrogen
TVC	Total Viable Count
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UV	Ultra Violet
VBN	Volatile Base Nitrogen
WBC	White Blood Cell
WHO	World Health Organization
WWF	World Wildlife Fund
XRD	X-Ray Diffraction

Abbreviations of Sources (Journals)

Abbreviated Form		Expanded Form
Acta Bot. Indica	-	Acta Botanica Indica
Acta Hydrobiol.	-	Acta Hydrobiologia
Acta Hydrochim. Hydrobiol.	-	Acta Hydrochemistry and Hydrobiology
Ann. Indust. Fish. Assoc.	-	Annals of Industrial Fisheries Association
Ann. Mag. Nat. Hist.	-	Annals of Magazine Natural History
Ann. Trop. Med. Parasit	-	Annals of Tropical Medicine and Parasitology
Annamalai University Historical Series	-	Annamalai University Historical Series
Anti-Corrosion Methods and Materials	-	Anti-Corrosion Methods and Materials
Appl. Fish. Aquac.	-	Applied Fisheries and Aquaculture
Aquacult. Mag.	-	Aquaculture Magazine
Aquaculture	-	Aquaculture
Aquacult. Engg.	-	Aquaculture Engineering
Aquacult. Res.	-	Aquaculture Research
Aquat. Bot.	-	Aquatic Botany
Asian Fish. Sci.	-	Asian Fisheries Science
Asian J. Chem.	-	Assian Journal of Chemistry
Assn. Microbiol. India	-	Association of Microbiologists of India
Atlantica	-	Atlantica
Beche-de-Mer Inf. Bull.	-	Beche-de-Mer Information Bulletin
Biofouling	-	Biofouling
Biomed. Lett.	-	Biomedical Letters
Biores. Technol.	-	Bioresource Technology
Biotechnol. Bioengg.	-	Biotechnology and Bioengineering
Bot. Mar.	-	Botanica Marina
Bull. Bot. Sur. India	-	Bulletin of Botanical Survey of India
Bull. Ceylon, Fish	-	Bulletin of Ceylon Fisheries
Bull. Dept. Mar. Sci. Univ. Cochin	-	Bulletin of Department of Marine Science, University of Cochin
Bull. Environ. Contam. Toxicol.	-	Bulletin of Environmental Contamination and Toxicology
Bull. Eur. Assoc. Fish Pathol.	-	Bulletin of Europian Association of Fish Pathologists
Bull. Fish. Res. Station. Ceylon	-	Bulletin of Fisheries Research Station, Ceylon
Bull. Fish. Surv. India	-	Bulletin of Fishery Survey of India
Bull. Inst. Oceanogr. Monaco.	-	Bulletin of Institute of Oceanography, Monaco
Bull. Madras Govt Mus. N. S. Nat. Hist.	-	Bulletin of Madras Government Museum Natural Science and Natural History
Bull. Mar. Sci.,	-	Bulletin of Marine Science
Bull. Mus. Natl. Hist. Nat. France 4e Ser. A. Zool. Biol. Ecol. Anim.	-	Bulletin of Museum of Natural History, France, Series A, Zoology, Biology and Ecology of Animals
Bull. Electrochem.	-	Bulletin of Electrochemistry
CMFRI Bulletin	-	Central Marine Fisheries Research Institute Bulletin
Cetacea	-	Cetacea
Ceylon J. Sci.,	-	Ceylon Journal of Science
Ceylon Trade J.	-	Ceylon Trade Journal
Contr. Mar. Biol. Stn. Krusadai Island Gulf of Mannar	-	Contributions of Marine Biological Station of Krusadai Island, Gulf of Mannar
Corrosion Houston.	-	Corrosion Houston
Corrosion Prevention & Control.	-	Corrosion Prevention and Control
Corrosion Sci.	-	Corrosion Science
Crustaceana	-	Crustaceana
Cur. Aff. Bull. Indo. Pacif. Fish. Coun.	-	Current Affairs, Bulletin of Indo Pacific Fisheries Council
Curr. Sci.	-	Current Science
Cymbium.	-	Cymbium
Cytologia.	-	Cytologia
Deep Sea Res.	-	Deep Sea Research
Dis. Aquat. Org.	-	Diseases of Aquatic Organisms
Down to Earth.	-	Down to Earth

