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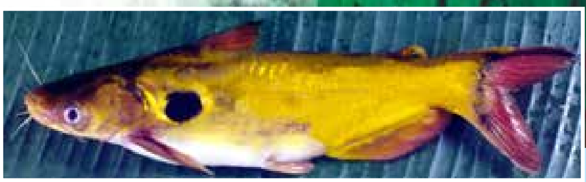
Endemic Fish Diversity of Western Ghats

Edited by
A. G. Ponniah
A. Gopalakrishnan



भाकृअनुप
ICAR

National Bureau of Fish Genetic Resources
Lucknow - 226 002, U.P., India

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National Bureau of Fish Genetic Resources

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Endemic Fish Diversity of Western Ghats

Proceedings of the workshop on "Germplasm Inventory, Evaluation and Gene Banking of Freshwater Fishes of Western Ghats" organised by National Bureau of Fish Genetic Resources during 12th – 13th October, 1998 at Central Marine Fisheries Research Institute, Cochin, Kerala.

Edited by
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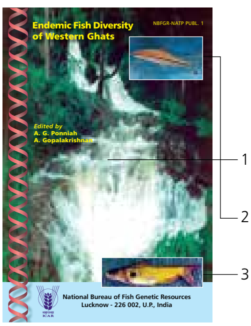
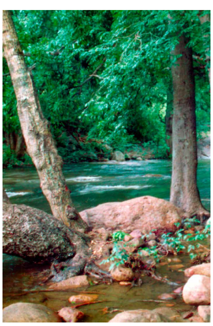


Front Cover
Cascade type habitat - Chalakudy River, Western Ghats, Kerala. (Photo courtesy: Shaji C. P. & Easa P. S. KFRI, Peechi, Thrichur, Kerala)
Puntius denisoni (Day) - An ornamental fish endemic to Western Ghats, Kerala. (Photo courtesy: Anna Mercy, T. V., College of Fisheries, Cochin, Kerala)
Horabagrus brachysoma Gunther - Cultivatable yellow catfish endemic to Western Ghats, Kerala. (Photo courtesy: NBFGR, Cochin unit)



Back Cover
Rapid type habitat - Kabini Rver, Western Ghats, Kerala. (Photo courtesy: Shaji C. P. & Easa P. S. KFRI, Peechi, Thrichur, Kerala)

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Foreword

The Western Ghats along the West coast of Peninsular India are well known for their richness of biodiversity including freshwater species. The area has vast potential for endemic, cultivable and ornamental fish species. Indeed, it was the spices from the hill chain of Western Ghats that brought Europeans to India, an event of much significance in shaping the course of modern world history. Today, these Western Ghats are recognized as one of the eighteen “biodiversity hotspots” in the world, and are therefore a focus of great scientific interest.

Though ideally biodiversity as a whole needs to be conserved, the prohibitive costs associated prevent such a possibility and hence we need to prioritise the groups populations and habitats that need immediate attention. The National Agricultural Technology Project (NATP) has identified “Fish Genetic Biodiversity” as one of the priority areas and the National Bureau of Fish Genetic Resources (NBFGR), Lucknow has been selected as the Coordinating institution in the field. The Bureau has short listed endemic cultivable, sport and ornamental species of Western Ghats for immediate research attention. To finalize the priority areas of research on fish germplasm resources, conservation and sustainable utilisation, a workshop on “Germplasm inventory, evaluation and gene banking of freshwater fish species of Western Ghats” was held at Cochin, in Kerala during 12 and 13 October, 1998 which was based on participatory planning process. The recommendations of the workshop served as the base to formulate the NATP Mission Mode project of NBFGR on Western Ghats. It is highly commendable to note captive breeding and milt cryopreservation of two endemic Western Ghats species viz. *Horabagrus brachysoma* and *Labeo dussumieri* have already been perfected under NATP by NBFGR along with one of its collaborating centres.

The publication entitled “Endemic fish diversity of Western Ghats” which is the outcome of the workshop would certainly serve as a handy reference material on the subject. The efforts of NBFGR in bringing out these proceedings and their activities in Western Ghats are highly appreciated.

3rd May 2001 **R. S. Paroda**

Secretary Department of Agricultural Research & Education
& Director General, Indian Council of Agricultural Research
Krishi Bhawan, New Delhi

Foreword

Conservation and sustainable utilization of natural resources are issues receiving worldwide attention after signing the Convention on Biodiversity. Unbridled exploitation of resources has crossed the sustainable levels and has also led to extinction of a number of species of plants and animals. Human interference has disturbed ecosystem of many water bodies. A few of them remain in pristine condition. In several parts of the world, there is growing awareness among the beneficiaries and user-agencies on the imperative need to conserve, protect and manage various ecosystems.

The Western Ghats in India is one of the 18 globally recognized biodiversity "hotspots". These mountain ranges along the west coast of peninsular India are known for their high levels of endemism as well as rich and highly varied species diversity, including that of freshwater fishes. This area has many potentially cultivable and ornamental fishes. During the last three decades, the main thrust in the country has been to increase fish production with the help of fast growing Indian and exotic major carps. Unfortunately, this has resulted in total negligence of native fauna. But now these species are steadily getting reduced in their own natural habitats. Conservation and sustainable utilization of this natural wealth have been handicapped by inadequate information on these species and their habitats.

The National Agricultural Technology Project (NATP), has identified "Fish Genetic Biodiversity as one of the priority areas and the National Bureau of Fish Genetic Resources (NBFGR), Lucknow has been selected as the coordinating institution in this field. The Bureau has short-listed endemic cultivable, sport and ornamental species of Western Ghats for immediate research attention. Research activities have already been initiated at NBFGR along with its collaborating centres under NATP for documenting the diversity and biology of these native species as well as develop strategies for their sustainable commercial exploitation.

The bringing out of the compendium entitled "Endemic Fish Diversity of Western Ghats" containing all the papers, extended abstracts and recommendations of workshop held at Cochin in October 1998 reflects the enthusiasm among the participants to work up on the conservation of endemic species. The Western Ghat component of NATP mission-mode project was formulated based on the recommendations of the workshop. Besides providing the much needed food and nutritional security, the project activities would be beneficial in widening the food basket of the country as well as boosting the trade and culture of endemic ornamental species of the area.

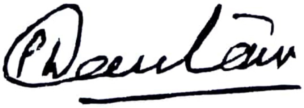
3rd May 2001 **K. Gopakumar**

Deputy Director General (Fisheries), ICAR, New Delhi – 110 001

Foreword

Biodiversity conservation necessitated knowledge on the diversity of animals and plants, their distribution, biology, abundance and status. Western Ghats with a variety of vegetation types, climatic zones and remarkable endemism is considered to be one of the hotspot areas for biodiversity conservation. The rivers originating from Western Ghats harbour a number of endemic species suitable for aquaculture, sport fisheries and aquarium keeping. Damming the rivers, introduction of exotic species and pollution of major aquatic systems have caused drastic decline of these native fauna in their own natural habitats. Unfortunately lack of information on these species and habitats has been a major handicap in taking timely steps in conservation. In order to address this issue, the National Agricultural Technology Project (NATP) Mission Mode Project on “Germplasm Inventory Evaluation and Gene Banking of Freshwater Fishes” has been initiated with NBFGR as the lead institutions and 12 collaborating centres including 5 centres from Western Ghats. In order to finalise priority areas of research and species for conservation and sustainable utilization, a national workshop on “Germplasm inventory and gene banking of Western Ghats fish fauna” was held at Cochin during 12 – 13 October, 1998. The workshop was based on participatory planning process in which the participants contributed in interactive working groups. The Western Ghats component of NATP Mission Mode project was formulated based on workshop recommendations. The effort of NBFGR in organizing the national workshop on such a topic is a welcome step. I am sure this compilation of papers and extended abstracts entitled “Endemic fish diversity of Western Ghats” would be of much use to all conservationists from Western Ghats.

I complement the efforts of Dr. A.G. Ponniah, Director, NBFGR and his team for bringing out the proceedings.



11th April 2001

P. L. Gautam
National Director (NATP), ICAR
New Delhi – 110 012

Preface

The Western Ghats mountains along the west coast of Indian Peninsula constitute one of the unique biological regions of the world. This mountain range is an extremely important life supporting system having very rich and diverse living resources and forms a distinct ecological and bio-geographical zone in India. It has been rightly recognized as a 'hotspot' area of biodiversity for conservation, one of the two such diversity-rich areas in the country. With respect to freshwater species, the streams and rivers originating from Western Ghats have been identified as one of the few sites in the world exhibiting high degree of endemism and exceptional biodiversity.

In-spite of its rich piscine diversity, practically no attention has been paid for the sustainable utilization and conservation of Western Ghat species. Several endemic food fishes of the region have been enlisted as endangered now, either due to over exploitation, wanton destruction of spawners, dynamiting or construction of dams. Attempts to promote aquaculture practices in the area using transplanted Indian major carps and other exotic species has led to further deterioration of the situation. These waters are also considered to be the gold mine for several endemic ornamental fishes like loaches, cyprinids and bagrid catfishes. But recent surveys reported their alarming rate of depletion due to over-exploitation and clandestine export.

The National Bureau of Fish Genetic Resources (NBFGR) has recently initiated its activities to conserve the aquatic resources of Western Ghats. In this regard, the attempts to cryopreserve milt of two endemic species viz. *Labeo dussumieri* and *Horabagrus brachysoma* met with high rate of success. The work is being further intensified by building up a database regarding distribution and life history traits and development of gene banking of genetically distinct populations of prioritised endemic food and ornamental fishes of Western Ghats under the World Bank aided National Agricultural Technology Project (NATP) launched by ICAR. For this purpose, NBFGR has prepared a base list of endemic food and ornamental species from Western Ghats. A pre-NATP workshop was organized on 12 and 13 October, 1998 by NBFGR at Cochin. It was aimed at (i) evolving action plan on issues relating to Western Ghats and Peninsular India (ii) building database relevant for conservation and sustainable commercial utilization of freshwater fishes endemic to Western Ghats, (iii) prioritizing species and water bodies for NATP research programmes. The base list of fishes prepared by the Bureau was initially communicated to experts in the field for scrutiny and later modified accordingly. The participants of the workshop prepared short notes or extended abstracts on past and present distribution, abundance and life history traits of these species and details of water bodies where cluster of these species are found. The delegates of the workshop were split into small working groups and for prioritization of species and water bodies, a set of criteria developed by NBFGR was followed. The workshop generated sufficient information on endemic species and provided a platform for meaningful interactions, free exchange of ideas that ended in fruitful recommendations for conservation and sustainable utilization of piscine fauna of Western Ghats.

The publication entitled "Endemic fish diversity of Western Ghats" reflects the keen interest, scientific insight and sincere efforts of all delegates of workshop. The book has been divided into five major sections viz. base-papers; biodiversity and conservation; ornamental and food fishes; life-history traits and captive breeding; and workshop recommendations. Detailed information about ichthyo-faunal resources of Kerala, Tamil Nadu, Karnataka and Maharashtra incorporated in the base paper section of the book was the result of pre-workshop exercise to assess the species richness of these states.

We express our thankfulness to all contributors for making the publication scientifically rich. Sincere effort has been made to give reliable data and latest information. Shortcomings and mistakes are bound to occur in such a work. We look forward for suggestions and constructive criticism from our enlightened readers which will be helpful in further improvement of this publication. It is hoped that this compendium will be useful to students, scientists, and policy makers involved in research and management of fish genetic resources of Western Ghats.

The Indian Council of Agricultural Research (ICAR) and NATP are greatly acknowledged for funding of the project to NBFGR. We would like to express our heartfelt thanks to Dr. M. Devaraj former Director, Central Marine Fisheries Research Institute (CMFRI), Cochin for his kind consent to organise the workshop in CMFRI premises and for all other arrangements. Dr. E.G. Silas, former Director, CMFRI and Ex-Vice-Chancellor, Kerala Agricultural University; Dr. K.C. Jayaram, the eminent fish taxonomist from Zoological Survey of India and Prof. T.J. Pandian, National Professor, Madurai Kamaraj University, enlightened all participants by their presence and active participation in discussions. We express our special thanks to all of them. Dr. N.G.K. Pillai, Head, Pelagic Fisheries Division and Dr. P. Vijayagopal, Scientist, CMFRI were helpful on various occasions for smooth conduct of workshop at Cochin. We express our sincere thanks to Dr. M. Arunachalam, M. S. University for critically going through the manuscripts and Dr. K. P. Agarwal, National Coordinator, NATP for all the support for the project. Research scholars of CMFRI especially Mr. A. Neelakanteswar, Ms. Bindhu Paul and Mr. V. Terence Rebello co-operated with NBFGR during the workshop. Many thanks to all of them. Dr. A.K. Pandey, Scientist (Sr. Scale), Mr. V.S. Basheer, Scientist and other staff members of NBFGR, Lucknow are also acknowledged for their sincere efforts during the workshop and Mr. K. K. Musammilu, senior research fellow, NBFGR Cochin Unit for his help during preparation of this publication. The whole-hearted assistance rendered by Mr. S. Prasanthakumar during the workshop and in typing the manuscript is also greatly acknowledged.

A. G. Ponniah
A. Gopalakrishnan

Contents

Part III: Ornamental and Food Fishes

Part I

Base Papers

An Overview of "Endemic Fish diversity of Western Ghats"

A.Gopalakrishnan and A.G. Ponniah*

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Gopalakrishnan, A. and Ponniah, A.G., 2000. An Overview of "Endemic Fish diversity of Western Ghats". pp. 1-12 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR – NATP Publication – 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

Background

The seed that gave fruit to the workshop was planted in late 1993 after India became a signatory to the International Convention on Bio-diversity Conservation held at Rio in December 1992. The convention emphasized the need to conserve the "areas of megabiodiversity" as well as to give priority to endemic species in farming practices. The World Bank in its technical paper on freshwater biodiversity of Asia (Kottelat & Whitten, 1996) identified Western Ghats as one of the 18 globally recognized bio-diversity hotspots with high levels of endemism as well as rich and varied species bio-diversity including freshwater teleosts. Subsequently in 1998, the Indian Council of Agricultural Research (ICAR) launched the National Agricultural Technology Project (NATP) with an aim to bring in the needed reforms towards technology generation, assessment and refinement and sustainable utilization of natural resources for meeting challenges of food security and rural poverty. One of the priority areas under NATP was "fish genetic bio-diversity". Under this programme, building up of fish database regarding distribution, abundance and life history traits of endangered, endemic, potentially cultivable and native ornamental species with special emphasis on hotspot areas of aquatic bio-diversity *viz*. Western Ghats & North Eastern Hills was aimed at. A base list of endemic cultivable, food and ornamental species endemic to Western Ghats was prepared with a view to prioritise the species that need to be conserved, propagated and sustainably utilized. The preparation for the workshop began with distribution of the base list to experts for validation. Incorporating the recommendations and suggestions of the workshop, a project proposal was prepared by National Bureau Fish Genetic Resources (NBFGR) for funding under NATP. The project started functioning with NBFGR as the lead centre from January 2000 onwards.

Objectives

The workshop was aimed at

1) Facilitating conservation and sustainable commercial utilisation of endemic freshwater fishes of Western Ghats (covering states of Kerala, Tamil Nadu, Karnataka, Goa and Maharashtra) and developing an overall plan for building bio-diversity database.
2) Identifying strategies and necessary linkages for undertaking conservation programmes in Western Ghats under National Agricultural Technology Project.

Venue and Participants

Within Western Ghats, the Kerala part is richest in aquatic resources with highest number of endemic and rare teleost species. Many premier fisheries research institutions are located in Cochin, a city in central Kerala. Moreover, NBFGR has a research unit stationed in the campus of Central Marine Fisheries Research Institute (CMFRI), Cochin. Also, holding the workshop at Cochin would facilitate greater participation of fishery research workers and other stake holders from the area. Hence it was decided to hold the two-day NATP – NBFGR national workshop in CMFRI premises at Cochin on 12th and 13th October, 1998.

The best way to get an input for a workshop like this was to invite people and organisation who had carried out work in Western Ghats. All efforts were made in this direction to bring experts like Drs. E.G. Silas, K.C. Jayaram, A.G.K. Menon and others who had earlier worked in Western Ghats. In addition to governmental organizations, non-governmental organizations from tribal areas were also invited as they were expected to give precise information about local knowledge, beneficial effects and abundance of fish species from their area. Western Ghat has been identified as a gold mine for ornamental fish species. In order to estimate the potential and prospects of ornamental species caught from the area, ornamental fish hobbyists and exporters like Mr. S. R. Sane and Mr.Eapen Zachariah were invited in consultation with the Marine Products Export Development Authority (MPEDA), Cochin. Recognizing that adequate information for full-length paper may note be available, it was decided to go for short notes or extended abstracts. As the workshop was aimed at prioritizing threatened as well as potential economic species, the base list prepared by Gopalakrishnan & Ponniah was circulated to key persons before the workshop and the same list was utilized by various working groups in finalizing their reports and recommendations. Most of the conventional and Agricultural Universities, ICAR fishery research institutes, Zoological Survey of India (ZSI), MPEDA, Kerala Forest Research Institute (KFRI), and state fisheries departments had responded to the invitation and sent their representatives and altogether 104 participants attended the workshop.

Summary of Papers

Base Papers

A consolidated list of 287 freshwater teleosts from Western Ghats has been prepared by Shaji, Easa and Gopalakrishnan. Of these, 192 were endemic* (67% endemicity) and 17 exotic/ transplanted to the area. High rate of endemicity is characteristic to Western Ghats as observed in other groups of animals (amphibians 74%; reptiles 54%) and plants (angiosperms, 40%) (Ranjith Daniels, 2000). Of these 192 species, 47 endemic fishes were identified as potential candidate species for aquaculture, food and sport-fishing and 106 as ornamental ones by Gopalakrishnan and Ponniah in their base paper. Potential cultivable and sport fishes have been identified based on their size, growth rate (if data available), local acceptance and information gathered from field trips and other publications (Kowtal, 1994; Sreenivasan, 1995, 1996; Chakraborty, 1996). The ornamental species list was prepared after a series of visits to ornamental fish shops and field, as well as in consultation with fish hobbyists and exporters. Bright colouration, appearance and acceptability by the customers were the criteria used to select ornamental species from Western Ghats. Species fetching very high amounts such as *Puntius denisonii*, *Tetraodon travancoricus*, *Horabagrus brachysoma*, loaches and juveniles of *P. jerdoni* and *Channa micropeltes* have been listed. In the absence of specific data, the present categorization with regard to potentially cultivable and ornamental species can be taken as the first step and not the final one. However, these lists could form the basis for focussed studies to evaluate the species along these lines. Apart from this, state-wise lists of freshwater fishes were also prepared by identified experts before the workshop. Gopi has prepared a list of 165 species from Kerala waters which included exotic and transplanted ones. Rema Devi and Indra have listed the number of freshwater teleosts in Tamil Nadu as 144. The same for Maharashtra was 100 by Acharya and Iftekhar. For Karnataka, the list has been prepared river-wise by Chandrashekhariah and co-authors and the number of species ranged from 60 to 101 in different river systems.

Bio-diversity and Conservation

Fish distribution and abundance from different parts of Western Ghats have been evaluated by different authors. The paper by Yadav recorded the ichthyofauna of northern part of Western Ghats (Maharashtra) while Anuradha Bhat in her paper has enlisted 58 species from four rivers of Northern Canara in Karnataka with Aghanashini River exhibiting maximum diversity. Efforts to conserve mahseer resources (*Tor khudree* and *T. mussullah*) in Karnataka have been explained by Basavaraja and Keshavanath.

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* Definition: The fish species found exclusively in a country or a drainage system where it is native and described has been termed as endemic.

Mahseer sanctuaries, their life history traits, *ex-situ* and *in-situ* conservation methods have also been discussed by them. Fish fauna of different river systems, lakes and wetlands of Kerala have been analysed by various authors. While Lal Mohan & Rema Devi attempted to list out species from Chaliyar River system, Mini Santhosh Lal has recorded fish species of Periyar Lake and the attempts to conserve endangered ones. Present status of Vembanad Lake and adjacent wetlands and its species richness have been dealt by Padmakumar and Anuradha Krishnan. Madhusoodana Kurup has outlined the management plans to arrest the decline of freshwater fish diversity of Kerala. His interesting suggestions include generating precise information on reproductive biology and spawning grounds of endemic species, standardizing brood stock management and captive breeding technique of local species and developing database on population size and regional distribution of native fish fauna.

Non-native species when introduced often have escaped and established natural aquatic ecosystem in several parts of the world. Two papers concentrate on these issues. Gopalakrishnan and Basheer have reported occurrence of ripe and 1+ year group specimens of transplanted Indian major carps in rivers of Kerala pointing towards their slow establishment in natural water bodies. Unnithan has focussed on the decline of endemic fish species in selected reservoirs along Western Ghats due to introduction of non-native teleosts. He has suggested to take appropriate measures to prevent accidental release exotic species and promote aquaculture of local varieties. The fish diversity of southern tip of Western Ghats has been recorded in four papers. Arunachalam and co-authors have listed the ichthyofauna of east flowing Chittar River of Tamil Nadu while Grubh and co-authors, Lazarus and co-authors and Thampi Jeyaraj have focussed on species diversity of various aquatic ecosystems of Kanyakumari District. Description of new species, taxonomic position and ambiguities and tools to resolve classification conflicts were highlighted by some authors. Adding to the species richness of Western Ghats, Jayaraj and Krishna Rao have described a new minnow *Salmostoma belachi* from a man-made lake in River Arkavathi (a tributary of River Cauvery), Karnataka. Selvaraj has focussed on the taxonomy and biology of *Puntius mahecola*, while Gopalakrishnan and Basheer have listed out five cases of taxonomic conflicts among important food and ornamental species from Western Ghats. Srivastava has been successful in drawing species-specific profiles of many freshwater species using ultra-thin iso-electric focussing and has suggested that the same technique can be applied to establish species identity of the region. Kapoor and Dayal have evaluated the conservation status of endemic fish fauna of Western Ghats.

The information collected from Western Ghats indicated that there is paucity of primary data on two critical fields i.e. documenting local knowledge and habitat inventory of stream fishes. Basheer and Gopalakrishnan have pointed out the need to document traditional knowledge on fish diversity citing an example how they could make use of information provided by fishermen in collection of spawners of endemic *Labeo dussumieri* from wild. Sanjeev K. Srivastava and Ponniah have summarized the application of Geographical Information System (GIS) to develop fishery information system for Western Ghats and the importance physical habitat studies for conservation of stream fish while Arunachalam has discussed fish habitat inventory methodology.

Ornamental and Food fishes

Potential cultivable and ornamental species from various streams, rivers and from different states have been highlighted by some authors. Ranjit Daniels and Ouseph in their brief review categorized aquarium species from Western Ghats as well-known, little known-yet appealing and larger species that can be popularized. They have pointed out the need to develop captive breeding techniques of all these species as the reserves can soon be under pressure mainly due to over harvest and loss of habitats. Arunachalam and co-authors have listed 50 food fishes and 85 ornamental species (including non-endemics) from whole of Western Ghats; 21 food/cultivable species and 15 ornamental species from Maharashtra; 41 food species and 19 ornamental species including exotic ones from Nilgiri Biosphere Reserve; 8 ornamental species from Hemavathi and Ekachi Rivers of Karnataka and 4 species from Gadana and Manimuthar Rivers. State-wise lists of ornamental species have been prepared by Shaji and Easa for Kerala and Sathyanarayanappa and co-authors for Karnataka. Kumaraiah and Chakraborty have highlighted the present status and suitability of carps such as *Puntius pulchellus*, *Labeo fimbriatus*, *Labeo kontius* and *Cirrhinus cirrhosa* for aquaculture. The importance of killi fishes as ornamental group including the genera *Aplocheilus* and *Aphanius* has been highlighted by Menon, while aquarium fish trader Sane has given an idea of the export potential of some freshwater species of Indian origin. Based on the search in 'Fish Base' (the database developed by ICLARM) for biological details of cultivable Peninsular Indian species, Sarkar and Kapoor have observed lack of information on many aspects and absence of many species such as *Horabagrus nigricollaris*. Dayal and Kapoor have given details of 53 ornamental species from Western Ghats, available in 'Fish Base' of ICLARM highlighting that information on their biology is scanty. Remadevi and co-authors have given their critical comments on the NBFGR base list of cultivable, food, sport and ornamental fishes of Western Ghats.

Life History Traits and Captive breeding

Information on life history parameters of fish species and their habitat requirements are essential for undertaking conservation and management programmes. Ramakrishniah has attempted to provide some information on the biology of 3 indigenous commercial cat fishes *viz*. *Mystus krishnensis*, *Silonia childreni* and *Proeutropiichthys taakree taakree* (Sykes) while Arunachalam and Sankaranarayanan have provided information on a cultivable fish, *Hypselobarbus dobsoni* and an ornamental species *Puntius arulius tambiraparniei*. Biology of a hill stream loach *Nemcheilus triangularis* was addressed by Selvanathan and Godwin Wesley while the critical life history traits of another hill stream fish *Garra mullya* was provided by Loviah Joseph and Godwin Wesley. The Kerala part of Western Ghats harbour many interesting species such as a blind catfish *Horaglanis krishnai* and Anna Mercy has thrown light on the biology of this curious catfish inhabiting the wells in Kottayam District., Kerala. *Labeo dussumieri*, the 'Malabar Labeo' once enjoyed a wide distribution in many rivers originating from Western Ghats. Presently it is confined to few rivers in southern Kerala and its present distribution, abundance and biology have been covered by Madhusoodana Kurup. Natarajan and Aravindan have reviewed information available on life history traits of inland fishes of Kerala. Screening secondary information, Sarkar and co-authors have reported data on age and growth of the commercially important/ cultivable species in Western Ghats is scanty. Ponniah and Lal have described the important life history traits like age and size at first maturity, spawning time, growth rate, fecundity, disease resistance, colouration and scale patterns which need to be documented for effective conservation and genetic management programmes. The reproductive biology estimators useful for planning and predicting reproductive success of a species identified by Lal and Ponniah include sexual dimorphism, sex ratio, reproductive strategy, age and size at maturity and potential fecundity. They have also identified gonado somatic index (GSI), oocyte size-frequency profiles, largest oocyte diameter (LOD) and changes in macroscopic features of gonads as estimators for classification of maturity process in teleosts.

The role of captive breeding in conservation of fish germplasm resources was also highlighted in the workshop. Pandey in his paper has cited examples of captive breeding and river ranching activities and fish refugia distributed in different parts of India. The captive breeding attempts on air-breathing fishes and endangered catfish *Ompok malabaricus* using natural and synthetic hormones have been presented by Haniffa and co-authors, while weaning diet requirements for post larvae, fry and fingerlings of murrels were addressed by Haniffa and Jesu Arockia Raj.

Summary of Workshop Recommendations

The structure of workshop was based on interactive group discussions. Fourteen groups were identified. For each group, specific focal themes were identified. The base papers and the extended abstracts were utilized by the groups for their discussion. The discussions were informal and lively with contribution by all the participants. What follows is a summary of the working group discussions and recommendations under the thematic headings identified.

Taxonomic Ambiguities

The focal theme of the working group was to resolve taxonomic ambiguity of few freshwater species from Western Ghat area and to assign proper generic and species names to fishes in NBFGR's base list for Western Ghats. The group opined that the generic name to be used for yellow catfish endemic to Kerala is *Horabagrus* as it differed in several morphological and meristic characters from Japanese and Chinese genus *Pseudobagrus*. The group also concluded that *Tor khudree* and *T. mussullah* are two distinct species, based on morphometric counts and indicated that the latter exhibited a patchy distribution. Similarly, validity of *Channa micropeltes*, *C. leucopunctatus*, *Labeo nigriscens* and *Macropodus cupanus dayi* as distinct species was agreed upon. The group also reported that *Puntius dobsoni* is a synonym of *P. jerdoni* while *P. pulchellus* is a valid species; and *Osteochilithys* and *Kantaka* as separate genera. For checking the validity of genus/species it was suggested that the works of Jayaram (1999) and Nelson (1994) were to be consulted.

Prioritisation of endemic species for aquaculture

The main objective of the group was prioritisation of potentially cultivable endemic species for development of aquaculture and to identify any constraints in propagating them. The group prioritised 16 potential species for both conservation and developing their culture technology in a phased manner. These include *Gonoproktopterus curmuca*, *Labeo dussumieri*, *Horabagrus brachysoma*, *Labeo fimbriatus*, *Tor khudree*, *Gonoproktopterus kolus*, *G. dobsoni*, *G. dubius*, *Ompok malabaricus*, *Cirrhina cirrohsa*, *Puntius pulchellus*, *Barbodes carnaticus*, *Etroplus suratensis*, *Clarias dussumieri*, *Channa micropeltes* and *C. leucopunctatus*. The working group also identified the organisations where aquaculture experiments of the species can be taken up. The constraints identified are lack of standardized seed production technique, dearth of information on the biology, especially on the reproduction as well as scarcity of spawners and seed.

Prioritization of potential ornamental species endemic to Western Ghats

Thirty ornamental species were prioritised from NBFGR base list to be considered for culture purpose, which included *Puntius denisonii*, *P. fasciatus*, *P. arulius*, *P. narayani*, *P. sahyadriensis*, *P. filamentosus*, *P. punctatus*, *P. setnai*, *P. fraseri*, *Horabagrus brachysoma*, all species of *Barilius*, *Danio malabaricus*, *D. neilgiriensis*, *Chela dadyburjori*, *Botia striata*, *B. macrolineata*, *Nangra ichthea*, *Tetraodon travancoricus*, *Pristolepis marginata*, *Scatophagus argus*, *Horaichthys setnai*, all species of *Nemacheilus* and *Etroplus canarensis*. The committee felt breeding of *Botia*, *Nemacheilus* species *Puntius denisonii* and *Tetraodon travancoricus* is urgent as over-exploitation of wild stock of these highly-priced fishes can lead to their extinction.

Repopulating of endemic food/ sport species

Prioritization of species for repopulating rivers to improve fishery was the main point discussed by the group. From NBFGR base-list, altogether 21 peninsular endemic species were selected for ranching to improve the commercial fishery. These, include *Tor khudree*, *Gonoproktopterus curmuca*, *Labeo dussumieri*, *Horabagrus brachysoma*, *H. nigricollaris*, *Ompok malabaricus*, *Cirrhina cirrhosa*, *Labeo fimbriatus*, *Tor mussullah*, *Barbodes bovanicus*, *B. carnaticus*, *Gonoproktopterus kolus*, *G. micropogon periyarensis*, *G. dubius*, *Channa micropeltes*, *C. leucopunctatus*, *Mystus krishnensis Puntius pulchellus*, *P. jerdoni* (*P.dobsoni*) and *Silurus wynaadensis* Of these, some information on breeding and rearing of larvae exists only for 6 species viz., *Labeo dussumieri*, *L. fimbriatus*, *Tor khudree*, *Puntius pulchellus*, *Ompok malabaricus* and *Silurus wynaadensis*. The working group felt the need to have centrally sponsored schemes for establishment of hatcheries for seed production of indigenous fish species for ranching. The group also suggested to preserve riverine/ reservoir habitats where the endemic species are to be ranched.

River–ranching of endangered, endemic species for conservation

The endangered, endemic species needing immediate steps for conservation, identified by the working group included *Gonoproktopterus curmuca*, *G. kolus*, *G. dubius*, *G. dobsoni*, *G. micropogon periyarensis*, *G. lithopidos*, *G. thomassi*, *Lepidopygopsis typus*, *Clarias dussumieri*, *Channa leucopunctatus*, *Etroplus canarensis*, *P. bovanicus*, *Horabagrus brachysoma*, *Tor mussullah*, *Neolissocheilus wynaadensis* and *Cirrhinus fulungee*. The group also recommended protection of specialized habitat like wells connected with underwater channels in Kottayam, Kerala of endemic blind catfish, *Horaglanis krishnai* and streams where *Lepidopygopsis typus* and *Puntius ophicephalus* are available. Lack of information on breeding biology of all the species listed above and non-availability of technology to breed these species under captivity were the major constraints identified by the group.

Database

The focal theme of the group included building database of fish fauna of Western Ghats and to collect details about the sources and type of information required. For this, the group identified the sources for collection of data of already listed species. The format to be adopted to record data was also discussed and finalized.

Life history traits – Parameters and Methodology

The group identified fecundity, batch fecundity, annual fecundity, size at first maturity, gonadosomatic index, age and growth, length-weight relationship, oocyte-size frequency profile, relative condition factor, food and feeding etc. are the crucial areas to be examined for any stock. The necessity to examine biological parameters of different populations of the same species from different geographic areas, in order to make out any of differentiation of stock was also discussed.

Habitat Inventory – Parameters and Methodology

The focal theme of the group was to identify parameters for habitat survey and inventory in streams and rivers originating from Western Ghats. The parameters to be recorded for habitat survey included stream order, name of stream/river, name of observer, reach length, climate, turbidity and flow rate, maximum/mean depth and length of channel, type of substrate, instream cover, bank stability and erosion, cause of erosion, riparian zone details, slope of habitat and gradient of stream. Chemical parameters of water to be analysed for unpolluted upland part of stream/river include dissolved oxygen, electrical conductivity, total hardness, alkalinity and pH. For middle and lower part of stream the parameters for chemical analysis must be based on localized pollution problems, the group recommended.

Local knowledge, access, benefits

The group discussed four aspects, i) To understand the type of local knowledge, ii) to gain access to local knowledge, iii) benefits of local knowledge, and iv) role of NGO's in gaining local knowledge. Local knowledge would be useful in determining the past and present abundance of a particular fish species in a locality when landing figures are not available. It would also be beneficial in understanding the medicinal property, cultural and religious values of a particular species, if any. For collecting such information from local people, the group felt that a carefully prepared detailed questionnaire with the help of social scientists would be beneficial. The ways by which NGOs could play an active role in fish diversity conservation programmes were also identified.

Region-wise species prioritisation – Kerala

The working group prioritized *Labeo dussumieri*, *Gonoproktopterus curmuca*, *Horabagrus brachysoma*, *Tor khudree*, *Clarias dussumieri*, *Channa micropeltes*, *C. leucopunctatus*, *Labeo ariza*, *Puntius* (*Barbodes*) *carnaticus* and *P. pulchellus* for **aquaculture** and *Gonoproktopterus kolus*, *G. periyarensis*, *Silurus wynaadensis* and *Ompok malabaricus* for **culture-based fishery**. The species identified for **conservation** through river ranching included *Tor mussullah*, *Neolissocheilus wynaadensis*, *Lepidopygopsis typus*, *Gonoproktopterus thomassi*, *G. lithopidos*, and *Horabagrus nigricollaris*. The **ornamental** species identified for captive breeding and aquariculture were *Puntius denisonii*, *P. fasciatus* (*melanampyx*), *P. filamentosus*, *P. arulius*, *Tetraodon travancoricus*, *Danio malabaricus*, *Chela dadyburjori*, *Horabagrus brachysoma*, *H. nigricollaris*, *Pristolepis marginata* and all species of *Garra* and *Nemacheilus*. The biggest constraint reported to standardize breeding technique and popularize the above species is the lack of information on the biology especially on reproduction except of *L. dussumieri*. Hence the group felt that studies on the breeding biology of the above species are to be given top priority,

Region-wise species prioritisation – Karnataka, Maharashtra and Goa

The working group identified *Labeo fimbriatus*, *Puntius pulchellus*, *Tor khudree*, *Puntius carnaticus*, *Cirrhinus fulungee*, *C. macrops*, *Gonoproktopterus micropogon*, *G. dobsoni*, *Thynnichthys sandkhol* and *Silonia childreni* for **aquaculture** and *Gonoproktopterus kolus*, *Tor mussullah*, *Labeo kawrus* and *L. porcellus* for **culture-based fishery**. The species prioritised for **conservation** through river ranching included *Gonoproktopterus thomassi*, *G. dubius*, *Labeo* potail and *Etroplus canarensis*. The potential **ornamental** species identified from the area include *Puntius narayani*, *P. sahyadriensis*, *P. setnai*, *Barilius* canarensis, *B. evezardi*, *Rasbora cauverii*, *Botia striata*, *Pangio goaensis*, *Nangra itchteea*, *Labeo* potail and all species of *Nemacheilus*. As in Kerala, lack of information on reproduction biology of most of these species is the bottleneck to take up captive breeding programmes of the above listed species.

Region-wise species prioritisation – Tamil Nadu and Andhra Pradesh

The group prioritized *Labeo kontius*, *Cirrhinus cirrhosa*, *Puntius* (*Barbodes*) *bovanicus*, *P. carnaticus*, *Cirrhinus macrops*, *Mystus krishnensis*, *Ompok malabaricus*, *Gonoproktopterus dubius* and *G. kolus* for **culture**, **culture-based fishery** and **conservation** through river ranching. The aquarium species prioritized from the region include *Puntius fasciatus*, *P. arulius tambraparniei*, *P. bimaculatus*, *Barilius* gatensis, *Esomus barbatus*, *Danio neilgiriensis*, *Mesonoemacheilus triangularis*, *M. pulchellus*, *Schistura nilgiriensis, Garra hughi, G. kalakkadensis and Aplocheilus rubrostigma.*

Sanctuaries

The focal points for this working group were to finalize criteria to select a water body as a sanctuary and to list out few water bodies in Western Ghats as potential sanctuaries based on the above criteria. The group felt that the first criterion should be water bodies harbouring endangered/endemic/rare species and large enough to support viable populations are to be considered as potential sanctuaries. Rivers, streams and large wetlands which are perennial and less disturbed can be the next criterion. The group identified following areas in Western Ghats as potential fish sanctuaries, *viz*. i) Moyar River from Pykara to Kalampalayam, Tamil Nadu, ii) Karimpuzha and Kunthipuzha of Chaliyar River, Kerala, iii)upstream areas of Chalakkudy River, Kerala, iv) Aghanashini River in Uttara Kannada, Karnataka, v) up-streams of Periyar River, Kerala, vi) selected stretches of Vembanad Lake, Kerala, and vii) Kabani River down to Panamaran, Karnataka. It was also suggested to identify spawning grounds of endemic/endangered species in each river and protect those areas.

Prioritisation of Water bodies

Under this theme, nature and source of information available on water bodies of Western Ghats with a view to prepare a database was discussed. The working group felt information on ichtyofaunal composition needs to be compiled for prioritization. This can be obtained by carrying out actual field surveys and also collecting already available information from different sources. The nature and source of information available with agencies like Kerala Forest Research Institute (KFRI), Peechi; Anna University, Chennai; Centre for Water Resources Development and Management (CWRDM), Calicut; Zoological Survey of India, Calcutta, Central Inland Fisheries Research Institute (CIFRI), Barrackpore etc. were identified. The eminent researchers working in the same field were also identified as potential sources for collection of relevant information.

Directory on Western Ghats

The need to bring out a directory on Western Ghats encompassing information on profile of institutes and individuals involved in research on fish fauna and aquatic habitats of Western Ghats; details of on-going and completed projects and a bibliography was felt by many participants.

Looking beyond the Workshop

The National Workshop on "Germplasm Inventory and Gene Banking of Freshwater fishes of Western Ghats" was a landmark event in that it brought together various research and government organisations concerned with sustainable utilization fishery resources of Western Ghats. It also indicated the availability of information as well as areas where further research is required. The working groups have identified the issues and the various options along with the institutions that could take up programmes to address these issues. The National Agricultural Technology Project (NATP) of NBFGR launched in January, 2000 with five collaborators drawn from the Western Ghats region is one such effort which would go a long way in generating the scientific information required for sustainable development of fishery resources of Western Ghats. However, the state government fisheries, forests and other departments need to develop linkages and utilize the research expertise available to develop with NGOs and local communities to implement these programmes. The National Workshop addressed the issue of local knowledge and community participation, however these important areas were not adequately represented and there is a need to incorporate them directly in developing fish bio-diversity conservation programmes.

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Cultivable, Ornamental, Sport and Food Fishes Endemic to Peninsular India with Special Reference to Western Ghats

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The aquatic resources of Peninsular India comprising of five southern states *viz*. Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Pondicherry, Goa and parts of Maharashtra and Orissa cover about 20% river and canal resources of the country, as much as 38.6% (8.07 lakh ha) of reservoirs, 50% of tanks and ponds and about 63% (7.67 lakh ha) swamp and derelict waters of the country (Ayyappan, 1996). Major rivers like Godavari, Krishna and Cauvery and a number of west flowing rivers originating from Western Ghats harbour a unique fish wealth showing a great diversity and endemicity. The mountains along the west coast of the Indian Peninsula, the Western Ghats constitute one of the unique biological regions of the world. The Western Ghats extend about 1600 km north wards from the southern tip of the peninsula (8°N) up to the mouth of river Tapti (21°N) (Fig.1). From the Western Ghats arise numerous west facing drainages which are rather small rivers. The richest expression in diversity, abundance and endemism of freshwater fish fauna is met in these drainages in India, in addition to the North Eastern region (Anon.,1998). Of the 18 biological hotspots of the world, the Western Ghats together with the west coast of India forms an important ecological region (Subash Chandran, 1997). In the World Bank technical report, streams of Kerala (*i.e*. southern and central division of Western Ghats) have been identified as one of the few sites in the world showing exceptional biodiversity and high degree of endemism with respect to freshwater fishes (Kottelat and Whitten,1996).

Of the 617 and odd species considered as belonging to the freshwater of India, several species are confined to South Indian waters and these are particularly concentrated in Western Ghats. These include (i) many endemic food/sport

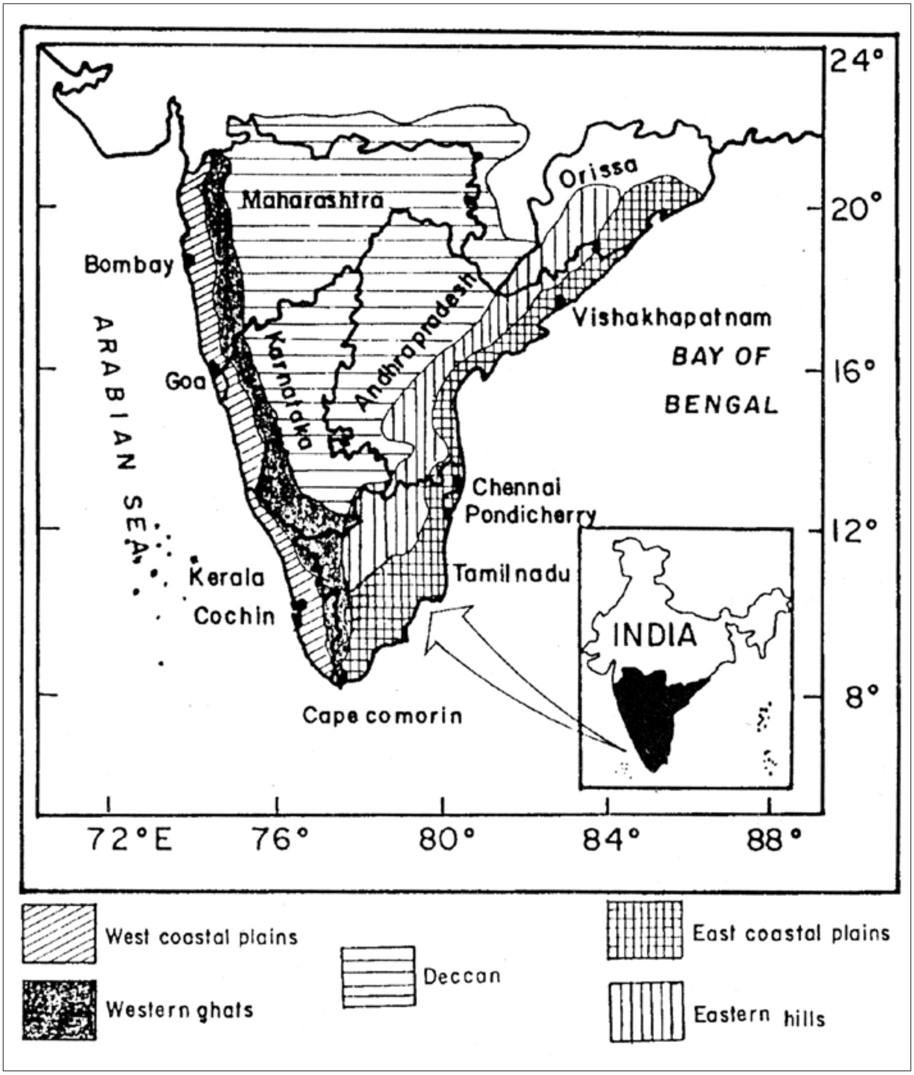

Fig.1. Peninsular india showing major physiographic divisions

fishes *viz*. *Labeo dussumieri*, *L. fimbriatus*, L. ariza, L kontius, *Tor khudree*, *T. mussullah*, Gonoproktopterus (Hypselobarbus) curmuca, *G. dubius*, *Cirrhinus cirrhosa*, *Puntius pulchellus* and *P. carnaticus* and (ii) several brightly coloured attractive ornamental fishes such as loaches of the genus Noemacheilus and Travancoria and many species of very elegant barbs such as *Puntius* arulius, P. *denisonii*, *P. narayani*, *P. filamentosus*, *Danio malabaricus*, etc. In India, during the last few decades, main thrust was augmenting fish production all over the country including Peninsular freshwater by introducing/transplantation of fast growing Chinese and Indian major carps and other exotic species. As a result, the native food fishes of the peninsula were totally neglected and introduced species got established themselves and started breeding naturally in many reservoirs in Peninsular India (Chakraborty, 1996). The endemic species such as *Puntius* dubius, *Labeo fimbriatus* and *Cirrhinus cirrhosa* contributed about 60-80% of total catch in some rivers and reservoirs in Peninsular India till late 50's (Sreenivasan, 1995). But introduction of exotic species affected the native fish fauna and many of them have become rare in several reservoirs (Chakraborty, 1996). Game fishes like *Tor khudree* and *T. mussullah* once conspicuous by their presence in several streams and reservoirs along Western Ghats also declined due to construction of dams and weirs, indiscriminate fishing and wanton destruction of brood fish and juveniles (Sreenivasan, 1995).

List of prioritised endemic species

Despite its vast water resources and a rich faunal biodiversity, the contribution of the peninsular species to total inland fish production in the country is negligible (Tripathi, 1996). It is obvious that the resources are neither properly utilized nor the potential is fully harnessed. One of the main reasons is that none of the peninsular species has been incorporated into culture systems. The starting point for diversification of aquaculture would be prioritizing potential cultivable species endemic to the region.