Abbreviated Form		Expanded Form
Earth, Planets and Space.	-	Earth, Planets and Space
Ecol.	-	Ecology
Ecol. Env. & Cons.	-	Ecology, Environment and Conservation
Ecological Modelling.	-	Ecological Modelling
Environ Int.	-	Environment International
Environ. Ecol.	-	Environmental Ecology
Environ. Poll. & Resources of land and water	-	Environmental Pollution and Resources of Land and Water
Environ. Geol.	-	Environmental Geology
Environmental Monitoring and Assessment.	-	Environmental Monitoring and Assesment
Fert. News.	-	Fertilizer News
Fish Dev. Ser. Natl. Swed. Board Fish.	-	Fishery Development Series National Swedish Board of Fisheries
Fish farming International	-	Fish farming International
Fish. Technol.	-	Fishery Technology
Fish. Manag. Ecol.	-	Fisheries Management and Ecology
Fishery Survey of India	-	Fishery Survey of India
Fishing Chimes	-	Fishing Chimes
Geogr. J.	-	Geographical Journal
Gondwana Research, Srilanka	-	Gondwana Research, Srilanka
Hindustan Antibiotics Bulletin.	-	Hindustan Antibiotics Bulletin
Hydrobiologia.	-	Hydrobiologia
Ind. Com. J.,	-	Indian Commerce Journal
Ind. J. Bot.	-	Indian Journal of Botony
Ind. J. Zool.	-	Indian Journal of Zoology
Indian Farming	-	Indian Farming
Indian Fish. Bull.	-	Indian Fishery Bulletin
Indian Fisheries, MPEDA	-	Indian Fisheries, MPEDA
Indian Hydrobiol.	-	Indian Hydrobiology
Indian J. Chem.	-	Indian Journal of Chemistry
Indian J. Earth Sci.	-	Indian Journal of Earth Sciences
Indian J. Ecol	-	Indian Journal of Ecology
Indian J. Microbiol	-	Indian Journal of Microbiology
Indian J. Env. Protection	-	Indian Journal of Environmental Protection
Indian J. Fish.	-	Indian Journal of Fisheries
Indian J. Mar. Sci.	-	Indian Journal of Marine Sciences
Indian Seafood	-	Indian Seafood
Indian Veterinary J.	-	Indian Veterinary Journal
Infofish Int.	-	Infofish International
Int. Inst. Envir. Dev.	-	International Institute for Environment and Development
Int. J. Acad. Ichthyol.	-	International Journal of Academy of Ichthyologists
Int. J. Environ. Sci. Tech.	-	International Journal of Environmental Science and Technology
Intellectual Obsr.	-	Intellectual Observer
Inter. Tree, crop. Journal	-	International Tree and Crop Journal
Inter. Biodeter. Biodegrad.	-	International Biodeterioration and Biodegradation
Inter. J. Parasitol.	-	International Journal of Parasitology
Jap. J. Icthyol.	-	Japanese Journal of Icthyology
J. Malacol. Soc. Aust.	-	Journal of Malacological Society of Australia
J. Mar. Biol. Assoc. India	-	Journal of Marine Biological Association of India
J. Pharm.	-	Journal of Pharmacology
J. Appl. Met.	-	Journal of Applied Meteorology
J. Appl. Geophy.	-	Journal of Applied Geophysics
J. Aqua. Trop.	-	Journal of Aquaculture in the Tropics.
J. Asiat. Soc. Beng.	-	Journal of Asiatic Society of Bengal
J. Biol. Res.,	-	Journal of Biological Research
J. Bom. Nat. Hist. Soc.,	-	Journal of Bombay Natural History Society
J. Ceylon Archh. R. Asiat. Soc.	-	
J. Chem. Res.	-	Journal of Chemical Research