In spite of a series of publications on the inventory of freshwater fish fauna of Peninsular India (Day 1865,1878; Pillay 1929; Hora and Law, 1941; Hora 1942; Silas, 1951a, b, 1952a, b, 1953; Jayaram,1981; Talwar and Jhingran, 1991; Kowtal, 1994, Chakraborty, 1996; Gopi, 1996; Shaji, 1996; Arun, 1997), no consolidated list of commercially important food, sport and ornamental fishes endemic to the region has been published so far. Such a list is essential for the scientists and governmental agencies to include the local fish species in fisheries research and developmental activities in the region. Hence an effort is made here to list out all such fishes (Table 1 and 2) endemic to the region. The past and present distribution, abundance and life history traits with special reference to annual growth rate of most of these species have not been studied. Hence in the absence of such specific data, the listing of food fishes (Table 1) is based on the (i) maximum size of the species reported in the literature, (ii) acceptance of these fishes by local people, (iii) discussion with experts from all peninsular states during the Conservation Assessment and Management Plan (CAMP) workshop on Indian freshwater fishes, held at the National Bureau of Fish Genetic Resources (NBFGR), Lucknow, during Sept, 1997 and (iv)in consultation with the local fishermen and fish farmers during field surveys. The regional names of

Table 1: Cultivable, Food and Sport Fishes Endemic to Peninsular India with special reference to Western Ghats

Sl. No.	Species	Common Name	Max. Size (TL/ TW)	Distribution	Category	Reference.
FAMILY – CYPRINIDAE						
1.	*Labeo dussumieri* (Valenciennes)	Malabar labeo, "Thooli" (Mal), "Pullan" (Mal)	55 cm	Rivers of Kerala	Cultivable; Excellent table fish , Highly priced	Talwar & Jhingran (1991)
2.	*Labeo ariza* (Hamilton-Buchanan)	Ariza labeo, "Coal kendai" (Tam), "Rogu" (Mal)	56 cm 1.36 kg	Nilgiris, Cauvery	Cultivable	Talwar & Jhingran (1991)
3.	*Labeo kontius* (Jerdon)	Pigmouth carp, "Currumuzhikendai" (Tam)	61 cm	Cauvery; Thanjavur Area	Cultivable	Talwar & Jhingran (1991)
4.	*Labeo potail*(Sykes)	Deccan labeo , "Dotondi" (Mar)	40 cm	Cauvery, Kabbini, Maharashtra, Western Ghats	Food fish	Talwar & Jhingran (1991) and Easa & Shaji (1997)
5.	*Labeo fimbriatus* (Bloch)	Fringed lipped carp, "Pirichundan" (Mal) "Venkendai" (Tam)	91 cm	Cauvery, Peninsular rivers	Cultivable	Talwar & Jhingran (1991)
6.	*Labeo nigrescens* Day*	Karnataka labeo, "Mulvel", "Kurri-meenu" (Kan).	45 cm	Mangalore; Cauvery; Karnataka	Food fish	alwar & Jhingran (1991)
7.	*Labeo kawrus* (Sykes)	Deccan labeo	60cm	Western Ghats upto Deccan	Cultivable	Talwar & Jhingran (1991)
8.	*Labeo porcellus* (Heckel)	Bombay labeo	30 cm	Western Ghats (Bombay region)	Food fish	Talwar & Jhingran (1991)

Sl. No.	Species	Common Name	Max. Size (TL/ TW)	Distribution	Category	Reference.
9.	*Neolissochilius wynaadensis* (Day)	Wynaad Mahseer	(Imm-ature 25cm)	Wynaad; Cauvery	Sport fish	Jayaram, (1981) Talwar & Jhingran (1991)
10.	*Tor khudree* (Sykes)/ *T. malabaricus* (Jerdon) *	Deccan Mahseer, Blue fin Mahseer, Black Mahseer, "Kuyil/ Katta" (Mal)	100 cm (~23 kg)	Head waters of Periyar, Kallada Wynaad and other rivers in Keralam, Cauvery, Head water of Godavari	Excellent sport fish , cultivable	Talwar & Jhingran (1991); Menon (1993)
11.	*Tor mussullah* (Sykes)	Red fin mahseer, "Katti" (Mal), "Masundi" (Tam)	150 cm (90 kg)	Head waters of Chaliyar (Nilambur, Kerala), Krishna, Cauvery and Moyar	Food fish.	Jayaram (1997); Talwar & Jhingran (1991)
12.	*Tor kulkarnii** (Menon)	---	---	Pune, Maharashtra.	Food fish	Menon (1993), Rema Devi *et al.* (2000)
13	*Tor neilli* (Day)*	---	~ 30kg	Krishna, Cauvery, Kurnool, Tungabhadra	Food fish	Jayaram (1999).
14.	*Gonoproktopterus* (Hypselobarbus) *curmuca* (Hamilton- Buchanan)	Curmuca barb, "Kooral" (Mal)	>120 cm	Head waters of rivers of Kerala like Pampa, Manimala, Kallada, Kunthipuza, Periyar, Malampuzha	Sport fish; Excellent table fish; Cultivable, Highly-priced.	Talwar & Jhingran (1991), Menon (1993), Menon & Rema Devi (1995)
15.	*Gonoproktopterus* (Hypselobarbus) *kolus (Sykes*	"Kariyan" (Mal)	>60 cm	Upperwaters of Chalakkudy River, Kerala, Krishna, Godavary & Cauvery, Pune, Karnataka	Excellent table fish; Sport fish	Talwar & Jhingran (1991), Menon & Rema Devi (1995)
16.	*Gonoproktopterus micropogon periyarensis* (Valenciennes)	"Kariyan" (Mal)	60-90 cm	Periyar Reservoir	Food fish; Sport fish; Highly priced	Raj (1941b), Talwar & Jhingran (1991)

Sl. No.	Species	Common Name	Max. Size (TL/ TW)	Distribution	Category	Reference.
17.	*Gonoproktopterus micropogon mysorensis* (Jerdon)	Korhi barb, "Coatee kendai" (Tam.)	90 cm	Upper Cauvery, Nilgiris, Bhawani, T.N., Ooty lake.	Important sport fish, highly priced.	Jayaram (1981), Talwar & Jhingran (1991)
18.	*Gonoproktopterus (Hypselobarbus) thomassi* (Day)	Red Canarese Barb	100 cm	Upper Cauvery, S. Canara, Cardamom Hills, Chalakkudi	Food fish.	Jayaram (1981), Talwar & Jhingran (1991), Menon (1993)
19.	*Gonoproktopterus lithopidos* (Day)	Canara barb	60 cm	Western Ghats: Streams & rivers from S. Canara to Nilambur, Kerala	Food fish.	Talwar & Jhingran (1991).
20.	*Gonoproktopterus* (Hypselobarbus) *dubius* (Day)	Nilgiri Barb, "Kozhimeen" (Tam)	61 cm	Upperwaters of Cauvery, Nilgiris	Food fish; Cultivable	Talwar & Jhingran (1991), Chakraborty (1996)
21.	*Gonoproktopterus (Hypselobarbus) jerdoni* (Day) * *or H. dobsoni* (Day)*	Krishna carp, "Saymeen"(Kan), "Chameen" (Tel), Jerdon's carp	120 cm	Krishna river drainages, Anjanapur, S. Canara , Chalakkudy.	Cultivable	Menon (1993)
22.	*Puntius pulchellus* (Day)	"Pachilavetti" (Mal), "Katladi" (Tul), "Hargimeenu" (Kan).	120 cm	Tungabhadra Reservoir, Krishna; S. Canara, Wynad.	Cultivable (macrophyte feeder)	Talwar & Jhingran (1991), Chakraborty (1996), Kowtal (1994).
23.	*Barbodes carnaticus* (Jerdon)	Carnatic carp, "Cauvery Kendai" (Tam)	>60 cm 12 kg	Nilgiri, Cauvery, Bhawani, Chinnar, Parambikkulam	Cultivable	Menon (1993), Talwar & Jhingran (1991)
24.	*Cirrhinus cirrhosus* (Bloch)	Cauvery white carp, "Venkendai" (Tam)	61cm, 6 kg	East flowing Rivers of Pennisular India esp. Cauvery, Krishna & Godavary	Cultivable	Menon (1993), Talwar & Jhingran (1991)

Sl. No.	Species	Common Name	Max. Size (TL/ TW)	Distribution	Category	Reference.
25.	*Cirrhinus fulungee* (Sykes)	Deccan white carp, "Mulicha ganna" (Mar).	30 cm	Maharashtra & Karnataka	Food fish.	Talwar & Jhingran (1991)
26.	*Cirrhinus macrops* (Steindachner) / *C. horai.*	Hora white carp	35 cm	Most common in Godavary	Food fish.	Menon (1993), Talwar & Jhingran (1991)
27.	*Crossocheilus periyarensis Menon & Jacob*	"Karimpachi"(Mal).	35 cm	Periyar lake, Kerala.	Food fish	Jayaram (1999), Rema Devi *et al.* (2000)
28.	*Puntius sarana subnasutus* (Valenciennes)	Peninsular Olivebarb, "Kurichi" or "Kuruva"(Mal)	25 cm	Cauvery, Krishna, most common in Kerala rivers	Cultivable.	Sobhana & Nair (1979), Jayaram (1981)
29.	*Lepidopygopsis typus Raj*	Peninsular hill trout, "Brahmana Kendai" (Mal)	25 cm	Periyar, Thannikudi	Food fish.	Arun (1997), Talwar & Jhingran (1991)
30.	*Barbodes bovanicus* (Day)	Bhavani barb	40 cm	Cauvery, Mettur dam	Cultivable	Jayaram *et al.* (1982).
31.	*Thynnichthys sandkhol* (Sykes)	Sandkhol barb	60 cm, 1.4kg in 1yr	Krishna , Godavary & Mahanadi	Cultivable	Talwar & Jhingran (1991)
32.	*Osteocheilus thomassi* Day	"Machal", "Mamal" (Mal); Konti barb	32 cm	Western Ghats of Karnataka, Kerala	Food fish.	Talwar & Jhingran (1991)
33.	*Osteocheilus longidorsalis Peth.& Kott.*	"Modon" (Mal)	30 cm	Chalakkudy River	Food fish.	Pethiyagoda & Kottelat (1994)
34.	*Osteochilichthys nashii* (Day)	"Modon" (Mal)	30 cm	Deccan, Coorg, Nilgiris, Anamalai	Food fish.	Talwar & Jhingran (1991)

Sl. No.	Species	Common Name	Max. Size (TL/ TW)	Distribution	Category	Reference.
35.	*Horabagrus brachysoma Gunther or Pseudobagrus chryseus Day*	"Gunther's catfish", "Manja koori" (Mal)	50 cm	Rivers of Kerala	Cultivable; Excellent table fish	Talwar & Jhingran (1991), Jayaram (1981)
36.	*Horabagrus nigricollaris Pethiyagoda & Kottelat.*	"Manja koori" (Mal)	17 cm	Upper reaches of Chalakkudy River	Food fish.	Pethiyagoda & Kottelat (1994)
37.	*Mystus punctatus* (Jerdon)	Nilgiri Mystus, "Setha Keletee" (Tam)	50 cm	Nilgiri hills & Western Ghats	Food fish.	Talwar & Jhingran (1991)
38.	*Mystus krishnensis Ramakrishniah*	Giant Krishna mystus, "Ponduga" (Tel)	116 cm; 58 kg	Krishna river & tributary	Food fish.	Talwar & Jhingran (1991)
FAMILY – SCHILBEIDAE						
39.	*Silonia childreni* (Sykes)	White catfish, "Silond"(Or), "Seelundh"(Mar)	50cm	Rivers of Western Ghat, Krishna, Godavary &Cauvery	Important food fish	Talwar & Jhingran (1991)
FAMILY – SILURIDAE						
40.	*Silurus wynaadensis Day*	Malabar Silurus, "Wyanad mushi" (Mal).	30 cm	Wynaad, Kerala, Cauvery, Thungbhadra	Food fish; Cultivable	Talwar & Jhingran (1991), Menon (1993)
41.	*Ompok malabaricus* (Valenciennes)	Goan catfish, "Chottu Vaala", "Thonnan vaala", Manglan" (Mal).	51 cm	Goa, Rivers of Kerala, Silent Valley, Chalakkudy, Achankoil.	Food fish.	Talwar & Jhingran (1991)

Sl. No.	Species	Common Name	Max. Size (TL/ TW)	Distribution	Category	Reference.
FAMILY – CLARIIDAE						
42.	*Clarias dayi Hora*	Malabar clarid	17.5 cm	Fast flowing streams, Wynaad, Kerala	Food fish.	Hora (1942), Talwar & Jhingran (1991)
43.	*Clarias dussumieri dussumieri* (Valenciennes)	Valenciennes clarid,	50 cm; 3.0 kg.	Rivers of Peninsular India	Cultivable; Highly - priced	Talwar & Jhingran (1991)
FAMILY – CHANNIDAE						
44.	*Channa micropeltes* (Cuvier)	Malabar snake-head, "Vaaka varaal" (Mal)	100 cm; 20 kg	Restricted to Kerala; Stray occurrence in Vembanad area	Food fish; highly priced	Talwar & Jhingran (1991)
45.	*Channa leucopunctatus* (Bloch)	"Varaal" (Mal)	3 feet and above	Kottayam, Malabar, Coromondal coast	Food fish.	Day (1878)
FAMILY – CICHLIDAE						
46.	*Etroplus canarensis Day*	Canara Pearl spot	15 cm	Restricted to S. Canara	Food fish.	Talwar & Jhingran (1991), Menon *et al.*, (1993)
47.	*Etroplus suratensis* (Bloch)	"Karimeen" (Mal)	50cm	Kerala, Karnataka, Tamil Nadu, Andhra Pradesh and Orissa	Cultivable (brackish and freshwater)	Talwar & Jhingran (1991)

* Taxonomic position to be confirmed. According to Dr. M. Arunachalam, M.S. Univ., T.N. (pers. comm.), *Gonoproktopterus jerdoni* and *G. dobsoni* are two distinct species.

Common names:- (Kan) Kannada; (Mal) Malayalam; (Mar) Marathi; (Or) Oriya; (Tam) Tamil;(Tel) Telugu; (Tul) Tulu.

Table 2: Potential Freshwater Ornamental Fishes Endemic to Peninsular India with special reference to Western Ghats

Sl. No.	Species & family	Common name	Distribution	Reference
FAMILY – CYPRINIDAE				
1.	*Puntius arulius arulius* (Jerdon)	"Aruli barb", "Pewal kandai" (Tam)	T.N., Kerala, Cauvery drainage	Talwar & Jhingran (1991)
2.	*Puntius arulius tambraparniei Silas*	Silas barb.	Tambraparnei River, T.N.	Anon (1998)
3.	*Puntius chalakkudiensis Menon, Rema Devi & Thobias*	---	Chalakkudy River, Kerala.	Shaji & Easa (1998)
4.	*Puntius deccanensis* (Yazdani & Rao)	Deccan barb.	Western Ghats at Poona, Maharashtra	Talwar & Jhingran (1991)
5.	*Puntius denisonii* (Day)	Redline torpedo. "Chenkaniyan" (Mal)	Kallar,Kallada, Chalakkudy, Chaliyar & Aralam in Kerala	Talwar & Jhingran (1991)
6.	*Puntius fasciatus* (Jerdon) *or P. melanampyx.**	"Vazhakkavarayan" (Mal), Melon barb.	Streams in Kerala, Goa, Cauvery, Cochin, Canara,	Talwar & Jhingran (1991)
7.	*Puntius filamentosus* (Valenciennes)	Indian tiger barb (Black spot barb)	Goa, Karnataka, Kerala & T.N. (Bhavani River)	Talwar & Jhingran (1991)
8.	*Puntius melanostigma* (Day)	Wynaad barb	Wynaad Hills, Bhawani river	Talwar & Jhingran (1991)
9.	*Puntius narayani* (Hora)	"Narayani"(Kan)	Coorg; Cauvery River (Karnataka)	Talwar & Jhingran (1991)
10.	*Puntius ophicephalus* (Raj)	Channa barb, "Eetilakanda"(Mal)	Kallar, Pampa, Kerala	Menon (1993)
11.	*Puntius parrah* (Raj)	"Para paral" (Mal)	Karuvannur, Trichur	Menon (1993)
12.	*Puntius sahyadriensis* (Silas)	"Khavli" (Mar)	Yenna river, Maharashtra	Menon (1993), Silas (1953)
13.	*Puntius fraseri* (Hora & Misra)	---	Western Ghats (Nasik)	Singh (1994)
14.	*Puntius setnai Chhapgar & Sane*	---	Sanguem, Ponda (Goa).	Menon (1999)
15.	*Puntius punctatus** (Day)	"Paral" (Mal)	Kerala, Tirunelveli (T.N.)	Menon (1999)
16.	*Puntius bimaculatus* (Bleeker)	Two spot barb.	Karnataka, Kalakkad & T.N.	Jayaram (1999).
17.	*Labeo potail* (Sykes)	"Dotondi" (Mar)	Kabbini (Kerala); Maharashtra	Talwar & Jhingran (1991); Easa & Shaji (1997)

Sl. No.	Species & family	Common name	Distribution	Reference
18.	*Amblypharyngodon chakaiensis Babu & Nair*	Veli lake carplet, "Vayambu" (Mal)	Veli Lake, Kerala	Talwar & Jhingran (1991)
19.	*Amblypharyngodon melettinus* (Val.)	Attentive carplet,"Pachathalai kendai" (Tam)	Streams and rivers of Western Ghats & T.N.	Talwar & Jhingran (1991)
20.	*Barilius bakeri Day*	Malabar baril, "Pavukan" (Mal)	Western Ghats, Kerala	Talwar & Jhingran (1991)
21.	*Barilius gatensis* (Valenciennes)	River carp baril, "Pavukan" (Mal).	Kerala, Maharashtra, Nilgiris	Talwar & Jhingran (1991)
22.	*Barilius canarensis* (Jerdon)	Jerdon's baril, "Pavukan" (Mal).	Western Ghats, Kerala & Karnataka	Talwar & Jhingran (1991)
23.	*Barilius evezardi Day*	Day's baril, "Jhorya" (Mar.)	Western Ghats (Maharashtra)	Talwar & Jhingran (1991)
24.	*Danio malabaricus* (Jerdon)	Malabar danio	Western Ghats, Kerala & Karnataka	Talwar & Jhingran (1991)
25.	*Danio neilgherriensis* (Day)	Peninsular Danio	Streams of Nilgiri	Talwar & Jhingran (1991)
26.	*Danio fraseri* (Hora)	Fraser danio, "Gayroonjee" (Mar).	Rivers of Nasik (Dt.)	Talwar & Jhingran (1991)
27.	*Esomus thermoicos* (Val.)	---	Kalakkad, Tirunelveli.	Jayaram (1999)
28.	*Esomus barbatus* (Jerdon)	"Meesai Paravai" (Tam), Flying barb	T.N. & Karnataka	Talwar & Jhingran (1991)
29.	*Rasbora caverii Jerdon*	Cauvery rasbora	Cauvery, Karnataka	Talwar & Jhingran (1991)
30.	*Parluciosoma* (Rasbora) *labiosa* (Mukerji)	Slender rasbora, "Dandai" (Mar)	Nasik (Dt), Maharashtra	Talwar & Jhingran (1991)
31.	*Garra hughi Silas*	Cardamom Garra, "Kallunthi", "Kallotti" (Mal)	Cardamom & Palani hills, T.N.	Talwar & Jhingran (1991)
32.	*Garra mcclellandi* (Jerdon)	Cauvery Garra	Cauvery river	Talwar & Jhingran (1991)
33.	*Garra surendranathanii Shaji, Arun & Easa*	---	Southern W. Ghats	Shaji *et al.* (1996).
34.	*Garra gotyla stenorhynchus* (Jerdon)	Nilgiri Garra	Cauvery & Krishna drainages, Nilgiris	Talwar & Jhingran (1991)
35.	*Garra kalakkadensis Rema Devi.*	---	Kalakkad, T.N.	Jayaram (1999).
36.	*Garra menoni Rema Devi & Indra*	---	Silent Valley, Kerala	Jayaram (1999).

Sl. No.	Species & family	Common name	Distribution	Reference
37.	*Garra bicornuta Rao*	---	Karnataka, Maharashtra	Jayaram (1999).
38.	*Chela dadyburjori* (Menon)	Dadio	Rivers of Kerala, Goa & Nagercoil	Talwar & Jhingran (1991)
39.	*Chela fasciata Silas*	Malabar hatchet Chela	Anamalai Hills, Bharatha-puzha.	Talwar & Jhingran (1991)
40.	*Osteobrama bakeri* (Day)	"Mullan paval" (Mal)	Kottayam, Kerala.	Talwar & Jhingran (1991)
41.	*Horalabiosa joshuai Silas*	---	Kalakkad, Tamil Nadu	Jayaram (1999)
42.	*Horalabiosa palaniensis Rema Devi & Menon*	---	Palani Hills, Tamil Nadu	Jayaram (1999)
FAMILY - BALITORIDAE				
43.	*Balitora mysorensis* (Hora)	Slender stone loach	Western Ghats, Tung-abhadra, Kolhapur	Talwar & Jhingran (1991)
44.	*Balitora shimogensis Menon et al. **	Slender stone loach	Western Ghats, Shimoga	Shaji C. P. (KFRI - pers. comm.)
45.	*Bhawania australis* (Jerdon)	Western Ghat loach	South Western Ghats	Talwar & Jhingran (1991)
46.	*Homaloptera montana Herre*	Anamalai loach	Anamalai (Kerala), Silent valley	Talwar & Jhingran (1991)
47.	*Homaloptera pillaii Indra & Rema Devi*	---	Kunthi River – Silent Valley, Kerala.	Jayaram (1999), Rema Devi *et al.* (2000)
48.	*Homaloptera menoni Shaji & Easa*	---	Bhavani River	Menon999)
49.	*Travancoria jonesi Hora*	Travancore loach, "Kalsravu" (Mal)	Anamalai (Kerala), Silent valley	Talwar & Jhingran (1991)
50.	*Travancoria elongata Pethiyagoda & Kottelat*	Travancore loach	Chalakkudi River, Kerala.	Pethiyagoda & Kottelat (1994)
51.	*Longischistura bhim-achari* (Hora)	---	Thunga River, Shimoga, Karnataka.	Jayaram (1999)
52.	*Mesonemacheilus menoni Zacharias & Minimol*	---	Periyar River, Kerala.	Zacharias & Minimol (1999)
53.	*Mesonemacheilus herrei Nalbant & Banarescu**	---	Anamalai, Valparai, Kerala	Menon (1999)
54.	*Mesonoemacheilus guentheri* (Day)	"Koitha" (Mal)	Nilgiri, Western Ghats	Talwar & Jhingran (1991)
55.	*Oreonectes keralensis Rita & Nalbant*	"Koitha" (Mal)	Pampadumpara, Kerala.	Talwar & Jhingran (1991)
56.	*Schistura kodaguensis* (Menon)	---	Mercara, Karnataka	Talwar & Jhingran (1991)

Sl. No.	Species & family	Common name	Distribution	Reference
57.	*Oreonectes evezardi* (Day)	---	Mercara, Karnataka	Talwar & Jhingran (1991)
58.	*Acanthocobitis moreh* (Sykes)	"Koitha" (Mal)	Wynaad, Kerala, Peninsular India.	Easa & Shaji (1997)
59.	*Schistura nilgiriensis* (Menon)	---	Pykara Dam, Ooty, Tamil Nadu	Talwar & Jhingran (1991)
60.	*Mesonoemacheilus petrubanarescui* (Menon)	---	Netravathi River, Dharmasthala, Karnataka	Talwar & Jhingran (1991)
61.	*Mesonoemacheilus pulchellus* (Day)	---	Bhawani River, Nilgiris	Talwar & Jhingran (1991)
62.	*Mesonoemacheilus rueppelli* (Sykes)	---	Western Ghats of Maharashtra & Karnataka	Talwar & Jhingran (1991)
63.	*Schistura semiarmatus* (Day)	"Koitha" (Mal)	Wynaad, Silent Valley, Cauvery basin	Talwar & Jhingran (1991)
64.	*Nemacheilus monilis Hora*	---	Western Ghats, Nilgiris	Talwar & Jhingran (1991)
65.	*Schistura striatus* (Day)	"Koitha" (Mal)	Wynaad, (Western Ghats), Kerala	Talwar & Jhingran (1991)
66.	*Mesonemacheilus remadeviensis Shaji & Easa*	"Koitha" (Mal)	Wynaad, (Western Ghats), Kerala	Shaji & Easa (2001)
67.	*Nemachilus poonaensis* Menon*	---	Krishna River Basin, Poona, Karnataka.	Menon (1999). (Specimens in K.F.R.I., Kerala).
68.	*Mesonoemacheilus triangularis* (Day)	"Koitha" (Mal)	Mundakkayam (Ker.); Tambraparni river	Talwar & Jhingran (1991)
69.	*Mesonoemacheilus pambarensis Rema Devi & Indra*	"Koitha" (Mal)	Idukki Dist., Kerala	Jayaram (1999), Rema Devi *et al.* (2000)
70.	*Noemacheilus triangularis tambraparniensis Menon*	---	Tambraparnei River, T.N.	Jayaram (1999), Rema Devi *et al.* (2000)
71.	*Noemacheilus anguilla Annandale*	---	Maharashtra .	Jayaram (1999), Rema Devi *et al.* (2000)
72.	*Noemacheilus denisoni mukambbikaensis Menon*	---	Mukambika, Karnataka	Jayaram (1999), Rema Devi *et al.* (2000)
73.	*Noemacheilus denisoni pambaensis Menon*	"Koitha" (Mal)	Sabarigiri, Kerala	Talwar & Jhingran (1991), Rema Devi *et al.* (2000)