Abbreviated Form		Expanded Form
J. Chemosphere	-	Journal of Chemosphere
J. Ecobiol.	-	Journal of Ecobiology
J. Ecol. Res. Biocon.,	-	Journal of Ecological Research and Biocontrol
J. Ecotoxicol. Environ. Monit.	-	Journal of Ecotoxicology and Environmental Monitoring
J. Environ. & Ecoplan.	-	Journal of Environment and Ecoplaning
J. Environ. Biol.	-	Journal of Environmental Biology
J. Environ. Monit.	-	Journal of Environmental Monitoring
J. Exp. Mar. Biol. Ecol.	-	Journal of Experimental Marine Biology and Ecology
J. Food Sci.	-	Journal of Food Science
J. Food Sci. Technol.	-	Journal of Food Science and Technology
J. Freshwater Biol.	-	Journal of Freshwater Biology
J. Geol. Soc. India.	-	Journal of Geological Society of India
J. Geophysical Research C: Oceans.	-	Journal of Geophysical Research. C: Oceans
J. Indian Assoc. Sedimentol.	-	Journal of Indian Association of Sedimentologists
J. Indian Bot. Soc.,	-	Journal of Indian Botonical Society
J. Indian Fish Assoc.	-	Journal of Indian Fishery Association
J. Ind. Soc. Remote Sensing	-	Journal of the Indian Society for Remote Sensing
J. Ind. Poll. Cont.	-	Journal of Industrial Pollution Control.
J. Linn. Soc. (Zool),	-	Journal of Linnaean Society (Zoology)
J. Mad. Univ.,	-	Journal of Madras University
J. Mar. Biol. Assoc. UK.	-	Journal of Marine Biological Association of UK
J. Napal Geol. Soc.,	-	Journal of Napal Geological Society
J. Nat. Prod.	-	Journal of Natural Products
J. Nat. Prod. Lloydia.	-	Journal of Natural Products Lloydia
J. Natl. Aquat. Resour. Agency Srilanka.	-	Journal of National Aquatic Resources Agency, Srilanka
J. Natural Remedies	-	Journal of Natural Remedies
J. Palaeontol. Soc. India.	-	Journal of Palaeontological Society of India
J. Proc. Inst. Chem., India	-	Journal and Proceedings of Institute of Chemists, India
J. Progcoat.	-	Journal of Progcoat
J. Sci. Ind. Res.	-	Journal of Scientific and Industrial Research
J. Shellfish Res.	-	Journal of Shellfish Research
J. Washington Acad. Sci.	-	Journal of Washington Academy of Sciences
J. Waterway, Port, Coast. Ocean Engg.	-	Journal of Waterway, Port, Coastal and Ocean Engineering.
J. Zool. Soc. India	-	Journal of Zoological Society of India
Key Eng. Mat.	-	Key Engineering Materials
Madras Agri. J.	-	Madras Agricultural Journal
Madras Fish Bull.	-	Madras Fisheries Bulletin
Madras Govt. Central Mus. Sci. Ser.	-	Madras Government, Central Museum, Science Series
Madras J. Fish.,	-	Madras Journal of Fisheries
Madras-India-FAO-SIDA	-	Madras-India-FAO-SIDA
Maharastra Assoc. Cultiv. Sci. Res. Inst.	-	Maharastra Association for Cultivation of Science and Research Institute
Mahasagar.	-	Mahasagar
Man in India	-	Man in India
Mar. Fish. Infor. Serv. T & E Ser.,	-	Marine Fishery Information Service, Technical and Extension Series
Mar. Ind. J.	-	Maritime Industrial Journal
Mar. Obsr.,	-	Marine Observer
Mar. Poll. Bull.	-	Marine Pollution Bulletin
Mar. Turtle News Lett.	-	Marine Turtle News Letter
Marine animal parasites Parazity morskikh zhivotnykh [IzvTinro], Kurochkin-YuV Vladivostok-USSR TINRO	-	Marine Animal Parasites
Mar. Biol.	-	Marine Biology
Mar. Geol.	-	Marine Geology
Matsya	-	Matsya
Mem. Asiat. Soc. Bengal.	-	Memoirs of Asiatic Society of Bengal
Microbiol. Res.	-	Microbiological Research