Sl. No.	Species & family	Common name	Distribution	Reference
FAMILY – COBITIDAE				
74.	*Lepidocephalus thermalis* (Valenciennes)	Malabar loach	Kerala, Karnataka, Maharashtra	Talwar & Jhingran (1991), Ritakumari & Nair (1978)
75.	*Botia striata Rao*	Tiger loach, "Waghamasa" (Mar)	Tunga River, Kolhapur	Talwar & Jhingran (1991)
76.	*Botia macrolineata Tengels, Devos & Snocks*	---	Western Ghats of Maharashtra	Talwar & Jhingran (1991)
77.	*Pangio goaensis* (Tilak)	Coolie loach	Colem River, Goa; Kerala	Talwar & Jhingran (1991); Rema Devi *et al.* (2000).
78.	*Pangio bashai Easa & Shaji*	---	Chaliyar River, Kerala	Jayaram (1999).
FAMILY – CLARIIDAE				
79.	*Horaglanis krishnai* (Menon)	Indian blind catfish	Wells of Kottayam Dist., Kerala	Anna Mercy (1981), Talwar & Jhingran (1991), Menon (1993)
FAMILY – SISORIDAE				
80.	*Glyptothorax anamalaiensis Silas*	"Kalkkari" (Mal)	Anamalai Hills, Kerala	Talwar & Jhingran (1991)
81.	*Glyptothorax housei Herre*	---	Anamalai Hills, Kerala	Talwar & Jhingran (1991)
82.	*Glyptothorax conirostre poonenesis Hora*	---	Mula-Mutha River, Pune	Jayaram (1999)
83.	*Glyptothorax lonah* (Sykes)	---	Western Ghats	Jayaram (1999)
84.	*Glyptothorax trewavasae* (Hora)	---	Southern Western Ghats	Jayaram (1999)
85.	*Glyptothorax madraspatanam* (Day)	Clown catfish	Western Ghats, Anamalai Hills, Kerala	Talwar & Jhingran (1991)
86.	*Nangra itchteea* (Sykes)	Clown catfish	Rivers of Deccan plateau	Talwar & Jhingran (1991)
FAMILY – NANDIDAE	**Sub family : Pristolepidinae**			
87.	*.Pristolepis malabaricus* (Gunther) *or P. marginata Jerdon*	Malabar Catopra, "Chuttichi" (Mal)	Stream of Nilgiri Biosphere reserve, Western Ghats, endemic to Kerala	Talwar & Jhingran (1991), Easa & Shaji (1997)

Sl. No.	Species & family	Common name	Distribution	Reference
FAMILY - APLOCHEILIDAE (Rivulines)				
88.	*Aplocheilus blocki* (Arnold)	Dwarf (Green) Panchax	Kerala, T.N., West coast, Coromandal coast	Talwar & Jhingran (1991)
89.	*Aplocheilus lineatus* (Valenciennes)	Malabar killie, "Manat-tukanni"(Mal)	Western & South Eastern Region of India	Talwar & Jhingran (1991)
90.	*Aplocheilus rubrostigma** (Jerdon)	---	Rivers of Kerala and Coromandel coast	Jayaram (1981)
FAMILY – MASTACEMBELIDAE				
91.	*Macrognathus guentheri* (Day)	Malabar spiny eel, "Aral" (Mal)	Canals & rivers of Kerala	Talwar & Jhingran (1991)
FAMILY – TETRAODONTIDAE				
92.	*Carinatetraodon imitator Pethiyagoda & Kottelat.*	Puffer fish.	Ernakulam, Kerala.	Pethiyagoda & Kottelat (2000, original not referred)
93.	*Tetraodon travancoricus Hora & Nair*	Malabar Puffer fish	Pampa river, Kerala	Talwar & Jhingran (1991)
FAMILY – BAGRIDAE				
94.	*Horabagrus brachysoma* (Gunther)	"Manjakoori" (Mal)	Meenachil, Chalakkudy & Pampa River (Kerala)	Talwar & Jhingran (1991)
95.	*Horabagrus. nigricollaris Pethiyagoda & Kottelat.*	"Manjakoori" (Mal)	Chalakkudy River (Kerala)	Pethiyagoda & Kottelat (1994)
FAMILY – SCHILBEIDAE				
96.	*Pseudeutropius mitchelli* (Gunther)	"Vellivala" (Mal)	Kerala: Periyar River	Talwar & Jhingran (1991)
FAMILY - BELONTIIDAE Sub family : Macropodinae				
97.	*Macropodus cupanus dayi* (Kohler)	Rosy Paradise fish, Day's paradise fish, "Karinkana" (Mal)	Rivers of Kerala, Karnataka & Tamil Nadu	Dey (1993)
FAMILY – AMBASSIDAE				
98.	*Parambassis dayi* (Bleeker)	Day's glass fish, "Nandan" (Mal)	Rivers of Kerala	Talwar & Jhingran (1991)
99.	*Parambassis (Chanda) thomassi* (Day)	Western Ghat Glassy perchlet	Rivers of Kerala and Karnataka	Talwar & Jhingran (1991)
FAMILY – CICHLIDAE				
100.	*Etroplus maculatus* (Bloch)	Spotted/orange chromide, "Pallathy" (Mal)	Kerala, South Canara and Tamil Nadu	Talwar & Jhingran (1991)
101.	*Etroplus canarensis Day*	Canara Pearlspot	South Canara, Karnataka	Talwar & Jhingran (1991); Menon *et al.* (1993).

Sl. No.	Species & family	Common name	Distribution	Reference
FAMILY – SCATOPHAGIDAE				
102.	*Scatophagus argus* (Bloch)	Scat, "Nachikarimeen" (Mal)	Even though a brackish-water form, common in many rivers of Kerala & South India	Talwar & Jhingran (1991)
FAMILY - GOBIIDAE (Sub family - Sicydiaphiinae)				
103.	*Sicyopterus griseus* (Day)	Clown goby	South Canara, Kerala, Tamil Nadu	Talwar & Jhingran (1991)
FAMILY - SYNGNATHIDAE				
104.	*Syngnathus argyrostictus* (Kaup)	Pipe fish	Goa & Tamil Nadu	Talwar & Jhingran (1991)
FAMILY – HEMIRAMPHIDAE				
105.	*Hemiramphus xanthopterus* (Valenciennes)	Vembanad Red half-beak, "Kolaan"(Mal)	Rivers of Kerala, Vembanad lake	Talwar & Jhingran (1991)
FAMILY – HORAICHTHYIDAE				
106.	*Horaichthys setnai Kulkarni*	Thready top –minnow, "Anu"(Mar).	West coast of India	Talwar & Jhingran (1991)

This list of potential ornamental fishes is based on the flashy colouration, and/or appearance of the species enlisted. In addition to the above, juveniles of endemic species such as *Hypselobarbus (Gonoproktopterus) curmuca, H. thomassi, Puntius jerdoni, Channa micropeltes, Osteochilichthys nashii, O. godavariensis, Osteochilus (Kantaka) brevidorsalis* and *Rohtee ogilbii* Sykes also enjoy good market value as ornamental species.

According to Rema Devi *et al.* (2000), fishes belonging to genera *Garra, Balitora, Bhawania, Homaloptera, Travancoria* and *Glyptothorax* are inhabitants of torrential streams, hence not suitable for aquarium keeping. However, the local traders of ornamental varieties indicated survival of these species in aquaria and their acceptance by customers. Hence these species are retained in the list.

* Taxonomic position to be confirmed. According to Dr. M. Arunachalam, M.S. Univ., T.N. (pers. comm.), *Puntius melanampyx* and *P. fasciatus* are two distinct species.

Common names:- (Kan) Kannada; (Mal) Malayalam; (Mar) Marathi; (Or) Oriya; (Tam) Tamil;(Tel) Telugu; (Tul) Tulu.

the fishes are also included wherever possible. Among the food fishes, some have been listed as cultivable in Table 1. Few of them have been cultivated since long in several parts of Peninsular India though not in a large scale as that of Indian major carps. The list of ornamental fishes (Table 2) indigenous to the area is prepared based on (i) attractive colouration, (ii)shape and(iii)overall beauty of the species. However, the breeding habits and compatibility of many of these with the other species in aquarium are yet to be fully understood. The base list was presented in the pre-NATP workshop at Cochin and based on the feedback from the participants, it was further modified.

The future of peninsular fisheries would largely be determined by the approach taken by the scientists and officials. If adequate attention is not paid, there is a likelihood that some of the species such a *Tor mussullah, Cirrhinus cirrhosa, Labeo dussumieri, L. kontius, Horabagrus brachysoma, Gonoproktopterus curmuca* etc. would become extinct. Therefore it is highly desirable to conserve and propagate some of them especially those which are still in greater demand by the consumers of peninsular region. Recognizing the importance of local adaptation of native organisms, several international gatherings including the "Earth Summit – 1992" had recommended the use of native stocks including fish, wherever possible, for enhancement of culture operations (FAO, 1993). Owing to the fast growth rate of Chinese and Indian major carps, their replacement with the native food fishes in peninsular region will not be preferred by farmers. But it is high-time to select some of the native popular food/sport fishes showing best growth rate and incorporate them in aquaculture/fisheries development operations in peninsular states and simultaneously to generate more information on their biology, breeding pattern, recruitment and stock identification. A large number of ornamental fish belonging to Western Ghats are still unknown to the trade and regularly some of these species find their way to the aquarium market (*e.g. Puntius denisonii, Tetraodon travancoricus, Horabagrus nigricollaris*). To cope up with the requirements of the steadily growing international trade on ornamental fishes, more effort will have to be paid to perfect the breeding techniques of the native ornamental fishes and set up hatcheries in order to ensure a constant supply of the species.

The list of fishes (Tables 1 and 2) along with this can never be a final one. Any suggestion to improve or update it is always welcome. It is hoped that the state fisheries departments of peninsular states, state agricultural universities, central government institutes and various NGOs would take steps for propagation and conservation of these valuable resources.

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Freshwater Fish Diversity of Western Ghats

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For undertaking fisheries conservation and management programmes at eco-regional level, information on fish genetic resources is essential. In the case of Western Ghats, the list prepared by Gopalakrishnan and Ponniah (2000) is restricted to economically important endemic teleosts of the region. The present compilation covers endemic, exotic, transplanted and widely distributed (naturally inhabit this region and other parts of India) fishes found in Western Ghats and is not confined to only those which are considered to be potential cultivable/ sport/ ornamental fishes. Certain estuarine fishes, which are found to ascend the freshwaters for longer distances are also included. This compilation is based on widely referred faunal volumes on the freshwater fishes of India (Day,1865; 1875-78;1889; Talwar and Jhingran,1991; Jayaram, 1999; Menon, 1999), new species descriptions (Bailey and Gans,1998; Vairavel *et al.*, 1998; Zacharias and Minimol, 1999; Bhat and Jayaram, 2000; Jayaraj *et al.*,1999; Gopi, 2001a,b) and field collections (unpublished data).

In the present compilation (Table 1), a total of 287 fishes are reported of which 67% (192 nos.) are endemic and 18 are exotic or transplanted. The taxonomic position of 14 species needs to be confirmed in view of some ambiguities.

Conservation Status of endemic fish fauna

In 1992, National Bureau of Fish Genetic Resources (NBFGR), Lucknow conducted a workshop in *1992 and identified 11 endemic fishes from this region as 'most threatened'. They are Tor khudree, Thynnichthys sandkhol, Labeo dussumieri, L. fimbriatus, Puntius carnaticus, Silonia childreni, Tor mussullah, Horaglanis krishnai, Lepidopygopsis typus, Etroplus suratensis* and *E. maculatus.* Kurup (1994) listed 24 freshwater species from Kerala and Kowtal (1994) reported 12 endemic species of Peninsular India as threatened. The endangered blind catfish of Kerala *Horaglanis* *krishnai* has found a place in the red data book of IUCN.

In 1997, of the 587 freshwater teleost species reported from India, 327 were assessed in a six day Conservation Assessment Management Plan (CAMP) Workshop under the Bio-diversity Conservation Prioritisation Project (BCPP), jointly organised by NBFGR and Zoo Outreach Organisation, Coimbatore, based on the criteria prepared by International Union for Conservation of Nature and Natural Resources (IUCN). Of these 327 evaluated species, only 98 belonged to Western Ghats (Anon, 1998). Details of their categorisation are tabulated in Table 1 and Figure 1.

The exercise done in CAMP workshop was based on the collective input from the participants based on the available secondary literature as well as their personal observations. The above categorisation needs further validation to confirm their current status on the basis of recent data on distribution and abundance of concerned species. Moreover, the fish species composition of a particular river/stream stretch studied earlier, require to be again evaluated by surveys to assess the present status. Limitations of data on the distribution of fish species in the drainages with reference to seasonality and location are the major lacunae in ascertaining their present conservation status in this region. Therefore, it is necessary to undertake extensive surveys to collect data on their abundance, catch per unit effort (CPUE), weight and length. To collect such information, the NBFGR has just initiated a National Agricultural Technology Project (NATP) with local collaborators and will be in a position to generate data that would help in both conservation as well as sustainable commercial utilization of these species.

Fig. 1 Conservation Status of Freshwater Fishes (98 Species) Endemic to Western Ghats

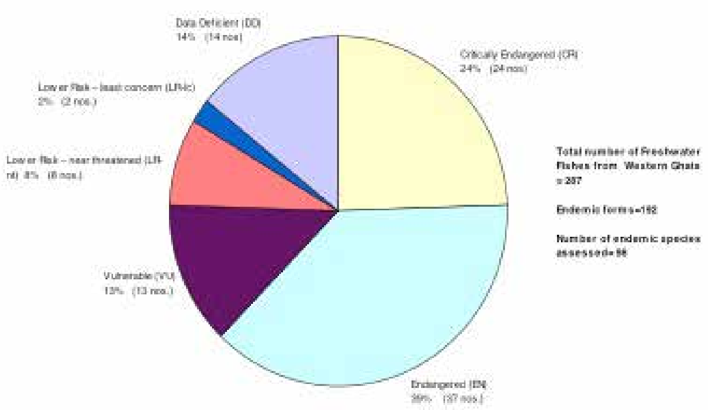

Table 1. Consolidated list of Freshwater Fishes of Western Ghats and Conservation Status of 98 Endemic Species of Western Ghats assessed in the CAMP Workshop held at NBFGR, Lucknow in September, 1997.

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
1.	*Acanthocobitis moreh* (Sykes)	✓	---	Balitoridae	Peninsular India, Wayanad, Poona, Karnataka
2.	*Ambassis commersoni Cuvier*			Ambassidae	Maharashtra, Kerala & Tamil Nadu.
3.	*Ambassis dussumieri Cuvier*			Ambassidae	South India, Indo-West Pacific
4.	*Ambassis gymnocephalus* (Lacepede)			Ambassidae	Indo-West Pacific
5.	*Ambassis nalua* (Hamilton-Buchanan)			Ambassidae	Indo-West Pacific
6.	*Amblypharyngodon chakaiensis Babu & Nair*	✓	**CR**	Cyprinidae	Veli lake, Trivandrum
7.	*Amblypharyngodon melettinus* (Val.)	✓	---	Cyprinidae	India (Western Ghats, Tamil Nadu) & Sri Lanka.
8.	*Amblypharyngodon microlepis* (Bleeker)			Cyprinidae	India
9.	*Anabas testudineus* (Bloch)			Anabantidae	Throughout India
10.	*Anguilla bengalensis bengalensis* (Gray)			Anguillidae	Indo-West Pacific
11.	*Anguilla bicolor bicolor* (McClelland)			Anguillidae	Indo-West Pacific
12.	*Aorichthys aor* (Hamilton)			Bagridae	India (Down upto Cauvery river), Pakistan, Burma
13.	*Aorichthys seenghala* (Sykes)			Bagridae	India (Down upto Cauvery river), Pakistan, Nepal
14.	*Aplocheilus blocki* (Arnold)	✓	---	Aplocheilidae	Tamil Nadu, Kerala and Sri Lanka
15.	*Aplocheilus rubrostigma* (Jerdon)*	✓	**DD**	Aplocheilidae	Kerala, Tamil Nadu.
16.	*Aplocheilus lineatus* (Valenciennes)	✓	---	Aplocheilidae	Western Ghats (Coorg, Wayanad, Kerala) & Sri Lanka.
17.	*Aristichthys nobilis* (Richardson, 1844) #			Cyprinidae	Exotic to India.

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
18.	*Awaous gutum (*Hamilton-Buchanan)			Gobiidae	India, Bangladesh & Indonesia.
19.	*Bagarius yarrellii Sykes*			Sisoridae	Throughout India.
20.	*Balitora mysorensis Hora*	✓	---	Balitoridae	India: Western Ghats.
21.	*Balitora shimogensis Menon et al.**	✓	---	Balitoridae	Shimoga, Karnataka.
22.	*Barilius bakeri Day*	✓	**VU**	Cyprinidae	Western Ghats of Kerala (High ranges).
23.	*Barilius bendelisis* (Hamilton-Buchanan).			Cyprinidae	Throughout India
24.	*Barilius canarensis* (Jerdon)	✓	**DD**	Cyprinidae	Western Ghats of Kerala & Karnataka
25.	*Barilius evezardi Day*	✓	**LR-nt**	Cyprinidae	Maharashtra
26.	*Barilius gatensis* (Valenciennes)	✓	---	Cyprinidae	Western Ghats (Maharashtra, Southern Karnataka, Nilgiri Hills & Kerala).
27.	*Batasio travancoria Hora & Law*	✓	**EN**	Bagridae	Kerala (Pamba, Chittar, Kallada, Chalakkudypuzha, Achenkovil, Neyyar rivers)
28.	*Bhavania australis Jerdon*	✓	**EN**	Balitoridae	Western Ghats (Karnataka, Nilgiris & Kerala)
29.	*Botia macrolineata Tengels, Devos & Snocks*	✓	---	Cobitidae	Western Ghats (Maharashtra)
30.	*Botia striata Rao*	✓	**EN**	Cobitidae	Western Ghats (Karnataka)
31.	*Brachydanio rerio* (Hamilton-Buchanan)			Cyprinidae	India (Eastern India from Bengal up to West to Krishna river system), Pakistan, Nepal, Bangladesh.
32.	*Carassius auratus Linnaeus #*			Cyprinidae	Throughout India (introduced)
33.	*Carinatetraodon imitator Pethiya goda & Kottelat*	✓	---	Tetraodontidae	Ernakulam, Kerala.
34.	*Catla catla* (Hamilton)*#*			Cyprinidae	Throughout India (transplanted to South India)

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
35.	*Chanda nama Hamilton-Buchanan*			Ambassidae	Pakistan, India, Myanmar and Bangladesh
36.	*Channa leucopunctatus* (Bloch)	✓	---	Channidae	Western Ghats (Kerala)
37.	*Channa marulius* (Hamilton-Buchanan)			Channidae	India, Pakistan, Sri Lanka, Bangladesh, Nepal, Myanmar, Thailand & China.
38.	*Channa micropeltes* (Cuvier)	✓	**CR**	Channidae	Western Ghats (Kerala)
39.	*Channa orientalis* (Bloch & Schneider)			Channidae	India, Afghanistan, Iran, Pakistan, Nepal, Sri Lanka, Myanmar & East Indies.
40.	*Channa punctatus* (Bloch)			Channidae	Afghanistan, Pakistan, India, Sri Lanka, Nepal, Myanmar, Yunan and India.
41.	*Channa striatus* (Bloch)			Channidae	India, Pakistan, Sri Lanka, Bangladesh, Nepal, Myanmar, Malay Archipelago, Thailand, Indonesia, Indochina & South China (as a result of introduction).
42.	*Chela cachius* (Hamilton-Buchanan)			Cyprinidae	Throughout India
43.	*Chela dadyburjori Menon*	✓	**DD**	Cyprinidae	Tamil Nadu, Goa & Kerala
44.	*Chela fasciata Silas*	✓	---	Cyprinidae	Anamalai hills, Kerala and Tamil Nadu
45.	*Chela laubuca* (Hamilton-Buchanan)			Cyprinidae	India, Pakistan, Nepal, Bangladesh, Myanmar, Malay Peninsula, Sri Lanka, Sumatra & Indonesia.
46.	*Cirrhinus cirrhosa* (Bloch)	✓	**VU**	Cyprinidae	Peninsular India
47.	*Cirrhinus fulungee* (Sykes)	✓	**LR-nt**	Cyprinidae	Godavari to Cauvary basins
48.	*Cirrhinus macrops* (Steindachner)/ *C. horai*	✓	**DD**	Cyprinidae	Godavery River.

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
49.	*Cirrhinus mrigala* (Ham.) #			Cyprinidae	Throughout India, Throughout India (Introduced South India) W. Ghats of Kerala
50.	*Cirrhinus reba* (Hamilton-Buchanan)			Cyprinidae	India, Nepal, Bangladesh, Pakistan
51.	*Clarias dayi Hora*	✓	**EN**	Clariidae	Wayanad hills of Kerala
52.	*Clarias dussumieri dussumieri* (Val.)	✓	**VU**	Clariidae	India: Peninsular India (Goa, Karnataka, Kerala & Pondicherry).
53.	*Clarias gariepinus Burchell,1822 #*			Claridae	Introduced to India.
54.	*Crossocheilus latius latius* (Hamilton-Buchanan)			Cyprinidae	W. Ghats of Karnataka, Kerala, and North India
55.	*Crossocheilus periyarensis Menon & Jacob*	✓	**VU**	Cyprinidae	Periyar lake, Kerala
56.	*Ctenopharyngodon idella* (Val.) #			Cyprinidae	Introduced to India
57.	*Cyprinus carpio communis Linnaeus #* (Also other varieties C. carpio specularis Bloch and C. carpio nudus Lacepedae)			Cyprinidae	India, Central Asia, Naturally found all through China, Korea, Japan, Taiwan, Europe & America. Introduced to India in 1939
58.	*Danio aequipinnatus* (McClelland)			Cyprinidae	India (Eastern Himalaya, Meghalaya & Deccan), Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar) & Thailand.
59.	*Danio fraseri Hora*	✓	---	Cyprinidae	Western Ghats (Maharashtra)
60.	*Danio malabaricus* (Jerdon)	✓	---	Cyprinidae	India: Western Coast & Sri Lanka.
61.	*Danio neilgherriensis* (Day)	✓	---	Cyprinidae	Nilgiri hills (TN)
62.	*Dayella malabarica* (Day)	✓	**CR**	Clupeidae	South Western India

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
63.	*Elops machnata* (Forsskal)			Elopidae	Indo-West pacific.
64.	*Esomus barbatus* (Jerdon)	✓	---	Cyprinidae	Tamil Nadu & Karnataka
65.	*Esomus danricus* (Hamilton-Buchanan)			Cyprinidae	India (throughout North India) Pakistan, Nepal, Bangladesh, Myanmar & Sri Lanka
66.	*Esomus thermoicos* (Valenciennes)	✓	---	Cyprinidae	Kerala & Sri Lanka
67.	*Etroplus canarensis Day*	✓	**DD**	Cichlidae	W. Ghats of South Canara – Karnataka
68.	*Etroplus maculatus* (Bloch)	✓	---	Cichlidae	India (Tamil Nadu, Kerala, South Karnataka) & Sri Lanka
69.	*Etroplus suratensis* (Bloch)	✓	---	Cichlidae	India (Andhra Pradesh, Tamil Nadu & Kerala) & Sri Lanka.
70.	*Euryglossa orientalis* (Bloch & Schneider)			Soleidae	Red Sea, Persian Gulf, Pakistan, India, Sri Lanka, East Indies Australia, Indonesia & China
71.	*Eutropiichthys goongwaree* (Sykes)	✓	---	Schilbeidae	Maharashtra & Andhra Pradesh
72.	*Gambusia affinis* (Baird & Girard) #			Poeciliidae	Introduced; throughout India
73.	*Garra gotyla stenorhynchus* (Jerdon)	✓	**EN**	Cyprinidae	India: Western Ghats (Cauvary & Krishna drainage).
74.	*Garra hughi Silas*	✓	**EN**	Cyprinidae	Palani Hills (Tamil Nadu), Kerala
75.	*Garra bicornuta Rao*	✓	---	Cyprinidae	Karnataka & Maharashtra
76.	*Garra kalakkadensis Rema Devi*	✓	---	Cyprinidae	Kalakkad, Tamil Nadu
77.	*Garra mcClellandi* (Jerdon)	✓	---	Cyprinidae	India: Western Ghats (Cauvary drainage, Nilgiris).
78.	*Garra menoni Rema Devi & Indra*	✓	**VU**	Cyprinidae	India: Kerala: Kunthipuzha, Silent Valley.
79.	*Garra mullya* (Sykes)			Cyprinidae	Throughout India except Assam & Himalaya.