Abbreviated Form		Expanded Form
Microfauna Mar.	-	Microfauna Marine
MSSRF Publ.	-	M.S. Swaminathan Research Foundation Publication
NAGA	-	NAGA
Nat. Environ. Pollut. Technol.	-	National Environmental Pollution Technology
Nat. Geogr. Mag.	-	National Geographic Magazine
Nat. Proc. Meet. Mem. R. Inst.,	-	
Nat. Prod. Sci.	-	Natural Product Sciences
Nature	-	Nature
Neues Jahrbuch fur Geologie und Palaontologie – Abhandlungen	-	Neues Jahrbuch fur Geologie und Palaontologie - Abhandlungen
Oceanologia	-	Oceanologia
ONGC Bull.	-	Oil and Natural Gas Commission Bulletin
Photonirvachak	-	Photonirvachak
Phuket Mar. Biol. Cent. Spec. Publ.	-	Phuket Marine Biological Centre Special Publication
Phycol. Res.	-	Phycological Research
Phykos	-	Phykos
Physiol. Ecol.	-	Physiology and Ecology
Phytochemistry	-	Phytochemistry
Phytomorphology	-	Phytomorphology
Phytotherapy Res.	-	Phytotherapy Research
Poll. Res.	-	Pollution Research
Prot. Env.	-	Protection of Environment
Radiation Protection Dosimetry	-	Radiation Protection Dosimetry.
Rec. Indian Mus.,	-	Records of Indian Museum
Rec. zool. Surv. India	-	Records of Zoological Survey of India
Remote Sens. Environ.	-	Remote Sensing of Environment
Rep. Br. Ass. Advmt. Sci.,	-	Report of the British Association for Advancement of Science
Res. Bull. Punjab. Univ.	-	Research Bulletin of Punjab University
Res. Ind.,	-	Research and Industry
Resour. Infor. Ser. Fishery Survey of India	-	Resource Information Series Fishery Survey of India
Rev. Algol. New Ser.	-	Reviews of Algology New Series
Salt Res. Ind.,	-	Salt Research and Industry
Samudra Rep	-	Samudra Report
Sci. Cult.	-	Science and Culture
Sci. Rep.	-	Science Reporter
Seafood Export J.	-	Seafood Export Journal
Seas at the millennium - An Environmental Evaluation	-	Seas at the millennium - An Environmental Evaluation
Seaweed Res. Utiln.	-	Seaweed Research and Utilisation
Senckenbergiana Biol.	-	Senckenbergiana Biologia
Seshaiyana	-	Seshaiyana
South Asian Anthropologist	-	South Asian Anthropologist
Spolia Zylan.	-	Spolia Zylanica
Summer Inst. Fish Eggs and Larva	-	Summer Institute for Fish Eggs and Larva
Tech. Pap. Proc. Indo. Pacific Fish.	-	Technical Paper Proceedings of Indo Pacific Fisheries Council
Tetrahedron Letters	-	Tetrahedron Letters
Tool Alloy Steels	-	Tool Alloy Steels
Trans. Inst. Brit. Geographers	-	Transactions of the Institute of British Geographers
Trans. Saest.	-	Transactions of the SAEST (Society for Advancement of Electrochemical Science and Technology)
Women, poverty and ideology in Asia	-	Women, poverty and ideology in Asia
ZKG International	-	

Abbreviations of Sources (Symposium / Conference)