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
81.	*Garra periyarensis Gopi*	✓	---	Cyprinidae	Mlappara, Periyar River, Kerala
82.	*Garra surendranathanii Shaji, Arun & Easa*	✓	**EN**	Cyprinidae	Kerala
83.	*Glossogobius giuris* (Hamilton-Buchanan)			Gobiidae	Indo-West Pacific
84.	*Glyptothorax anamalaiensis Silas / G.davissinghi Manimekalan & Das**	✓	**CR**	Sisoridae	Kerala (Anamalai hills, Nilambur)
85.	*Glyptothorax annandalei Hora*			Sisoridae	India(Western Ghats & Vindhya) & Nepal.
86.	*Glyptothorax conirostre poonaensis Hora*	✓	---	Sisoridae	Mula mutha river (Maharashtra)
87.	*Glyptothorax housei Herre*	✓	**DD**	Sisoridae	Puthuthottam Estate, Kerala
88.	*Glyptothorax lonah* (Sykes)	✓	**LR-nt**	Sisoridae	Western Ghats
89.	*Glyptothorax madraspatanam* (Day)	✓	**VU**	Sisoridae	Western Ghats (Anamalai & Nilgiri hills ; Cauvery river system).
90.	*Glyptothorax trewavasae Hora*	✓	---	Sisoridae	Western Ghats of South India
91.	*Gonoproktopterus periyarensis Raj*	✓	**EN**	Cyprinidae	Periyar lake and streams
92.	*Gonoproktopterus curmuca* (Hamilton-Buchanan)	✓	**EN**	Cyprinidae	Rivers of Western Ghats
93.	*Gonoproktopterus dubius* (Day)	✓	**EN**	Cyprinidae	Cauvery river system
94.	*Gonoproktopterus kolus* (Syes)	✓	**EN**	Cyprinidae	Western Ghats (Kerala, T.N., Karnataka & Maharashtra)
95.	*Gonoproktopterus kurali* (Menon & Rema Devi)*	✓	**EN**	Cyprinidae	Western Ghats (Kerala & Karnataka)

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
96.	*Gonoproktopterus lithopidos* (Day)	✓	**EN**	Cyprinidae	Western Ghats (Kerala & Karnataka)
97.	*Gonoproktopterus micropogon* (Valenciennes)	✓	---	Cyprinidae	Western Ghats (Cauvery bas*in:* Bhavani, Kabini, & South Canara hill ranges).
98.	*Gonoproktopterus thomassi* (Day)	✓	**EN**	Cyprinidae	Western Ghats (Kerala and Karnataka).
99.	*Hemiramphus xanthopterus* (Val.)	✓	---	Hemiramphidae	Kerala.
100.	*Heteropneustes fossilis* (Bloch)			Heteropneus-tidae	Pakistan, India, Andaman Islands, Nepal, Bangladesh, Sri Lanka, Myanmar, Thailand & Laos.
101.	*Heteropneustes microps* (Gunther)			Heteropneus-tidae	Throughout India
102.	*Homaloptera menoni Shaji & Easa*	✓	---	Balitoridae	Kerala, Bhavani river at Muthikkulam.
103.	*Homaloptera montana Herre*	✓	**CR**	Balitoridae	Western Ghats of India
104.	*Homaloptera pillai Indra & Rema Devi*	✓	**VU**	Balitoridae	Kerala: Kunthi river, Silent Valley.
105.	*Horabagrus brachysoma* (Gunther)	✓	**EN**	Bagridae	Kerala, South & North Canara
106.	*Horabagrus nigricollaris Pethiyagoda & Kottelat*	✓	**CR**	Bagridae	Chalakudy river (Kerala)
107.	*Horadandia attukorali Deraniyagala*	✓	**EN**	Cyprinidae	Kerala & Sri Lanka
108.	*Horaglanis krishnai Menon*	✓	**CR**	Clariidae	Kottayam, Kerala (Indian blind catfish, found in wells).
109.	*Horaichthys setnai Kulkarni*	✓	---	Horaichthyidae	Cochin, Trivandrum and Bombay
110.	*Horalabiosa joshuai Silas*	✓	---	Cyprinidae	Kalakkad & Silent Valley
111.	*Horalabiosa palaniensis Rema Devi & Menon*	✓	---	Cyprinidae	Palani Hills, Tamil Nadu

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
112.	*Hyporhamphus limbatus* (Valenciennes)			Hemiramphidae	Persian Gulf, Pakistan, India (Coromandel coast, Malabar) Sri Lanka, Myanmar, Thailand & China.
113.	*Hyporhamphus xanthopterus* (Valenciennes)	✓	**CR**	Hemiramphidae	Vembanad lake, Kerala
114.	*Hypophthalmichthys molitrix* (Valenciennes) #			Cyprinidae	Exotic; Throughout India
115.	*Kantaka brevidorsalis* (Day)	✓	---	Cyprinidae	Western Ghats of Kerala, Nilgiri & Karnataka
116.	*Labeo ariza* (Hamilton-Buchanan)	✓	**CR**	Cyprinidae	Wyanad , Nilgiri hills, Cauvery River system & Poona
117.	*Labeo bata* (Hamilton-Buchanan)			Cyprinidae	India and Nepal
118.	*Labeo boga* (Hamilton-Buchanan)			Cyprinidae	Pakistan, India, Nepal and Myanmar
119.	*Labeo boggut* (Sykes)			Cyprinidae	Northern India and Cauvery river system
120.	*Labeo calbasu* (Ham. -Buch.) #			Cyprinidae	Pakistan, India, Nepal, Myanmar, Thailand and Yunan
121.	*Labeo dussumieri* (Val.)	✓	**EN**	Cyprinidae	Western Ghats of Kerala and Sri Lanka
122.	*Labeo fimbriatus* (Bloch)	✓	**LR-nt**	Cyprinidae	Peninsular India
123.	*Labeo gonius* (Hamilton-Buchanan) #			Cyprinidae	Transplanted to Krishna River system from North India
124.	*Labeo kawrus* (Sykes)	✓	---	Cyprinidae	Western Ghats up to Deccan
125.	*Labeo kontius* (Jerdon)	✓	**EN**	Cyprinidae	Cauvery river system
126.	*Labeo nigrescens Day*	✓	---	Cyprinidae	Karnataka State
127.	*Labeo porcellus* (Heckel)	✓	---	Cyprinidae	Western Ghats (Bombay)

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
128.	*Labeo potail* (Sykes)	✓	---	Cyprinidae	Maharashtra , Deccan & Cauvery river system.
129.	*Labeo rohita* (Hamilton-Buchanan) #			Cyprinidae	India, Pakistan, Sri Lanka, Bangladesh, Nepal & Myanmar. Transplanted to Peninsular India
130.	*Lepidocephalus thermalis* (Valenciennes)	✓	---	Cyprinidae	South India & Sri Lanka.
131.	*Lepidocephalus guentea* (Hamilton – Buchanan)			Cobitidae	Throughout India
132.	*Lepidopygopsis typus Raj*	✓	**CR**	Cyprinidae	Periyar lake in Kerala
133.	*Macrognathus guentheri* (Day)	✓	**VU**	Mastacembe-lidae	Kerala
134.	*Macropodus cupanus* (Valenciennes)			Belontidae	India, Sri Lanka, Myanmar, Malay Peninsula & Sumatra.
135.	*Macropodus cupanus dayi* (Kohler) *	✓	---	Belontidae	Kerala, Karnataka, Tamilnadu.
136.	*Mastacembelus armatus* (Lacepede)			Mastacembe-lidae	Pakistan, India, Sri Lanka, Nepal. Myanmar, Thailand, Malaya, Vietnam, Sumatra, Java & South China
137.	*Megalops cyprinoides* (Broussonet)			Megalopidae	Indo-West pacific (migrate to the freshwaters)
138.	*Mesonemacheilus herrei Nalbant & Banarescu**	✓	---	Balitoridae	Anamalai Hills, Valparai (Kerala)
139.	*Mesonemacheilus remadeviensis Shaji & Easa*	✓	---	Balitoridae	Wayanad, Kerala
140.	*Mesonoemacheilus petrubanarescui* (Menon)	✓	**DD**	Balitoridae	Netravati river, Dharmasthala (Karnataka).
141.	*Mesonoemacheilus guentheri* (Day)	✓	**LR-lc**	Balitoridae	Western Ghats
142.	*Mesonoemacheilus menoni Zacharias & Minimol*	✓	---	Balitoridae	Periyar river (Kerala)

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
143.	*Mesonoemacheilus pambarensis Rema Devi & Indra*	✓	---	Balitoridae	Chinnar river, Idukki (Kerala)
144.	*Mesonoemacheilus pulchellus* (Day)	✓	**DD**	Balitoridae	Western Ghats (Kerala, Tamil Nadu)
145.	*Mesonoemacheilus rueppelli* (Sykes)	✓	---	Balitoridae	Maharashtra & Karnataka
146.	*Mesonoemacheilus triangularis* (Day)	✓	**LR-lc**	Balitoridae	Western Ghats (Kerala & Tamil Nadu)
147.	*Microphis cuncalus* (Hamilton-Buchanan)			Syngnathidae	India, Bangladesh & Sri Lanka.
148.	*Monopterus digressus Gopi*	✓	---	Synbranchidae	Wells of Calicut, Kerala (a blind eel)
149.	*Monopterus roseni Bailey & Gans*	✓	---	Synbranchidae	Wells of Kottayam, Kerala (a blind eel)
150.	*Monopterus eapeni Talwar*	✓	**CR**	Symbranchidae	Kerala
151.	*Monopterus fossorius* (Nair)	✓	**EN**	Symbranchidae	Karamana river, Trivandrum
152.	*Monopterus indicus* (Silas & Dawson)	✓	---	Symbranchidae	Western Ghats of Bombay
153.	*Mystus armatus* (Day)	✓	---	Bagridae	India: Western Ghats (Wayanad hills),
154.	*Mystus bleekeri* (Day)			Bagridae	Northern India and Kerala (recent report)
155.	*Mystus cavasius* (Hamilton-Buchanan)			Bagridae	India, Pakistan, Sri Lanka, Nepal, Bangladesh, Myanmar, Thailand, Malaysia, Java, Sumatra & Thailand.
156.	*Mystus gulio* (Hamilton-Buchanan)			Bagridae	Coastal area of India
157.	*Mystus keletius* (Valenciennes)	✓	---	Bagridae	Western Ghats of Kerala, Tamil Nadu and Karnataka
158.	*Mystus krishnensis Ramakrishniah*	✓	---	Bagridae	Krishna river

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
159.	*Mystus malabaricus* (Jerdon)	✓	**EN**	Bagridae	Western Ghats (Wayanad hills (Kerala), Karnataka, & Maharashtra).
160.	*Mystus montanus* (Jerdon)			Bagridae	Kerala, Karnataka, Maharashtra, Assam.
161.	*Mystus punctatus* (Jerdon)	✓	**EN**	Bagridae	Western Ghats : Kerala, Nilgiris, Karnataka.
162.	*Mystus oculatus* (Valenciennes)	✓	---	Bagridae	Kerala & Tamil Nadu part of Western Ghats
163.	*Mystus vittatus* (Bloch)			Bagridae	Throughout India
164.	*Nandus nandus* (Ham. –Buch.)			Nandidae	Throughout India
165.	*Nangra itchkeea (Sykes)*	✓	---	Sisoridae	Maharashtra & Karnataka
166.	*Nemacheilus anguilla Annandale*	✓	---	Balitoridae	Maharashtra & Karnataka
167.	*Nemacheilus denisoni mukambbikaensis Menon*	✓	---	Balitoridae	Kollur, Karnataka
168.	*Nemacheilus denisoni pambaensis Menon*	✓	---	Balitoridae	Sabarigiri, Kerala
169.	*Nemacheilus monilis* (Hora)	✓	**EN**	Balitoridae	Western Ghats (Bhavani river, Nilgiri hills).
170.	*Nemacheilus poonaensis Menon **	✓	---	Balitoridae	Pune & Karnataka.
171.	*Nemacheilus triangularis tambraparniensis Menon*	✓	---	Balitoridae	Tambraparnei, Tamil Nadu
172.	*Neolissochilus wynaadensis* (Day)	✓	**CR**	Cyprinidae	Wayanad & Headwaters of Cauvery
173.	*Neotropius khavalchor Kulkarni*	✓	**DD**	Schilbeidae	Maharashtra & Andhra Pradesh
174.	*Notopterus notopterus* (Pallas)			Notopteridae	India, Pakistan, Nepal, Bangladesh, Myanmar, Thailand, Malaya & Indonesia

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
175.	*Ompok bimaculatus* (Bloch)			Siluridae	India, Afghanistan, Pakistan, Sri Lanka, Myanmar, Thailand, Java, Sumatra, Borneo, Malaya, Vietnam, East Indies, Yunnan & China.
176.	*Ompok malabaricus* (Valenciennes)	✓	**CR**	Siluridae	India: Goa & Kerala
177.	*Ophisternon bengalense Mc Clelland*			Synbranchidae	India : West Bengal & Kerala.
178.	*Oreichthys cosuatis* (Hamilton-Buchanan)			Cyprinidae	India, Bangladesh and Thailand
179.	*Oreochromis mossambica Peters #*			Cichlidae	East Africa. Introduced to India & Pakistan, Sri Lanka, Indonesia, etc.
180.	*Oreonectes evezardi* (Day)	✓	---	Balitoridae	Western Ghats
181.	*Oreonectes keralensis Rita & Nalbant*	✓	**EN**	Balitoridae	Travancore (Kerala)
182.	*Oryzias carnaticus* (Jerdon, 1849)			Oryziidae	Kerala, Tamil Nadu, Karnataka, West Bengal & Bangladesh
183.	*Oryzias dancena* (Hamilton, 1822)			Oryziidae	Tamil Nadu, Andhra Pradesh, W. Bengal & Bangladesh
184.	*Osphronemus goramy Lacepede #*			Osphronemidae	Introduced to India.
185.	*Osteobrama bakeri* (Day)	✓	**EN**	Cyprinidae	Kerala: Kottayam, Chaliyar, Periyar
186.	*Osteobrama bhimensis*	✓	---	Cyprinidae	Bhima river
187.	*Osteobrama cotio peninsularis Silas*	✓	---	Cyprinidae	Peninsular India
188.	*Osteobrama dayi* (Hora & Misra)	✓	---	Cyprinidae	Godavari River.
189.	*Osteobrama neilli* (Day)	✓	---	Cyprinidae	Western Ghats (Tamil Nadu)
190.	*Osteobrama vigorsii* (Sykes)	✓	---	Cyprinidae	Krishna and Godavari river systems

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
191.	*Osteochilichthys godavariensis* (Rao)	✓	**DD**	Cyprinidae	Western Ghats of Maharashtra
192.	*Osteochilichthys longidorsalis Pethiyagoda & Kottelat*	✓	**CR**	Cyprinidae	Chalakudy river (Kerala)
193.	*Osteochilichthys nashii (Day)*	✓	---	Cyprinidae	Western Ghats (Bhavani river, Coorg, Wayanad).
194.	*Osteochilichthys thomassi* (Day)	✓	---	Cyprinidae	Western Ghats (Kerala & Karnataka)
195.	*Pangasius pangasius* (Hamilton-Buchanan)			Pangasidae	Throughout India
196.	*Pangio bashai Easa & Shaji*	✓	---	Cobitidae	Chaliyar River, Kerala.
197.	*Pangio goaensis* (Tilak)	✓	---	Cobitidae	Goa & Kerala
198.	*Parabatasio sharavatiensis Anuradha Bhat & Jayaram*	✓	---	Bagridae	Sharavati river, Karnataka
199.	*Parambassis dayi* (Bleeker)	✓	**EN**	Ambassidae	Kerala
200.	*Parambassis thomassi* (Day)	✓	**VU**	Ambassidae	India: Western Ghats of Kerala & Karnataka.
201.	*Parapsilorhynchus discophorus Hora*	✓	---	Cyprinidae	Western Ghats
202.	*Parapsilorhynchus prateri Hora & Misra*	✓	---	Cyprinidae	Western Ghats
203.	*Parapsilorhynchus tentaculatus* (Annandale)			Cyprinidae	Western Ghats (Poona, Yenna River), Bastar, Pachmari.
204.	*Parluciosoma* (Rasbora) *caverii* (Jerdon)	✓	---	Cyprinidae	Western Ghats of Karnataka
205.	*Parluciosoma* (Rasbora) *daniconius* (Hamilton-Buchanan)			Cyprinidae	India (Throughout), Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, Malay Archipelago, Zanzibar & Mekong.

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
206.	*Parluciosoma*(Rasbora) *labiosa* (Mukerji)	✓	---	Cyprinidae	Maharashtra
207.	*Pisodonophis boro* (Hamilton-Buchanan)			Ophichthidae	Indo-West Pacific
208.	*Plotosus canius* (Hamilton)	✓	---	Plotosidae	Kerala and Maharashtra
209.	*Plotosus lineatus* (Thunberg)	✓	---	Plotosidae	Kerala and Maharashtra
210.	*Poecilia reticulata Peters #*			Poecilidae	Netherlands, Antilles, Venezuelan Islands Trinidad, & British Guiana. Introduced to India especially South India (Tamil Nadu, Malabar, Cuddapah & Kurnool & Maharashtra).
211.	*Pristolepis marginata* (Jerdon)	✓	**VU**	Nandidae	India: Western Ghats of Kerala.
212.	*Proeutropiichthys taakree taakree* (Sykes)	✓	**VU**	Schilbeidae	Peninsular India
213.	*Pseudambassis ranga* (Hamilton-Buchanan)			Ambassidae	Pakistan, India, Bangladesh, Myanmar, Thailand & Malaysia.
214.	*Pseudeutropius mitchelli Gunther*	✓	**DD**	Schilbeidae	Western Ghats of Kerala
215.	*Puntius amphibius* (Valenciennes)			Cyprinidae	India (Peninsular India, Orissa, Madhya Pradesh & Rajasthan) & Sri Lanka
216.	*Puntius arulius arulius* (Jerdon)	✓	**EN**	Cyprinidae	Cauvery river system, Tamil Nadu (TN), Karnataka, Kerala (Wynad, Kulathupuzha).
217.	*Puntius arulius tambraparniei Silas*	✓	**CR**	Cypriniade	Tambraparnei River, Tamil Nadu
218.	*Puntius bimaculatus* (Bleeker)	✓	---	Cyprinidae	Kerala and Sri Lanka
219.	*Puntius bovanicus* (Day)	✓	**CR**	Cyprinidae	Western Ghats (Karnataka, Tamil Nadu)

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
220.	*Puntius carnaticus* (Jerdon)	✓	**LR-nt**	Cyprinidae	Cauvary & Krishna river systems, Nilgiri hills, Wayanad & Canara hills.
221.	*Puntius cauveriensis Hora*	✓	**DD**	Cyprinidae	Western Ghats of Karnataka
222.	*Puntius chalakkudiensis* (Menon, Rema Devi & Thobias)	✓	---	Cyprinidae	Chalakkudy River, Kerala.
223.	*Puntius chola* (Hamilton-Buchanan)			Cyprinidae	Pakistan, India, Nepal, Myanmar and Sri Lanka
224.	*Puntius conchonius* (Hamilton-Buchanan)			Cyprinidae	Afghanistan, Pakistan (Indus drainage), Nepal, India (throughout) & Bangladesh.
225.	*Puntius deccanensis Yazdani & Rao*	✓	**CR**	Cyprinidae	Maharashtra
226.	*Puntius denisonii Day*	✓	**EN**	Cyprinidae	Kerala
227.	*Puntius dorsalis* (Jerdon)			Cyprinidae	India (Cauvery & Krishna River systems, Kerala, Orissa, Madhya Pradesh & Rajasthan) & Sri Lanka.
228.	*Puntius fasciatus* (Jerdon)/ *P. melanampyx* (Day) *	✓	**EN**	Cyprinidae	Peninsular India & Western Ghats
229.	*Puntius filamentosus* (Valenciennes)	✓	---	Cyprinidae	Cauvery river system, Goa, Karnataka, Kerala, Tamil Nadu & Sri Lanka
230.	*Puntius fraseri* (Hora & Misra)	✓	---	Cyprinidae	Western Ghats of Maharashtra
231.	*Puntius guganio* (Hamilton-Buchanan)			Cyprinidae	Tamil Nadu, Andhra, Orissa,Assam & Bangladesh
232.	*Puntius jerdoni* (Day) / *P. dobsoni* (Day)*	✓	**EN**	Cyprinidae	Western Ghats (Kerala & Karnataka)
233.	*Puntius melanostigma* (Day)	✓	**EN**	Cyprinidae	Wayanad hills, Cauvery & Periyar rivers ; Maharashtra.
234.	*Puntius mudumalaiensis Menon & Rema Devi*	✓	**CR**	Cyprinidae	Mudumalai, Tamil Nadu.