Abbreviated Form		Expanded Form
6th Inter. Seaweed Symp.	-	6th International Seaweed symposium
CMFRI Spec. Publ.	-	Central Marine Fisheries Research Institute, Special Publication
ICAR Publ.,	-	Indian Council of Agricultural Research Publication
III Natl. Conf. On Dock and Harbour Engg.,	-	III National Conference on Dock and Harbour Engineering
Nat. Symp & Expo.	-	National Symposium and Exposition
Nat. Symp. Environ. Biol.	-	National Symposium on Environmental Biology
Natl. Sem. On Microbial Ecol.	-	National Seminar on Microbial Ecology
Proc. Ind. Nat. Sci. Acad.	-	Proceedings of Indian National Science Academy
Proc. Indo - Pacif. Fish. Counc.,	-	Proceedings of Indo-Pacif Fishery Council
Proc. 25th Indian Sci., Congr.,	-	Proceedings of 25th Indian Science Congress
Proc. 29th Indian Sci. Cong.,	-	Proceedings of 29th Indian Science Congress
Proc. 2nd Int. Coral Reef Symp. Brisbane	-	Proceedings of 2nd International Coral Reef Symposium, Brisbane
Proc. 31st Indian Sci. Cong.,	-	Proceedings of 31st Indian Science Congress
Proc. 39th Sess. Indian Sci. Cong.	-	Proceedings of 39th Session of Indian Science Congress
Proc. 3rd Internat. Symp.Coral Reefs, Miami	-	Proceedings of 3rd International Symposium on Coral Reefs, Miami
Proc. 48th Sess. Indian Sci. Congr.	-	Proceedings of 48th Session of Indian Science Congress
Proc. 6th Int. Seaweed Symp., Spain,	-	Proceedings of 6th International Seaweed Symnposium, Spain
Proc. 8th Nat. Symp. Env.	-	Proceedings of 8th National Symposium on Environment
Proc. Am. Philos. Soc.	-	Proceedings of American Philosophical Society
Proc. Andhra Pradesh Akad. Sci.	-	Proceedings of Andhra Pradesh Akademy of Science
Proc. Aquacult. Int. Congr. Expo. Vancouver, B.C. (Canada)	-	Proceedings of Aquaculture International Congress and Exposition Vancouver, B.C. (Canada)
Proc. Asiat. Soc. Beng.	-	Proceedings of Asiatic Society of Bengal
Proc. Biol. Soc. Wash.	-	Proceedings of Biological Society, Washington
Proc. First Scient. Workshop Result. FORV Sagar Sampada	-	Proceedings of First Scientific Workshop Results, FORV Sagar Sampada
Proc. Ind. Aca. Sci.,	-	Proceedings of Indian Academy of Science
Proc. Indian Fish. Forum, Mangalore	-	Proceedings of Indian Fisheries Forum, Mangalore
Proc. Indian Sci. Cong.	-	Proceedings of Indian Science Congress
Proc. Indo-Pacific. Fish Coun.,	-	Proceedings of Indo-Pacific Fishery Council
Proc. Malac. Soc. Lond.,	-	Proceedings of Malacological Society, London
Proc. Nat. Conf. on Tunas, CMFRI (ICAR)	-	Proceedings of National Conference on Tunas, Central Marine Fisheries Research Institute (Indian Council of Agricultural Research)
Proc. Nat. Inst. Sci. India	-	Proceedings of National Institute of Science, India
Proc. Nat. Sem, Mar. Biodiversity.	-	Proceedings of National Seminar on Marine Biodiversity
Proc. Nat. Sem. Atom Energ. Ecol. Environ.	-	Proceedings of National Seminar on Atomic Energy, Ecology and Environment
Proc. Ocean life food and Med. Expo.,	-	Proceedings of Ocean Life, Food and Medicine Exposition
Proc. 2nd Indian Fish. Forum	-	Proceedings of 2nd Indian Fisheries Forum
Proc. 4th Indian Fish. Forum	-	Proceedings of 4th Indian Fisheries Forum
Proc. Symp. Corals and Coral Reefs, MBAI	-	Proceedings of Symposium on Corals and Coral Reefs, Marine Biological Association of India
Proc. Symp. Crustacea	-	Proceedings of Symposium on Crustacea
Proc. Symp. Mollusca MBAI,	-	Proceedings of Symposium on Mollusca, Marine Biological Association of India
Proc. Symp. Scombroid fishes, MBAI,	-	Proceedings of Symposium on Scombroid Fishes, Marine Biological Association of India
Proc. V Nat. Symp. Env.	-	Proceedings of V National Symposium on Environment
Proc. VII Nat. Conf. Tamilnadu Sci. Cong.	-	Proceedings of VII National Conference on Tamilnadu Science Congress
Proc. Zool. Soc. Lond.,	-	Proceedings of Zoological Society, London
Souvenir 20th Ann. CMFRI	-	Souvenir 20th Anniversary, Central Marine Fisheries Research Institute
Spec. Publ. Eur. Aquacult. Soc.	-	Special Publication of Europian Aquaculture Society
Symp. Ser. Mar. Biol. Assoc. India	-	Symposium Series of Marine Biological Association of India