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
235.	*Puntius narayani* (Hora)	✓	**CR**	Cyprinidae	Western Ghats (Karnataka)
236.	*Puntius ophicephalus* (Raj)	✓	**EN**	Cyprinidae	Periyar lake & upstreams (Kerala)
237.	*Puntius parrah* (Day)	✓	**EN**	Cyprinidae	Western Ghats of Kerala, Karnataka & Tamil Nadu,
238.	*Puntius puckelli* (Day)*	✓	---	Cyprinidae	Wayanad, Kerala.
239.	*Puntius pulchellus (*Day)*	✓	---	Cyprinidae	Krishna, Cauvery Rivers & Wayanad.
240.	*Puntius sahyadriensis Silas*	✓	---	Cyprinidae	Western Ghtas, Yenna river (Maharashtra)
241.	*Puntius sarana sarana* (Hamilton-Buchanan)			Cyprinidae	Afghanistan, Pakistan, India, Nepal, Bangladesh and Bhutan
242.	*Puntius sarana subnasutus* (Valenciennes)	✓	---	Cyprinidae	Peninsular India (Krishna & Cauvary river system, Goa, Kerala).
243.	*Puntius setnai Chhapgar &Sane*	✓	---	Cyprinidae	Goa.
244.	*Puntius sophore* (Hamilton-Buchanan)			Cyprinidae	India, Nepal, Banladesh, Myanmar and China
245.	*Puntius ticto ticto* (Hamilton-Buchanan)			Cyprinidae	India (throughout), Pakistan, Nepal, Sri Lanka, Bangladesh, Myanmar & Thailand.
246.	*Puntius ticto punctatus* (Day)*	✓	**CR**	Cyprinidae	Kerala, Tamil Nadu.
247.	*Puntius vittatus Day*			Cyprinidae	India (throughout), Sri Lanka & Pakistan.
248.	*Rhinomugil corsula* (Hamilton-Buchanan) #			Mugilidae	Transplanted to South India (Cauvery & Vaigai Rivers).
249.	*Rita kuturnee* (Sykes)	✓	**LR-nt**	Bagridae	Andhra Pradesh, Karnataka & Maharashtra
250.	*Rita pavimentata* (Valenciennes)	✓	**EN**	Bagridae	Mutha-Mula, Bhima, Godavary & Krishna Rivers

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
251.	*Rita rita* (Hamitlon-Buchanan)			Bagridae	Afghanistan, Pakistan, Nepal, Bangladesh, Nepal, Myanmar & India.
252.	*Rohtee ogilbii Sykes*	✓	**LR-nt**	Cyprinidae	Western Ghats
253.	*Salmo gairdnerii Richardson #* (Different strains)			Salmonidae	Introduced : Munnar (Kerala), Nilgiris (Tamil Nadu).
254.	*Salmostoma acinacea* (Valenciennes)	✓	---	Cyprinidae	Maharashtra; Bhavani and Cauvery rivers.
255.	*Salmostoma belachi Jayaraj et al.*	✓	---	Cyprinidae	Karnataka
256.	*Salmostoma boopis* (Day)	✓	---	Cyprinidae	Western Ghats (Goa, Poona & South Canara).
257.	*Salmostoma clupeoides* (Bloch)			Cyprinidae	Peninsular India, Madhya Pradesh, Gujarat.
258.	*Salmostoma horai* (Silas)	✓	---	Cyprinidae	Coorg, Cauvery River.
259.	*Salmostoma novacula* (Valenciennes)	✓	**LR-nt**	Cyprinidae	Western Ghats
260.	*Salmostoma untrahi* (Day)			Cyprinidae	Throughout India
261.	*Scatophagus argus* (Bloch)	✓	---	Scatophagidae	Kerala, Karnataka
262.	*Schismatogobius deraniyagalei Pethiyagoda & Kottelat*			Gobiidae	India, Philippines, Australia & Sri Lanka.
263.	*Schismatorhynchus* (Nukta) *nukta* (Sykes)	✓	---	Cyprinidae	Maharashtra & Karnataka
264.	*Schistura bhimachari* (Hora)	✓	---	Balitoridae	Thunga River, Karnataka.
265.	*Schistura denisoni denisoni* (Day)			Balitoridae	Peninsular India, Chota Nagpur Plateau, Bihar & Bastar.
266.	*Schistura kodaguensis* (Menon)	✓	---	Balitoridae	Western Ghats (Kerala, Tamil Nadu)
267.	*Schistura nilgiriensis* (Menon)	✓	**EN**	Balitoridae	Pykara Dam, Nilgiris (Tamil Nadu).

Sl. No.	Species	Ende-mic to WG	IUCN Status	Family	Distribution
268.	*Schistura semiarmatus* (Day)	✓	**VU**	Balitoridae	Cauvery basin in Wayanad, Nilgiris & Mysore.
269.	*Schistura striatus* (Day)	✓	**DD**	Balitoridae	Wayanad, Kerala
270.	*Sicyopterus griseus* (Day)	✓	---	Gobiidae	Kerala: South Canara & Travancore
271.	*Silonia childreni* (Sykes)	✓	**EN**	Schilbeidae	Western Ghats
272.	*Silurus wynaadensis* (Day)	✓	**CR**	Siluridae	Wayanad hills of Kerala
273.	*Syngnathus argyrostictus* (Kauip)	✓	---	Syngnathidae	Goa, Kerala, Tamil Nadu
274.	*Tetraodon travancoricus Hora & Nair*	✓	**EN**	Tetraodontidae	Kerala (Pamba river, Vembanad Lake, Chaliyar & Kole wetlands of Trichur).
275.	*Thynnichthys sandkhol* (Sykes)	✓	---	Cyprinidae	Krishna and Godavari river systems
276.	*Tinca tinca* (Linnaeus) #			Cyprinidae	Introduced to Peninsular India
277.	*Tor khudree* (Sykes)	✓	**VU**	Cyprinidae	Kerala, Karnataka, Maharashtra.
278.	*Tor kulkarnii* (Menon)*	✓	**DD**	Cyprinidae	Pune, Maharashtra
279.	*Tor malabaricus* (Jerdon)*	✓	**CR**	Cyprinidae	Kerala part of Western Ghats
280.	*Tor mussullah* (Sykes)	✓	**CR**	Cyprinidae	Cauvery, Bhavani, Krishna & Godavari rivers).
281.	*Tor neilli* (Day)	✓	---	Cyprinidae	Krishna, Cauvery, Thungabhadra
282.	*Travancoria elongata Pethiyagoda & Kottelat*	✓	**CR**	Balitoridae	Chalakudy river, Kerala.

283.	*Travancoria jonesi Hora*	✓	**EN**	Balitoridae	Western Ghats of Kerala (Travancore Hills)
284.	*Wallago attu* (Bloch & Schneider)			Siluridae	Pakistan, India, Nepal, Bangladesh, Myanmar, Thailand, Vietnam, Kampuchea, Indo-China, Malay Peninsula & Indonesia.
285.	*Xenentodon cancila* (Hamilton-Buchanan)			Belonidae	Pakistan, India, Bangladesh, Sri Lanka, Myanmar, Malaya, Nepal & Thailand.
286.	*Xenetodon sp. Roberts*			Belonidae	India: South India & Malay Peninsula.
287.	*Zenarchopterus dispar* (Valenciennes)			Hemiramphidae	Throughout India

✓ Species ***endemic*** to the area (**192** nos.). The definition for endemic fish -- "The fish species found exclusively in a country or a drainage system where it is native and described".
* Taxonomic position to be confirmed (**14** nos.)
# Exotic/ transplanted species in the area (**18** nos.). **CR**= Critically Endangered; **EN**= Endangered; **DD**= Data Deficient; **LR-lc**= Lower Risk – least concern; **LR-nt**= Lower Risk – near threatened; **VU**= Vulnerable; --- not assessed.

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Freshwater Fishes of Kerala State, India

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Introduction

The state of Kerala is a narrow strip of land located at the southern extremity of the Indian subcontinent, along the shores of Arabian Sea covering a distance of about 580 km. with Karnataka state on the north and north east and Tamilnadu state on the east and south. Lying between 8° 17 ' 30" and 12 ° 47' 40" north latitude and 74 ° 51' and 77 ° 24" east longitude, the state is spread over an area of 38855 sq. km. A significant feature of Kerala from zoogeographer's and naturalist's point of view is the majestic presence of the Western Ghats all along its stretch influencing the physiographic and eco-climatic factors of the state. About 500 km. of Ghats' total length of over 1300 km., fall in Kerala, with a break or gap at Palakkad. The Ghat region of Kerala covers nearly 21856 km., or 56% of the total geographic area of the state and 42.7% of the entire ghat region. This hilly region intricately balances the whole life-supporting system of the state. The Western Ghats is an extremely important life supporting system having very rich and diverse biological resources and forming a distinct ecological and biogeographical region of India. It has been rightly recognized as a 'hotspot' area of biodiversity for conservation, one of the two such diversity-rich areas in the country.

Major Water Resources

The Western Ghats of Kerala is the watershed of 44 rivers of which 41 are west flowing and 3 east flowing, all of which form a dendritic pattern of drainage system. Besides these rivers, the other inland water bodies include extensive stretches of Kayals (backwaters and wetlands), freshwater lakes, dam reservoirs, tanks and ponds. These inland waters are potential habitats for a large variety of fish fauna, many of which are endemic to the state. Tribals and nontribals, to a great extent, depend on the fishes from these freshwater bodies for their livelihood. Damming the rivers for the irrigation and hydro-electric projects, large scale pollution of water bodies, out break of epidemic diseases on fishes and introduction of exotic fishes have caused considerable deleterious effect on the native stock of fish fauna. Protection of native fish fauna and their habitat has not so far received any attention. Conservation of fish-life in the country is urgently needed both for economic and ecological reasons.

Primary freshwater fishes of 165 species (excluding marine forms visiting fresh waters) found in the inland waters of Kerala are listed hereunder. The data and listing of species are based on the information compiled after scanning relevant literature on fishes from Kerala (as listed in reference portion), pooling the information from the faunistic survey programmes of Z.S.I., Calicut, and also consulting a few ichthyologists and officials of Fisheries Dept. of Kerala. No statistical analysis or discussion has been made on the parameters of distribution (D), occurrence (O) and abundance (A) of the fish species, other than recording the identity of the species and noting their occurrence and relative abundance (status) tentatively. Therefore information given pertaining to the above parameters (Table 1) are inferences for the present period only, not relating to that of the past. The identification and classification of fishes are based on Day (1865, 1875-78), Jayaram (1981, 1991) Menon (1987, 1992) and Talwar and Jhingran (1991).

For selected freshwater fishes found rarely in Kerala waters, their distribution and abundance in particular water bodies are also given (Table 2). Their status shown as indicated above are based on the faunistic survey programmes of ZSI, Calicut, during the period 1993 to 1997.

Table 1. Systematic List of Primary Freshwater Fishes of Kerala State, India

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Trans-planted	Relat Abun.	General Distribution
1.	**Order: Osteoglossiformes** **Family: Notopteridae** *Notopterus notopterus* (Pallas)	Ambattan-Vala		A1	India, Pakistan, Nepal, Bangladesh, Burma, Thailand, Malaya and Indonesia. (fresh and brackish waters)
2.	**Order: Anguilliformes** **Family: Anguillidae** *Angullia bengalensis bengalensis Gray*	Mlangil, Vilangu		A2	Throughout India, Pakistan, Bangladesh, Burma and the East Indies (fresh waters, also estuaries and in the sea)
3.	Anguilla bicolor bicolor (McClelland)	Mlangil		A2	Throughout India, Pakistan, Bangladesh, Burma and the East Indies (fresh waters, also estuaries and in the sea)

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
4.	**Order: Clupeiformes Family: Clupeidae Hilsa** *ilisha* (Ham.-Buch.)	----	EN-IS	A2	India: Ganga,Yamuna, Narmada, Tapi, Krishna, Godavary, Cauvery, and Pennar rivers, transplanted into the waters of other South Indian rivers. Pakistan, Bangladesh,Burma and Srilanka.
5.	**Order: Cypriniformes Family: Cyprinidae** Subfamily: Cultrinae *Chela dadyburjori* (Menon)		EN-1	A2	India Kerala: (Cochin, Trivandrum;) Tamilnadu: (Nagercoil)
6.	*Chela fasciata* (Silas)		EN-1	A2	Peninsular India: Anamalai Hills (Kerala part)
7.	*Chela laubuca* (Ham.-Buch.)	Mathiparal		A3	India, Pakistan, Bangladesh, Srilanka, Burma, Malay Peninsula and Sumatra.
8.	*Salmostoma clupeioides* (Bloch)		EN-1	A1	India: Hooghly river (West Bengal), Poona (Maharashtra), Bhavani river (T.Nadu), Kabani river (Kerala)
9.	*Salmostoma acinaces* (Val.)		EN-1(WG)	A2	India: W. Ghats, Wyanad, S.Karnataka, Poona
10.	*Salmostoma boopis* (Day)		EN-1	A2	India: Eastern Ghats, Western Ghats, (Nelliampathy Hills), Kerala, T.Nadu, Maharashtra, Madhya Pradesh and Gujarat; and Burma.
11.	*Salmostoma untrahi* (Day)		EN-1	A2	India: Mahanadi river drainage (Orissa), Kabani river (Wynaad, Kerala)
12.	Esomus danricus (Ham.)	Meesaparva		A3	India, Pakistan, Nepal, Srilanka and Burma (streams, ponds and ditches)
13.	*Brachidanio rerio* (Ham.-Buch.)		EN-IS	A1	India: Eastern India from Bengal to Krishna river system and further down to Malabar, Nepal, Bangladesh and Pakistan.
14.	*Danio aequipinnatus* (Mc Clell.)	Ozhukkilatti	EN-IS	A4	India: Eastern Himalaya, Meghalaya and South India; Nepal, Bangladesh, Burma, Thailand, Srilanka.
15.	*Danio malabaricus* (Jerdon)	Ozhukkilatti	EN-IS	A3	India: Western coast; Srilanka

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
16.	*Horadandia atukorali brittani* Remadevi & Menon		EN-K	A2	India: Kerala (Pathiramanal Island Cherthalla).
17.	*Rasbora rasbora* (Ham.-Buch.)	Thup-palkudiyan		A3	India: Gangetic Provinces, Coromandel Coast and South Kerala; Pakistan, Bangladesh and Thailand.
18.	*Parluciosoma daniconius* (Ham.-Buch.)	Thup-palkudiyan		A4	India, Pakistan, Srilanka, Bangladesh, Burma and Mekong
19.	*Amblypharyngodon chakaiensis* Babu & Nair	Vayampu, Thup-palkothi	EN-K	A1	India: Veli lake (Trivandrum District Kerala)
20.	*Amblypharyngodon melettinus* (Val.)		EN-IS	A2	India: Western Ghats and Tamil Nadu; and Srilanka (Ponds, streams and lakes)
21.	*Amblypharyngodon microlepis* (Ham.-Buch.)	Oolari	EN-I	A2	India: Uttar Pradesh, Bihar, West Bengal Orissa, Andhra Pradesh, Tamil Nadu and Kerala
22.	*Amblypharyngodon mola* (Ham.-Buch.)	Oolari	EN-IS	A2	India: throughout the country; Pakistan, Bangladesh and Burma
23.	*Barilius bakeri* (Day)	Pavukan	EN-WG(K)	A2	India: Western Ghats of Kerala
24.	*Barilius bendelisis* (Ham.-Buch.)	Paral, Pavukan	EN-IS	A3	India, (Kerala: Rivulets, Streams, Periyar Tiger Reserve (Idukki Dist.), Parambikkulam Wild Life Sanctuary (Palakkad Dist.) Srilanka, Pakistan, Nepal, Bangladesh.
25.	*Barilius canarensis* (Jerdon)	Paral	EN-WG	A3	India: Western Ghats of Karnataka and Kerala
26.	*Barilius gatensis* (Val.)	Vendakurichi	EN-WG	A3	India: Western Ghats in Maharashtra Southern Karnataka; and the Nilgiri hills
27.	**Order: Cypriniformes** **Family: Cyprinidae** *Cyprinus carpio communis* (Linn.)	Carp	EX	A4	Naturally found all through China, Korea, Japan, Taiwan, Europe, America. Introduced into India, in 1939
28.	*Catla catla* (Ham.-Buch.)	Karakatla, Kenda	TR	A3	Pakistan, India: Northern India, Bangladesh, Nepal and Burma Transplanted into some of the rivers of Peninsular India, notably river Cauvery and in more recent times into Srilanka and China.

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
29.	*Cirrhinus cirrhosus* (Bloch)	Venkanta	EN-1	A3	India: Cauvery, Krishna and Godavary river system, S-India
30.	*Cirrhinus mrigala* (Ham. -Buch.)	Vengalam	TR	A3	Throughout North India, Pakistan, Nepal, Bangladesh, Burma, Intro-duced to South India.
31.	*Cirrhinus reba* (Ham.)	Reba carp	EN-IS	A2	Throughout India, Pakistan, Nepal and Bangladesh
32.	*Gonoproktopterus curmuca* (Ham.-Buch.)	Kadimeen	EN-WG	A3	India: Western Ghats (rivers usually in deep cool and shady parts in the hilly regions).
33.	*Gonoproktopterus kurali* (Menon & Remadevi) (=*Hypselobarbus kurali* Menon & Remadevi)	Kooral	EN-WG	A2	India: Western Ghats, rivers in the Southern Ghats, Periyar Lake (Idukki Dist.), Parambikulam wild life sanctu-ary (Palakkad Dist.) of Kerala
34.	*Gonoproktopterus lithopidos* (Day)		EN-WG	A1	India: Western Ghats from South Canara to Kerala
35.	*Gonoproktopterus micropo-gon micropogon* (Val.)	Kariyan	EN-WG	A2	India: Rivers at base of Nilgiris as Bha-vani, Wynad in Kerala; South Kanara, Karnataka. Intr-oduced into Ooty Lake.
36.	*Gonoproktopterus micropo-gon periyarensis* (Raj.)	Kariyan	EN-WG(K)	A1	India: Periyar Lake, Kerala
37.	*Gonoprotopterus thomassi* (Day)		EN-WG	A1	India: South Canara and Cardamon Hills (Western Ghats)
38.	*Puntius amphibius* (Val.)	Ooleeparal, Urulanparal	EN-IS	A4	India: Rajasthan, Uttar Pradesh, Bihar, Goa, Maharashtra, Andhra Pradesh, Tamilnadu, Kerala, Karnataka, Mad-hya Pradesh, Orissa, Srilanka
39.	*Puntius arulius arulius* (Jerdon)	Arliparal	EN-WG	A2	India: Wyanad and Nilgiri Hills, Also known from the Cauvery river in its middle and upper reaches in Karnataka
40.	*Puntius arulius tambrapar-niei* (Silas)	Arliparal	EN-WG	A2	India: Tambraparni river, near Kalladakurichi, Tirunelveli, Tamilnadu, S-India
41.	*Puntius bimaculatus* (Bleeker)		EN-IS	A3	India: Kalakkad, Parmambikulam wild life sanctuary, Chimminy Wild life Sanctuary, S.India, Srilanka

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
42.	*Puntius carnaticus* (Jerdon)	Kavery kenda	EN-WG	A3	India: Cauvery, Krishna river systems, Nilgiris, Wynad in Kerala and Kanara in Karnataka
43.	*Puntius chalakudiensis* (Menon, Remadevi & Thobias)		EN-WG(K)	A1	India: Kerala:- Chalakudi river
44.	*Puntius chola* (Ham.Buch.)	Poovali	EN-IS	A3	Throughout India, Pakistan, Nepal, Bangladesh, Burma and Srilanka
45.	*Puntius conchonius* (Ham.-Buch.)		EN-IS	A3	India: J&K, U.P., Bihar, M.P., Rajasthan, Assam, Tripura, Bengal, Nagaland, Manipur, Orissa, South–India; Pakistan, Bangladesh
46.	*Puntius denisonii* (Day)	Kendai	EN-WG(K)	A1	India: Mundakayam, Travancore hill ranges, Aralam, W.L.S., Kannur Dist. Kerala.
47.	*Puntius dorsalis* (Jerdon)		EN-IS	A1	India: Cauvery, Krishna River Systems; Kerala, Karnataka, Andhra Pradesh, Mahanadi in Orissa, Narmada in Hoshangabad Dist., M.P.; Srilanka
48.	*Puntius fasciatus* (Jerdon) [=P.melanampxy (Day)]	Kyli Kadukunda Vazhakka-varay-an	EN-WG	A4	Penissular India: Upper reaches of Cauvery Drainage and further southward to Cape; also Western watersheds draining South Kanara, Malabar and Travancore/ Cochin
49.	*Puntius filamentosus* (Val.)	Katchiparal	EN-IS	A4	India: Cauvery, Krishna drainages and rivers, Kerala, Andhra Pradesh, Karnataka, Tamilnadu, Goa, Srilanka
50.	*Puntius jerdoni* (Day)	Tameen, Tolu	EN-WG	A2	India: South Karnataka, Kerala, Tamilnadu and Maharashtra
51.	*Puntius melanostigma* (Day)	Kendai	EN-WG	A1	Southern India: Cauvery river system, Wynad Hills and Bhavani river
52.	*Puntius ophicephalus* (Raj.)	Eeetilakanda	EN-WG(K)	A1	India: Pambiyar river and its tributary, Head waters of Periyar river, Manimalayar, Peermed Hills, Kerala
53.	*Puntius parrah* (Day)	Paraparal	EN-WG	A2	India: Kerala, Karnataka and Tamilnadu

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
54.	*Puntius sarana subnasutus* (Val.)	Kuruvaparal Kuruva,Kuri-chi	EN-WG	A3	India: Krishna and Cauvery river sys-tems, and Kerala in Peninsular India
55.	*Puntius sophore* (Ham.-Buch.)	Undakanni		A3	India, Pakistan, Nepal, Bangladesh, Burma and Yunnan (China)
56.	*Puntius ticto ticto* (Ham.)	Kadumkali		A3	India: throughout; Nepal, Pakistan, Srilanka, Bangladesh, Burma, Thailand
57.	*Puntius ticto punctatus* (Day)		EN-I	A2	India: Kerala and Coromandel coasts
58.	*Puntius vittatus* (Day)	Chelikunthi, Kaippa	EN-IS	A3	India: Karnataka, Kerala, Tamilnady, Goa, Kutch, Srilanka, Pakistan
59.	*Osteobrama bakeri* (Day)	Mullanparal	EN-WG(K)	A1	India: Kottayam, Nilambur, Kerala
60.	*Labeo ariza* (Ham.-Buch.)	'Rogu'	EN-WG	A2	Peninsular India: Nilgiri Hills, Wyan-aad and Cauvery river system
61.	*Labeo calbasu* (Ham.-Buch.)	Karuth-ameen, Kakkameen, Kalanchi		A2	India, Pakistan, Bangladesh, Nepal, Burma, Thailand and Yunnan (South China)
62.	*Labeo dussumieri* (Val.)	Thooli, Pullan	EN-IS	A1	India: Western Ghats up to North Canara and probably Srilanka
63.	*Labeo fimbriatus* (Bloch.)	Pirichundan	EN-IS	A2	India: West Bengal and Eastern Ghats; Nepal; Pakistan; and Burma
64.	*Labeo potail* (Sykes)	---	EN-1	A1	India: Maharashtra, the Deccan, and the Cauvery river system
65.	*Labeo rohita* (Ham.-Buch.)	Chemballi, Rohitam, Rohu	TR	A3	Pakistan; North and Central India (Transplanted to other areas of the country including Kerala); Bangladesh; Teri region of Nepal; and Burma
66.	*Neolissochilus wynaadensis* (Day)		EN-WG(K)	A1	India: Wynaad (Kerala) and headwa-ters of Cauvery river
67.	*Tor khudree* (Sykes)	Kuyil	EN-IS	A2	India: Madhya Pradesh, Deccan and entire Peninsular India; and Srilanka
68.	*Tor mussullah* (Sykes)	Kuyil	EN-I	A1	Peninsular India: Krishna and Goda-vari rivers; Hill streams in Malappur-am and Wynaad Dists., Kerala

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
69.	Osteochilus (Kantaka) brevidorsalis (Day)	Machal, Mamal	EN-WH(K)	A3	India: Western Ghats of Kerala
70.	Osteochilus (Osteo-chilichthys) longidorsalis (Pethiyagoda & Kottelat)	Machal, Mamal	EN-WG(K)	A2	India: Kerala: Chalakudy river
71.	Osteochilus (Osteo-chilichthys) nashii (Day)	Machal, Mamal	EN-WG	A2	India: Western Ghats of Karnataka and Kerala
72.	Crossocheilus latius latius (Ham.-Buch.)	Karimpachy	EN-IS	A2	India: drainages of the Ganga and Brahmaputra in Northern India; Mahanadi river drainage in Orissa; and Western Ghats South to the head waters of Krishna river
73.	Crossocheilus periyarensis (Menon & Jacob)	Karimpachy	EN-WG(K)	A2	India: Western Ghats of Kerala (Periyar river)
74.	Garra gotyla stenorhynchyus (Jerdon)	Kallemutty	EN-WG	A2	India: Cauvery and Krishna drainag-es, Western Ghats.
75.	Garra hughi Silas	Kallemutty	EN-WG(K)	A1	Peninsular India: Cardamom and Palani Hills, Western Ghats
76.	Garra mcCleandi (Jerdon)	Kallemutty	EN-WG	A2	India: Cauvery drainage, Kerala and Karnataka; Periyar lake (Kerala)
77.	Garra menoni Remadevi & Indira	Kallunakki	EN-WG(K)	A2	Inida: Western Ghats: Kunthi river, Silent Valley kerala
78.	Garra mullya (Sykes)	Kallunakki	EN-I	A4	India: throughout except Assam and the Himalaya
79.	Garra surendranathani Shaji, Easa & Arun	Kallemutti	EN-WG (K)	A3	India: Kerala: Chalakudy, Pamba and Periyar river systems
80.	**Subfamily: Schizothoracinae** Lepidopygopsis typus (Raj)	Brahman-kenda	EN-WG (K)	A1	India: Western Ghats: Periyar river and lake
81.	**Family; Balitoriadae** **Subfamily: Balitorinae** Balitora mysorensis (Hora)		EN-WG	A1	India: Western Ghats-Cauvery and Tungabhadra river systems (Karna-taka) and Kolhapur (Maharashtra). (Kerala: Kabani river, Bhavani river)

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
82.	*Bhavania australis* (Jerdon)	Kalveli	EN-WG	A2	India: extreme south of Western Ghats (Karnataka, Nilgiris and Kerala)
83.	*Homaloptera menoni* Shaji & Easa	Kalveli	EN-WG (K)	A2	India: Bhavani river (Kerala Part) of the Western Ghats
84.	*Homaloptera montana* Herre	Kalveli	EN-WG	A1	Western Ghats - Anamalai Hills
85.	*Homaloptera pillai* Indira & Remadevi	Kalveli	EN-WG(K)	A2	India: Western Ghats-Kunthi river, Silent Valley, Kerala
86.	*Travancoria elongata* Pethia-goda & Kottelat	Kallotty	EN-WG(K)	A1	India: Western Ghats-Chalakudy river Kerala
87.	*Travancoria jonesi* Hora	Atunda	EN-WG(K)	A1	India; Western Ghats-High ranges of northern Travancore and Anamalai Hills (Kerala)
88.	**Subfamily: Nemacheilinae** *Nemacheilus botia* (Ham.-Buch.)	Ayira	EN-1	A1	Northern India: Brahmaputra and Ganga basins; South India: Western Ghats-Hill streams of Travancore, and Periyar Lake (Zacharias et al 1996)
89.	*Nemacheilus denisoni denisoni* (Day)	Kalkani Atumeen	EN-I	A3	Peninsular India, Chota Nagpur Plateau (Bihar) and Bastar (Madhya Pradesh)
90.	*Nemacheilus evezardi* (Day)	Ayira	EN-I	A1	Western Ghats: Krishna and Godavari basins; and Satpura range: Pachmari Hills and also in small streams of Periyar river, Kerala
91.	*Nemacheilus guentheri* (Day)	Koima	EN-WG	A1	Peninsular India: Western Ghats
92.	*Nemacheilus keralensis* Rita & Nalbant	Koima	EN-WG(K)	A1	India: Western Ghats of Kerala
93.	*Nemacheilus monilis* Hora	Koima	EN-WG	A2	India: Western Ghats: Nilgiris, Cardamon Hills
94.	*Nemacheilus moreh* (Sykes)	Koima	EN-I	A2	Peninsular India
95.	*Nemacheilus nilgiriensis* (Menon)	Koima	EN-WG	A2	India: Pykara Dam, Nilgiri Dist. (Tamil-nadu); Kabani river Wyand (Kerala)
96.	*Nemacheilus petrubanares-cui* (Menon)	Koima	EN-WG	A2	India: Netravati river, Dharmasthala (Karnataka); Kabani river, Wyand (Kerala)

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
97.	*Nemacheilus semiarmatus* Day	Koima	EN-WG	A2	Peninsular India: Cauvery basin in Wyand, Nilgiris and Mysore; and Silent Valley (Bharathapuzha basin)
98.	*Nemacheilus striatus* Day	Koima	EN-WG	A1	India: Western Ghats: Kerala: Wya-naad and Karnataka; Shimoga
99.	*Nemacheilus triangularis* Day	Koima	EN-WG	A2	Peninsular India: Western Ghats: Kerala and Tamilnadu
100.	**Family: Cobitidae** **Subfamily: Cobitinae** *Lepedocephalus thermalis* (Val.)	Koima	EN-IS	A3	India: Coastal districts of Kerala, Karnataka and Maharashtra; Srilanka
101.	*Pangio bashai* Easa & Shaji	Manalaran	EN-WG(K)	A2	Kerala: Chalikkal River, a tributary of Chaliyar
102.	*Pangio goaensis* (Tilak)		EN-WG	A1	India: Colem river, Goa, Chaliyar river, Calicut, Kerala (Pers. Commun.; Dr. C. Radhakrishnan, ZSI, Calicut)
103.	**Order: Siluriformes** **Family: Bagridae** *Batasio travancoria* (Hora & Law)		EN-WG(K)	A2	India: Western Ghats of Kerala
104.	*Horabagrus brachysoma* (Gunther)	Manjaletta, Manjakoori	EN-(K)	A3	India: Rivers and Backwaters of Kerala
105.	*Horabagrus nigricollaris* Pethiyagoda & Kottelat	Manjaletta, Manjakoori	EN-WG(K)	A2	India: Chalakkudy river of Kerala
106.	*Mystus armatus* (Day)	Koorie, Kotti	EN-IS	A3	India: Wynaad range of hills, Western Ghats; and Nagaland; and probably also Burma
107.	*Mystus cavasius* (Ham.-Buch.)	Kotti		A3	India: Pakistan, Srilanka, Nepal, Bangladesh, Burma and Thailand
108.	*Mystus keletius* (Val.)	Kotti	EN-IS	A2	India: Tamilnadu, Western Ghats of Kerala and Karnataka; and Srilanka.
109.	*Mystus malabaricus* (Jerdon)	Kallankaree, Kotti	EN-WG(K)	A1	India: Western Ghats

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
110.	*Mystus montanus* (Jerdon)	Kotti	EN-I	A2	India: Wynad range of hills (Kerala State) Karnataka, Maharashtra, Madhya Pradesh and Assam.
111.	*Mystus oculatus* (Val.)	Koorie Kotti	EN-I	A2	India: Kerala and Tamilnadu
112.	*Mystus punctatus* (Jerdon)	Varikallan Koorie, Kotti	EN-WG	A2	India: Nilgiri hills (Tamilnadu) and the Western Ghats (Kerala and Karnataka)
113.	*Mystus vittatus* (Bloch)	Ettachulli, Chillan	EN-WG	A2	India,. Pakistan, bangladesh, Nepal, Srilanka, Burma and Thailand
114.	**Family: Siluridae** *Ompok bimaculatus* (Bloch)	Vala, Thon-nan vala		A3	India: Pakistan, Srilanka, Ban-gladesh, Burma, Thailand, Java, Sumatra, Borneo and China.
115.	*Ompok malabaricus* (Val.)	Manjavala, Chottuvala	EN-I	A2	India: Goa and Kerala
116.	*Silurus wynaadensis* Day	Wynadan mushi	EN-WG	A1	India Western Ghats of Kerala, Tamilnadu
117.	*Wallago attu* (Schneider)	Attuvala			India, Pakistan, Srilanka, Nepal, Ban-gladesh, Burma and further east.
118.	**Family: Schilbeidae** **Subfamily: Schilbeinae** *Pseudeutropius mitchelli* Gunther	Nakkelletta	EN-I	A3	India: Kerala and Tamil Nadu (Fresh Waters in coastal area)
119.	*Proeutropilchthys taakree taakree* (Sykes)		EN-IS	A3	India: Western Ghats, Kerala, Maha-rashtra, Burma
120.	**Family: Sisoridae** *Glyptothorax anamalaiensis* Silas	Parayotti	EN-WG(K)	A2	India: Base of Anamalai Hills (Kerala part)
121.	*Glyptothorax annandalei* Hora	Parayotti	EN-IS	A3	India: Western Ghats and the Vind-hyas, Nepal
122.	*Glyptothorax housei* Herre	Parayotti	EN-WG(K)	A2	India: Western Ghats-Anamalai Hills (Kerala)
123.	*Glyptothorax madraspata-nam* (Day)	Parayotti	EN-WG	A2	India: Western Ghats: Anamalai and Nilgiri Hills

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
124.	**Family: Clariidae** *Clarias batrachus* (Linnaeus)	Musi, Mushi, Moshi	EN-IS	A4	India: Pakistan, Nepal, Srilanka, Bangladesh, Burma, Indonesia, Singapore, Borneo and the Philippines
125.	*Clarias dayi* Hora	Musi	EN-WG	A1	India: Wynad Hills, Western Ghats of Kerala
126.	*Clarias dussumieri* Val.	Musi	EN-I	A1	Peninsular India (Goa, Karnataka, Kerala and Pondicherry)
127.	*Clarias gariepinus*	African mushi	EX	A2	Vembanad lake
128.	*Horaglanis krishnai* Menon	Kuruda-mushi	EN-WG(K)	A1	India: Kerala (Kottayam District) .
129.	**Family: Heteropneustidae** *Heteropneustes fossilis* (Bloch)	Kaduku-meen	EN – IS	A4	India: Pakistan. Nepal. Srilanka, Bangladesh, Thailand, Laos
130.	*Heteropneustes microps*	Kari	ENI	A4	Trichur, Kerala
131.	**Order: Salmoniformes** **Family: Salmonidae** *Salmo gairdnerii gairdnerii* Richardson	Salmon	EX	A1	Atlantic coast to North America, From South Alaska to Mexico; introduced in India, Pakistan and Srilanka. (Kerala: Eravikulam National Park-Idukki Dist.)
132.	*Salmo trutta fario* Linnaeus	Salmon	EX	A1	Introduced into India, Pakistan, Bangladesh. Also in S.Africa, Australia, N.America, Naturally found in Eurasia.
133.	**Order: Cyprinodontiformes** **Family: Belonidae** *Xenentodon cancila* (Ham.-Buch.)	Kolan	EN-IS	A3	India, Pakistan, Bangladesh, Srilanka, Burma and Thailand.
134.	**Family: Oryzidae** *Oryzias melastigma* (Mc-Clelland)	Poochutti	EN-IS	A2	India;, Bangladesh, Burma and also Srilanka
135.	**Family: Aplocheilidae** *Aplocheilus lineatus* (Val.)	Varayan-ponjan, Manattu-kanni	EN-IS		India: Coorg, Wynaad, Kerala Coast, Srilanka
136.	*Aplocheilus rubrostigma* (Jerdon)	Poonjan	En-I	A2	India: Kerala and Coromandel Coast

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
137.	**Family: Poecilidae** *Gambusia affinis* (Baird & Girard)		EX		Introduced throughout India, Pakistan, Bangladesh, Srilanka, Burma, Thailand, Malaya, Philippines, Hawait, Formosa. Native of coastal waters of United States from New Jersey southwards
138.	**Order: Syngnathiformes** **Family: Syngnathidae** *Icthyocampus carce* (Ham.-Buch.)				Throughout India to Australia (Frequently found in rivers streams and estuaries)
139.	*Microphis cuncalus* (Ham.-Buch)		EN-IS		India: West Bengal, Orissa, Tamilna-du, maharashtra, Goa and Kerala; Bangladesh and Srilanka (Fresh waters and estuaries)
140.	**Order: Perciformes** **Family: Amabssidae** *Chanda nama* Ham.-Buch.		EN-IS	A3	India: Pakistan, Nepal, Bangladesh and Burma. (Fresh and brackish waters, both in standing and running waters)
141.	*Parambassis dayi* (Bleeker)		EN-K	A3	India: Western Ghats of Kerala. (Fresh waters and estuarine lakes)
142.	*Parambassis thomassi* (Day)	Aringil	EN-WG	A2	India: Western Ghats of Kerala and Karnataka (Streams and lakes)
143.	*Pseudambassis ranga* (Ham.-Buch.)	Aringil	EN-IS	A3	India: throughout, Pakistan, Nepal, Bangladesh and Burma (Fresh and brackish waters)
144.	**Family: Nandidae** *Nandus nandus* (Ham.-Buch.)				India., Pakistan, Nepal, Bangladesh; Burma; and Thailand. (Fresh and brackish waters)
145.	*Pristolepis malabarica* (Gunther)	Cheepathip-aral Chutichi	ENWG(K)	A1	India: Western Ghats
146.	*Pristolepis marginata* Jerdon		ENWG(K)	A1	India: Western Ghats of Kerala (Man-anthoddy river, Wynaad, Kerala)
147.	**Family: Cichlidae** *Etroplus maculatus* (Bloch)	Palathi	EN-IS	A3	India: Tamilnadu, Kerala and South Karnataka; and Srilanka
148.	*Etroplus suratensis* (Bloch)	Karimeen	EN-IS	A3	India: Orissa, Andhra Pradesh, Tamil-nadu and Kerala; and Srilanka

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
149.	*Oreochromis mossambica* (Peters) (= *Tilapia mossambica* Peters)	Thilopi	EX-TR	A4	East Africa; an introduced species in India, Pakistan, Srilanka.
150.	**Family: Gobiidae** **Subfamily: Gobiinae** *Awaous stamineus* (Val.)	Vayapottan	EN-IS	A3	India and Bangladesh (Streams, rivers and estuaries)
151.	*Glossogobius giuris* (Ham.-Buch.)	Poolan			Indo-West Pacific (Primarily fresh water and estuaries)
152.	**Family: Anabantidae** *Anabas testudineus* (Bloch)	Antikalli, Karippidi, Karooppu		A2	Throughout India, Pakistan, Bangladesh, Srilanka, Burma, Malay Archipelago, Singapore, Philippines (fresh and brackish waters)
153.	**Family: Belontidae** **Subfamily: Macropodinae** *Macropodus cupanus* (Val.)	Karinganna Wuntee		A1	India: Kerala, Coromandel coasts, Bangladesh, Pakistan, Srilanka, Malaya, Malay Archipelago. (Fresh water ponds and ditches of low country)
154.	**Family: Osphronemidae** *Osphronemus goramy* Lacepede	Gouramy	EX	A3	An exotic species, from Indonesia, Introduced in our waters. Found throughout India, Pakistan, Srilanka. Also in Mauritius, Seychelles, Malaya, Malay Archipelago, Thailand, China
155.	**Order: Synbranchiformes** **Family: Synbranchidae** *Monopterus* (*Amphipnous*) *fossorius* (Nair)		EN-K	A2	India: Coastal areas of Kerala State (marshy areas in paddy fields, borrowing in the bottom of ditches and pools)
156.	*Monopterus (Monopterus) eapeni* Talwar		EN-K	A1	India: Kerala State (Subterranean waters and wells).
157.	**Order: Channiformes** **Family: Channidae** *Channa marulius* (Ham.-Buch.)	Bral		A3	India: throughout Srilanka, Pakistan, Bangladesh, Burma, Thailand, China, (large lakes and rivers).
158.	*Channa micropeltes* (Cuvier)	Cherumeen Vakavaral		A0	India: Kerala, Thailand to Malay, Archipelago (Large streams and canals) (presently untraceable in waters of Kerala)
159.	*Channa orientalis* Bloch & Schneider (= *Channa gachua* Ham.)	Vatton, Vattudi	EN-IS	A3	Throughout India, Nepal, Srilanka, Bangladesh, burma, Pakistan. (Mountains, streams and lowland waters)

Sl. No	Scientific Name	Local Name	Endemic/ Exotic/ Transplant-ed	Relat. Abun.	General Distribution
160.	*Channa puncatus* (Bloch)	Pullivaral		A2	Throughout India, Nepal, Srilanka, Bangladesh, Pakistan, Burma, Malaya, China. (large fresh water ponds and tanks in the plains)
161.	*Channa striatus* (Bloch)	Pullivaral	EN -	A2	India, Pakistan, Srilanka, Bangladesh, Nepal and Burma (fresh and brackish ponds, streams and tanks)
162.	**Order: Mastacembeliformes** **Family: Mastacembelidae** *Macrognathus aral* (Bloch & Schneider)	Aaron, Aral	EN-IS	A3	India, Pakistan, Srilanka, Bangladesh, Nepal and Burma. (fresh and brackish waters, both running and stagnant waters)
163.	*Mastacembelus armatus* (Lacepede)	Muk-kanarakkan		A3	Throughout India, Pakistan, Nepal, Bangladesh, Srilanka, Burma, Thailand, Malaya, to Southern China. (Fresh and brackish waters in plains and hills)
164.	*Mastacembelus guentheri* Day	Muk-kanarakkan	EN-I	A1	India: Kerala, Assam (pools and running waters)
165.	**Order: Tetraodontiformes** **Family: Tetraodontidae** *Tetraodon travancoricus* Hora & Nair				India: Kerala-Pampa river, South Kerala and also Central Kerala

EN-IS: Endemic to Indian Subcontinent, **EN-I:** Endemic to India, **EN-WG:** Endemic to Western Ghats **EN-WG(K):** Endemic to Western Ghats within Kerala, **TR:** Transplanted from other parts of India, **EX:** Exotic.

Rel. Abund: Relative Abundance (A1 to A4): A1: Very rare, **A2**: Rare, **A3**: Abundant, **A4:** Very Abundant

Table 2. Distribution and abundance of selected freshwater fish species from Kerala.

Sl. No.	Species	Water Body			Para- meters	Time Scale		Ref. & Remarks
		Type R/S/B/L/P	Name	Geographic Area/ District		Past	Present	
1.	*Osteobrama bakeri* (Day) (= *Rohtee bakeri* (Day))	R/S	Chalikkal tributary of Chaliyar River	Nilambur, Malappu-ram Dist.	DOA		1995- UA 1995 -O1 1995- A1	1995-Easa & Basha
2.	*Gonoproktopterus micropogon* (= *Puntius micropogon*)	R/L	Kabani river	Mananthavadi Wynad Dist.	DOA	1985-UA 1985-O1 1985-A1	1995 -UA 1995- O1 1995- A1	1993-Raghunathan 1985-ZSI, Calicut 1995-Sur. Report
3.	*Gonoproktopterus thomassi* (Day)	S	Chendurni WLS	Kollam Dist.	DOA		1997- 1997-O1 1997-A1	1997- ZSI, Calicut survey report
4.	*Neolissochilus wynaadensis* (Day)	R/S	Thirunelli puzha (Kabani river); Vythiri river.	Wynad Dist.	DOA	1985-UA 1985-O1 1985-A1	1995- UA 1995- O1 1995- A2	1993-Raghunathan 1985- ZSI, Calicut 1995-Sur. Report
5.	*Puntius denisonii* (Day)	R/S	Aralam puzha Aralam WLS	Kannur Dist.	DOA		1995- 1995- O1 1995- A2	1995-ZSI Sur. Rep. 1995-Shaji, Easa & Chand Basha
6.	*Tor khudree* (Sykes)	R/B R/B	Parabikulam river & Parambikulam Dam, WLS Periyar river & lake-Periyar TR	Palakkad Dist. Idukki Dist.	DOA	1995-UA 1995 -O1 1995- A1	1996-UA 1996-O1 1996-A1	1995-ZSI Sur. rep. 1996-Zacharias et al.

Sl. No.	Species	Water Body			Para- meters	Time Scale		Ref. & Remarks
		Type R/S/B/L/P	Name	Geographic Area/ District		Past	Present	
7.	*Tor mussullah* (Sykes)	S R/B	Meenmutti area Periyar river & lake	Malappuram Dist. Idukki Dist.	DOA	1993-UA 1993- O1 1993-A1	1996-UA 1996-O1 1996-A1	1993-ZSI Survey 1996-Zacharias (Pers. Commun,)
8.	*Balitora mysorensis* Hora	R/S R/S	Sinkaparathodu, Keralamedu (Bhavani river) Kabani river.	Silent valley Wyn-ad Dist.	DOA	1985-UA 1985-O1 1985-A1	1995-UA 1995-O1 1995-A1	1995-Easa & Basha
9.	*Travancoria jonesi* Hora	R/S R/S	Parambikulam river, (Chalakkudi river) Peri-yar river (Periyar Tiger Reserv.)	Palakkad Dist. Idukki Dist.	DOA		1995-97 UA 1995-97-01 1995-97 A1	1995-'97-ZSI Sur.
10.	*Bastasio travancoria* Hora & Law	R/B/S	Parambikulam river & reservoir (Parambi-kulam WLS)Aralam puzha & streams	Palakkad Dist. Kannur Dist.	DOA		1995-96 UA 1995-96 01 1995-96 A1	1995-Shaji et al. 1995-96
11.	*Horabagrus brachysoma* (Gunther) (= *Pseudebagrus chryseus* (Day))	R	Chalakkudi river (Not available in Malabar (North Kerala) area after survey)	Trichur Dist.	DOA		1995-UA 1995-01 1995-A1	1995-ZSI sur.

Sl. No.	Species	Water Body			Para- meters	Time Scale		Ref. & Remarks
		Type R/S/B/L/P	Name	Geographic Area/ District		Past	Present	
12.	*Lepidopygopsis typus* (Raj)	R/L	Periyar river & lake Periyar Tiger Resv.	Idukki Dist.	DOA	1948-UA 1948-01 1948-A1	1996-UA 1996-01 1996-A1	1996-Chacko 1996-Zacharias et al. 1996-ZSI Surv.
13.	*Gonoproktopterus curmuca* (Menon) (= *Hypselobarbus kurali* Menon)	R/B R/L	Parambikulam river & reservoir Periyar River & lake	Palakkad Dist. Idukki Dist.	DOA		1995-96 UA 1995-96 01 1995-96 A1	1995-96-ZSI Surv. 1996-Zacharias et al.
14.	*Pristolepis marginata* Jerdon	S	Stream of Kabani river	Mananthavadi Wynad Dist.	DOA		1994- 1994-01 1994-A1	1994-ZSI report
15.	*Silurus wynaadensis* Day	S S	Streams at Theertha kundu of Thirunelli Aar (Kabhani river) Streams at Ranip-uram(Chandragiri river)	Thirunelli, Wynad Dist. Ranipuram (Kanjangad Taluk), Kasaragod Dist.	DOA		1994-UA 1994-01 1994-A1	
16.	*Tetraodon travancoricus* Hora & Nair	R R	Pamba river Chalakkudi river	South Kerala Central Kerala (Ernakulam & Trichur Dist.)	DOA		1995-UA 1995-01 1995-A1	1995-Easa (Pers. Commun.)

S: Stream; **R:** River; **B:** Barricade; **L:** Lake/Reservoir; **P:** Ponds.
D: Distribution, **UA:** Unaltered; **O:** Occurrence, (1,2,3), 1= Sporadic to stray or scanty; 2 & 3 = Common to very common;
A: Abundance, **A1**= Very rare to rare

Editors' comments:- In addition to the above, following **42 species** are also reported from freshwaters of Kerala, according to Jayaram (1999) and Easa & Shaji (Kerala Forest Research Inst., Peechi, Pers. Comm.): thus, making the **total number of freshwater species 207** in the state. **Exotic species**:- *Hypophthalmichthys molitrix* (Val.), *Aristichthys nobilis* (Richardson), *Ctenopharyngodon idellus* (Val.), *Osphronemus goramy* Lacepede. **Native species**: - *Garra periyarensi*s Gopi, *Monopterus digressus* Gopi, *Monopterus roseni* Bailey and Gans, *Carinatetraodon imitator* Pethiyagoda and Kottelat, *Esomus barbatus* (Jerdon), *E. thermoicos* (Val.), *Osteobrama neilli* (Day), *Oreichthys cosuatis* (Ham-Buch.), *Puntius bovanicus* (Day), *Puntius cauveriensis* (Hora), *Gonoproktopterus kolus* (Sykes), *G. dubius* (Day), *Gonoproktopterus* (=*Puntius/ Hypselobarbus*) *pulchellus* (=*jerdoni/dobsoni*?), *Nemacheilus denisoni pambaensis* (Menon), *N. kodaguensis* (Menon), *Mesonemacheilus herrei* Nalbant & Banarescu, *M. pulchellus* (Day), *M. menoni, Silonia childreni* (Sykes), *Horaichthys setnai* Kulkarni, *Hyporamphus xanthopterus* (Val.), *Hemiramphus limbatus* (Val.), *Aplocheilus blocki* (Arnold), *Microphis brachyurus* (Bleeker), *Sicyopterus griseu*s (Day), *Macropodus cupanus dayi*, *Channa leucopunctatus* (Sykes), *Scatophagus argus* (Linnaeus). **Brackishwater forms commonly caught even from upstreams of rivers**: *Mugil cephalus Linnaeus, Liza parsia,* (Ham-Buch.), *L. macrolepis, L. vaigiensis* (Quoy & Gairnard), *Valamugil cunnesius* (Forsskal), *Chanos chanos* (Forsskal), *Elops machnata* (Forsskal), *Megalops cyprinoides* (Broussonet), *Awaous gutum* (Ham-Buch.) and *Lates calcarifer* (Bloch).