Abbreviations of Sources (Reports)

Abbreviated Form		Expanded Form
AIMS report	-	Australian Institute of Marine Science Report
BOBP	-	Bay of Bengal Program
BOBN	-	Bay of Bengal News
CAS report	-	Centre of Advanced Study Report
CMFRI Ann. Rep.	-	Central Marine Fisheries Research Institute Annual Report
Ceylon Mar. Biol. Rep.,	-	Ceylon Marine Biology Report
CMCS report	-	Centre for Marine and Coastal Studies Report
CMFRI and CSMCRI combined report	-	Central Marine Fisheries Research Institute and Central Salt and Marine Chemicals Research Institute combined report
CMFRI News Letter	-	Central Marine Fisheries Research Institute News Letter
CMFRI Report	-	Central Marine Fisheries Research Institute Report
CSMCRI Report	-	Central Salt and Marine Chemicals Research Institute Report
CSMCRI, CMFRI and SF Report	-	Central Salt and Marine Chemicals Research Institute, Central Marine Fisheries Research Institute and State Fisheries Report
DOD Report	-	Department of Ocean Development Report
FAO Fish Report	-	Food and Agricultural Organization Fishery Report
FAO Report	-	Food and Agricultural Organization Report
FAO/SIDA Report	-	Food and Agricultural Organization and Sweedish International Development Agency Report
FAO/UN Report	-	Food and Agricultural Organization and United Nations Report
ICMR report	-	Indian Council of Medical Research Report
Int. Indian Ocean Exped. Newsl.,	-	International Indian Ocean Expedition Newsletter
ISRO/SAC report	-	Indian Space Research Organization / Space Application Centre Report
Mad. Fish. Dept. Report	-	Madras Fisheries Department Report
MOEF Report	-	Ministry of Environment and Forests Report
MSSRF report	-	M.S. Swaminathan Research Foundation Report
NIO report	-	National Institute of Oceanography Report
NRSA Report	-	National Remote Sensing Agency Report
Occas. Pap. Fish. Surv. India.	-	Occasional Papers of Fishery Survey of India
Rep. Ceylon Mar. Biol. Lab.,	-	Report of Ceylon Marine Biological Laboratory
Rep. Ceylon Pearl oysters Fish. Gulf of Mannar	-	Report of Ceylon Pearl Oysters Fisheries of Gulf of Mannar
Rep. Mar. Zool. Okhmandal Kathiawar	-	Report of Marine Zoology, Okhmandal Kathiawar
Scott.Geogr. Mag.,	-	Scottish Geography Magazine
SLF report	-	Sri Lankan Fishery Report
UNDP/FAO Pelagic Fishery Project Progress Report	-	United Nations Development Programme / Food and Agricultural Organization Pelagic Fishery Project Progress Report
UNESCO report	-	United Nations Educational, Scientific and Cultural Organization Report
ZSI report	-	Zoological Survey of India Report

Author Index

(The Numbers Indicate Reference Numbers in the Bibliography)

C

D

E

F

G

H

K

L

M

N

O

P

Q

R

S

T

Taxonomy Index

(The Numbers Indicate Reference Numbers in the Bibliography)

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

Subject Index

(The Numbers Indicate Reference Numbers in the Bibliography)

B

C

D

F

G

H

I

J

K

L

M

O

P

Q

R

S

T

U

V

W

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