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Introduction

India with its vast water resources, has a rich ichthyo-faunal diversity, comprising 447 primary freshwater species, under 124 genera, 33 families and 11 orders. In the inland waters of Tamil Nadu, a total of 144 species have been recorded, based mostly on the collections made by the Zoological Survey of India, Southern Regional Station, Madras, for over 2 decades.

Major water resources

Tamil Nadu is rich in the extent and variety of its inland water resources. There are about 0.81 million hectares of inland water spread in the state, which includes the major river systems, the Cauvery-Bhavani river complex, the Thambraparani, the Vaigai, the Periyar and the Pennaiyar with their irrigation canals and associated tanks and paddy fields. There are about 28 major irrigation and hydel reservoirs with water spreads of 48,960 ha. There are more than 3000 major and 30,000 minor irrigation tanks. The individual areas of inland water spreads are as follows: Major reservoirs (48,960 ha), minor irrigation tanks, either perennial containing water for more than 8 months in the year (97,690 ha) or major and minor tanks which are seasonal (1,27,430 ha), ponds (30,000 ha), and estuaries and backwaters (46,750 ha) (Raghunathan, 1995).

The major studies on the river systems of Tamil Nadu are those on Cauvery (Jayaram *et al*. 1982), Bhavani (Rajan, 1955), Tambraparani basin (Silas, 1953; Rema Devi, 1992; Rema Devi *et al*., 1997), and Pennaiyar (Indra in press). Studies confined to various districts of Tamil Nadu subsequent to Day (1875-78) are those of Raj (1916), Venkateswarulu *et al*. (1975), Raghunathan (1978), Indra (1991, 1992, 1993, 1994), Talwar and Jhingran (1991) and Menon (1993), Indra & Mary

Bai (1996 and 97), Rema Devi (1996), Rema Devi & Ilango (1993) and Rema Devi & Raghunathan (1996, 1997). The fishes of various biosphere reserves and sanctuaries have been studied by Silas (1951), Jayaram *et al*. (1976), John Singh & Vikram (1987), Venkateswarulu and Ilango (1990) and Rema Devi (1992 a, b). New taxa and range extension are dealt with in the following papers *viz*. Silas (1953), Menon and Rema Devi (1992,1992a), Rema Devi (1992, 1996), Rema Devi and Menon (1994) and Rema Devi *et al*. (1996).

Status of freshwater fish fauna

The 144 species so far known from the inland water bodies of Tamil Nadu include 9 exotics and 6 saltwater dispersents belonging to 63 genera, 27 families and 11 orders, about 3/4 of which are constituted by Cyprinoids and Siluroids. The order Cypriniformes is represented by 86 species (59.7%), under 3 families and 8 subfamilies and the order Siluriformes by 21 species (14.6%) under 7 families.

Though the Cyprinoids are found to be more speciose than Siluroids the latter is found to be more diversified. Among the Cyprinids, the most species rich are *Puntius* (18 spp.) followed by *Labeo* (11 spp.) and Noemacheilus (8 spp.) and among the Siluroids, the genus Mystus (10 spp.) has the most number of species.

Except the hill stream fishes, all other species are widely distributed throughout Tamil Nadu; 16 species are endemic to Tamil Nadu *viz*. Danio neilgherriensis (Day), *Barbodes bovanicus* (Day), *Puntius* arenatus (Day), P.arulius *tambraparniei* Silas, P.mudumalaiensis Menon & Rema Devi, P.sharmai Menon & Rema Devi, Horalabiosa joushuai Silas, H.palaniensis Rema Devi & Menon, *Garra hughi* Silas, G.kalakadensis Rema Devi, Noemacheilus monilis Hora, N.nilgiriensis Menon, N.*pulchellus* Day, N.triangularis tambaraparaniensis Menon and Glyptothorax madraspatanam (Day). These endemic faunas constitute 11.1% of the total Tamil Nadu fish fauna. Of the 16 species listed above, 13 are from Western Ghats. From the Western Ghats so far 211 species have been recorded, 54% of which are represented in Tamil Nadu.

Based on the collection and analysis of data on the occurrence and distribution of species collected from various districts of T.N. through the years, it is felt that to a certain extent the species could be placed in the major categories of IUCN (Menon, 1994). Accordingly 40.27% (58 spp.) fall in these categories *viz*. 'extinct' (1 spp.), 'endangered' (22 spp.), 'vulnerable' (13 spp.) and 'rare' (22 spp.). The species, Enobarbichthys maculatus is extinct. The endangered category which includes 22 species, of which the following 9 species are endemic: Danio neilgherriensis, *Barbodes* bovancicus, Horalabiosa joshuai, H. palaniensis, *Puntius* arulius *tambraparniei*, *Garra hughi*, G. kalakadensis, Noemacheilus nilgiriensis and Glyptothorax madraspatanam; the remaining 13 endangered species are Bhavania australis, *Barbodes carnaticus*, *Hypselobarbus curmuca, H. dobsoni, H. dubius, H. jerdoni, H. kurali, Osteobrama neilli, Osteocheilichthys brevidorsalis, O. nashii, Neolissocheilus wynaadensis, Garra gotyla stenorhynchus* and *Silurus wynaadensis*. The vulnerable category includes, *Barilius bendelisis, B. gatensis, Danio aequipinnatus, D. rerio, Rasbora caverii, Horadandia atukorali, N. triangularis triangularis* and the three endemics, *viz*. *Noemacheilus monilis, N. pulchellus* and *N. triangularius tambraparanei*. The rare catogery includes several *Puntius* species of which 3 are endemic to T.N., *viz*. *P. arenatus, P. mudumalaiensis, P. sharmai*, the other species which can be included under this category are *P. arulius arulius, P. conchonius, P. melanampyx, P. melanostigma, P. parrah, P. punctatus, Osteobrama cotio cotio, Garra mcllellendi, Pseudeutropius atherinoides, Silonia childreni, Pangasius pangasius, Aplocheilus lineatus, Etroplus maculatus, Pseudosphronemus cupanus, Colisa fasiatus, Macrognathus aral, M. guentheri, M. pancalus* and *Mastacembelus armatus.*

Threats and conservation measures

A striking observation made during the collection of fresh water fish fauna is the wide occurrence of the exotic cichlid, *Oreochromis mossambica* and a recent observation of *O. niloticus* in natural waters in North Arcot district. Of the 15,000 specimens collected and studied from the different districts of Tamil Nadu, 11.8% is constituted by *O. mossambica* and invariably from all collection localities, ranging from reservoirs and rivers, in the hill ranges to the plains. Unplanned introduction of this species and carps into all the water systems will be detrimental to the native fauna as observed in the case of the indigenous cichlid Etroplus maculatus which is absent from most of its earlier known areas of distribution. Likewise several other native species of carps like *Barbodes bovanicus*, *Cirrhinus cirrhosus*, *Puntius carnaticus*, *Puntius dubius*, *Puntius pulchellus* and many small *Puntius* species have now become very rare and exhibit a narrow range of distribution after the transplantation of Gangetic carps. It is suggested that atleast in future, necessary precautions should be taken while introducing exotic species into inland water bodies and their spread be strictly monitored. The other threat to fish diversity is habitat loss, as rivers are dammed or diverted and wetlands are cleared for agriculture and aquaculture. Endemism with regard to fish fauna is more in the hilly regions than in the plains. Hence it is all the more important that these regions need greater protection. The fauna evolved and adapted is unique to this region and we owe our rich endemism to this ecosystem which faces threat due to deforestation and construction of dams.

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Table 1. Distribution, abundance, occurrence and size range of freshwater fish species of Tamil Nadu

Table 1. Distribution, abundance, occurrence and size range of freshwater fish species of Tamil Nadu

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
1.	*Anguilla bengalensis* (Gray)	Seram Pambu Vilangu Porivelangu	ENIS	1994 UA	1973 UA	1994 0-1	1973 0-1	1994 A-1	1973 A-1	121 cm. 1973	120+ 1878	1, 6, 9, 11
2.	*Anguilla bicolor* (McClelland)	Vilangu	ENIS	1973 UA	1878 UA	1973 0-1	1878 0-1	1973 A-1	1878 A-1	70 cm. 1973-74	55 cm. 1878	1, 9, 11
3.	*Dayella malabarica* (Day)	Nil	ENI	1994 I	1873	1994 0-1	1973 0-1	1994 A-1	1873 A-1	3.8 cm. 1994	7.5 cm. 1878	1, 5
4.	*Notopterus notopterus* (Pallas)	Ambattam Vazhai, Chinna Vazhai, Cotta Vazhai	ENIS	1977 I	1878	1997 0-3	1878	1997 A-3	1878	36.1 cm. 1973	60 cm. 1878	1, 6, 9, 18, 25, 26, 11
5.	*Megalops cyprinoides* (Brousonet)	Mooran Kendai	ENIS & else where	1973 I	1878	1973 0-3	1878	1973 A-3	1878	9.14 cm. 1973	40 cm. 1878	1, 9, 21, 29
6.	*Chela cachius* Ham.	--	ENIS	1973 R	1878	1973 0-1	1878	1973 A-1	1878	6 cm. 1993	10 cm. 1878	1, 9, 11
7.	*Chela laubuca* (Hamilton)	--	ENIS	1994 R	1878	1994 0-1	1878	1994 A-1	1878	3.5 cm. 1994	9 cm. 1878	1, 9, 11, 14, 15, 16, 21
8.	*Salmostoma acinaces* (Val.)	Chaya Vallaches Vella chae-Kendai	ENI	1973 UA	1878	1973 0-1	1878	1973 A-1	1878	--	15 cm. 1878	1, 9, 11
9.	*Salmostoma clupeoides* (Bloch)	Netteli	ENIS	1996 I	1878	1996 0-3	1878	1996 A-3	1878	12.4 cm. 1996	15 cm 1878	1, 2, 3, 5, 6, 9 11, 14, 15, 16, 25, 26, 29

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
10.	*Salmostoma novacula* (Val.)	Netteli	ENI	1988 UA	1878	1988 0-1	1878	1988 A-2	1878	1988 9.5 cm	1878 12.5	1, 3, 5, 14, 15, 16, 29,11
11.	*Ambly-pharyng-odon microlepis* (Bleeker)	Oori	ENI	1997 I	1878	1997 0-4	1878	1997 A-4	1878	1997 6.5 cm	1878 10 cm	1,2,3,5,6,7,9,11,14 ,15,16,18,21,22,24 ,25,26,27,30, 33
12.	*Ambly-pharyn-godon melettinus* (Val.)	Pachai talai Kendai, Oolares	ENIS	1998 I	1878	1988 0-1	1878	1988 A-3	1878	1988 7.7 cm	1878 8 cm	1,9,11,17
13.	*Barilius bend-elisis* (Ham.)	Vanathi kendai	ENIS	1997 UA	1878	1997 0-1	1878	1997 A-2	1878	1991 11.3 cm	1878 15.5 cm	1, 9, 5, 6, 11, 18, 26, 27
14.	*Barilius gaten-sis* (Val.)	Coores Art-candee	ENI	1997 UA	1878	1997 0-1	1878	1997 A-3	1878	1997 7.8 cm	1878 15 cm	1,9,11,16,27,29,33
15.	*Danio aequipinnatus* (McClelland)	Selai-parav-ai,Van-nathi Podi	ENIS	1997 UA	1878	1997 0-3	1878	1997 A-3	1878	1973 15.2 cm	1878 15 cm	1,2,3,5,6,7,9,11, 14,15,16,17,25, 26,29
16.	*Danio (Brachy-danio) rerio* (Ham.)	------------	ENIS	1994 R	1878	1994 0-1	1878	1994 A-1	1878	1994 2 cm	1878 5 cm	1,11,6
17.	*Danio neilgherriensis* (Day)	Cowlie	ENL	1991 UA	1878	1991 0-1	1878	1991 A-1	1878	1991 6 cm	1878 10 cm	1,11,33
18.	*Esmous danri-cus* (Ham.)	Meesaipar-avai Ovarikend-ai	ENIS	1997 UA	1878	1997 0-1	1878	1997 A-1	1878	1994 7.6 cm	1878 13 cm	1, 5, 6, 7, 21, 14, 15, 16
19.	*Esmous ther-moicus* (Val.)	Meesaipar-avai	ENIS	1996 UA	1878	1996 0-4	1878	1996 A-3	1878	1996 8.6 cm	1878 12.7 cm	1,3,5,6,13,14,15,1 6,17,18,21,22,25,2 6,27,29,33

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
20.	*Horadandia atukorali* Deraniyagala	-------------	ENIS	1996 I	1992	1996 0-1	1992	1996 A-1	1992	1996 1.7 cm	1992 2 cm	11,20
21.	*Rasbora dani-conius* (Ham.)	Ovaree kendai	ENIS	1997 UA	1878	1997 0-4	1878	1997 A-3	1878	1988 8.7 cm	1878 22 cm	1,2,3,4,5,6,7,9,11, 14,15,19,21,22,24, 25,26,29,33
22.	*Rasbora caverii* (Jerdon)	-------------	ENI	1997 I	1973	1997 0-2	1973	1997 A-2	1973	1997 11.0 cm	1973 7 cm	2, 5, 6,7, 8, 11,14, 15, 17, 18, 21
23.	*Barbodes bovanicus* (Day)	------------	ENIL	R 1991	1878	0-1 1991	1878	A-1 1991	1878	8 cm 1991	12.5 cm 1878	1,9,11,16, 33
24.	*Barbodes carnaticus* (Jerdon)	Pouree, Sall-Kendai, Schelle, Pelli Kendai	ENIL	1997 R	1878	1997 0-1	1878	1997 A-1	1878	1996 12.6 cm	1878 12 Kg 1973 23.5 cm	1,9,11,26
25.	*Barbodes sarana sarana* (Ham.)	------------	ENIS	1986	1878	1986 0-1	1878	1986 A-1	1878	1986 8.4 cm	1878 31 cm	1,2,11 juvenile specimen, hence doubtful
26.	*Barbodes sara-na subnasutus* (Val.)	-------------	ENI	1997 UA	1878	1997 0-3	1878	1997 A-2	1878	1997 18.8 cm	1878 26.5 cm	1, 3, 4, 5, 6, 7, 14, 15, 19, 21, 24, 25, 26, 33
27.	*Catla catla* (Ham.)	Thop-pam-eenu, Yamaneri Kendai	TR	1997 I	1878	1997 0-3	1878	1997 A-2	1878	1997 15.5 cm	1878 180 cm	1, 2, 9, 11, 14, 15, 21, 24, 25, 26

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
28.	*Cirrhinus cir-rhosa* (Bloch)	Ven kendai	ENI	1992 UA	1878	1992 0-2	1878	1992 A-2	1878	1992 13.8 cm	1878 45 cm	1,9,7,11, 21
29.	*Cirrhinus mri-gala* (Ham.)	Pudu kendai, Mrigala	TR	1994 I	1878	1994 0-3	1878	1994 A-3	1878	1994 13.8 cm	1878 92 cm	1, 2, 6, 7, 14, 15, 21, 24, 25, 26
30.	*Cirrhinus reba* (Ham.)	Arinjan, Kulla arinjan	ENI	1991 I	1878	1991 0-3	1878	1991 A-3	1878	1991 15 cm	1878 30 cm	1, 5, 6, 7, 16, 21, 24, 25, 33
31.	*Cteno-pharyn-godon idellus* (Val.)	Grass crap (Eng)	Ex.	1992 I	-----	1992 0-2	------	1992 A-2	-----	1992 27.5 cm	1959 86 cm	30,21 (rare in the wild)
32.	*Cyprinus carpio commu-nis* Linnaeus	Scale carp (Eng)	Ex.	1991 I	1939	1991 0-2	1939	1991 A-2	1939	1991 26.0 cm	1939 10 Kg	33,21,2,7, & Anamalai
33.	*Cyprinus carpio specu-laris* Lacapede	Mirror Carp (Eng.)	Ex.	1991 I	1939	1991 0-2	1939	1991 A-2	1939	1991 20.5 cm	1939 10 Kg.	33
34.	*Hypselobar-bus curmuca* (Ham.)	-----	ENI	1997 UA	1878	1997 0-1	1878	1997 A-2	1878	1997 19.5 cm	1878 120 cm	1,11, & Anamalai Hills
35.	*Hypselobarbus dobsoni* (Day)	-----	ENI	1951 R	1878	1951 0-1	1878	1951 A-1	1878	1951 6.9 cm	1878 19 cm	1,11,27 Anamalai
36.	*Hypselobarbus dubius* (Day)	Kozhimeen, Kozhi Arinjan Kendai		ENL	1996 R	1878	1996 0-1	1878	1996 A-2	1878	1996 12.8 cm	1878 25.5 cm
37.	*Hypselobarbus jerdoni* (Day)	-----	ENL	1997 R	1878	1997 0-1	1878	1997 A-1	1878	1997 3.5 cm (juv.)	1878 45 cm	1,9,11, & Anamalai

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
38.	*Hypselobarbus kurali* Menon & Rema Devi	Kurali	ENL	1996 R	1991	1996 0-1	1991	1996 A-1	1991	1996 21.5 cm	1991 35 cm	11, 24 & Anamalai
39.	*Horalabiossa joshuai* Silas	-----	ENL	1992 UA	1953 UA	1992 0-1	1953 0-1	1992 A-2	1953 A-2	1992 9cm	1953 4.9 cm	11,17
40.	*Horalabiossa palaniensis* Rema Devi & Menon	-----	ENL NA	1992 UA	1992 UA	1992 0-1	1992 0-1	1992 A-1	1992 A-1	1992 7.7 cm	1992 7.7 cm	11,26 A
41.	*Labeo ariza* (Ham.)	Coal kendai	ENL	1942	1878	1942	1878	1942	1878	1942 (Hora)	1878 24 cm	1,11,33
42.	*Labeo bata* (Ham.)	Kindameen, Kolarinjak-endai	ENIS	1973 I	1878	1973 0-3	1878	1973 A-3	1878	1973 13.3 cm	1878 61 cm	1,7,9,11,24,33
43.	*Labeo boga* (Ham.)	-- do --	ENIS	1991 I	1878	1991 0-3	1878	1991 A-3	1878	1991 14 cm	1878 30 cm	1,5,7,9,11,21,24
44.	*Labeo boggut* (Sykes)	-------	ENIS	1973 R	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 19 cm	1,9,11
45.	*Labeo calbasu* (Ham.)	Kakka meen Karuppusel Karum Chel	ENIS	I 1996	1878	0-3 1996	1878	A-3 1996	1878	20 cm 1973	1878	1,7,9,11, 21,24,25, 26
46.	*Labeo dero* (Ham.)	-----	ENIS TR	1996 I	1878	1996 0-1	1878	1996 A-1	1878	1986 15.2 cm	1878 30 cm	1,5,11,24
47.	*Labeo fimbriatus* (Bloch)	Gundumani Sel, Sel kendai	ENIS	1995 UA	1878	1995 0-2	1878	1995 A-2	1878	1973 29 cm	1878 45 cm	1,7,9,11, 21,33
48.	*Labeo kontius* (Jerdon)	Currumuzh-i Kendai, Curr-muneekendai	ENIS	1992 R	1878	1992 0-1	1878	1992 A-1	1878	1992 14.5 cm	1878 60 cm	1,9,11,21,33

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
49.	*Labeo pangusia* (Ham.)	-----	ENIS TR	1996 I	1878	1996 0-2	1878	1996 A-2	1878	1996 13.1 cm	1878 60 cm	1, 5, 6, 7, 11, 17, 24, 26
50.	*Labeo potail* (Sykes)	-----	ENI TR	1973 I	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 25.5 cm	1,9,11
51.	*Labeo rohita* (Ham.)	Kannadi Kendai	TR	1996 I	1878	1996 0-3	1878	1996 A-3	1878	1996 18.2 cm	1878 90 cm	1, 2, 7, 14, 15, 21, 25, 17, 26
52.	*Osteobrama cotio cotio* (Ham)	Patta Kunji	ENIS	1973 R	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 15 cm	1,9,11
53.	*Osteobrama neilli* Day	-----	ENL	R	1878		1878		1878		1878 12 cm	1,11
54.	*Osteo-chilichthys brevidorosalis* (Day)	Mean-kendai	ENL	1996 R	1878	1996 0-1	1878	1996 A-1	1878	1996 14.2 cm	1878 15 cm	1,9,11,26
55.	*Osteo-chilichthys nashii* (Day)	-----	ENL	1951 R	1878	1951 0-1	1878	1951 A-1	1878	1951 18 cm	1878 10 cm	1,11
56.	*Puntius amphibius* (Val)	Kulla Kendai	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-2	1878	1995 11 cm	1878 15 cm	1,9,11 in almost all Dists. of T.N.
57.	*Puntius arenatus*	-----	ENI	1997 I	1878	1997 0-1	1878	1997 A-1	1878	1995 5 cm	1878 10 cm	1,2,7,25,(earlies known from one Dist.) only
58.	*Puntius arulius arulius* (Jerdon)	-----	ENL	1996 UA	1878	1996 0-1	1878	1996 A-1	1878	1987 10 cm	1878 10 cm	1,10,11,3 Taxon. ambiguityexists
59.	*Puntius arulius tambraparnei* Silas	-----	ENL	1996 UA	1953	1996 0-1	1953	1996 A-1	1953	1996 9cm	1953 9.2 cm	11,28

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
60.	*Puntius bimaculatus* (Bleeker)	-----	ENIS	1997 I	1878	1997 0-2	1878	1997 A-2	1878	1996 6.0 cm	1878 7.5 cm	1, 11, 17, 18, 21, 25, 26, 27, 33 (known from many dists.)
61.	*Puntius chola* (Ham.)	Kooran kendai	ENIS	1997 UA	1878	1997 0-3	1878	1997 A-3	1878	1992 7.8 cm	1878 12.5 cm	1,9,11, almost all the Dts. Of T.N.
62.	*Puntius, conchonius* (Ham.)	-----	ENIS	1996 UA	1878	1996 0-2	1878	1996 A-1	1878	1996 6 cm	1878 12.5 cm	1,6,9,11, 14,15,21, 26
63.	*Puntius dorsalis* (Jerdon)	Palpooran kendai, Sall kendai	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-3	1878	1996 11 cm	1878 24 cm	1,9,11 Almost all the Dists of Tamil Nadu
64.	*Puntius filamentosus* (Val)	Macchakendai, Sevvali	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-2	1878	1996 12.5 cm	1878 15 cm	1,9,11 Almost all the Dists of Tamil Nadu
65.	*Puntius melanampyx* (Day)	-----	ENI	1997 UA	1878	1997 0-2	1878	1996 A-2	1878	1986 5.7 cm	1878 7.5 cm	1,2,3,11, 16,27,29, 33
66.	*Puntius melanostigma* (Day)	-----	ENI	1991 UA	1878	1991 0-1	1878	1991 A-1	1878	1991 4.8 cm	1878 8 cm	1,11,16,33
67.	*Puntius mudumalaiensis* Menon & Rema Devi	-----	ENL NA	1996 UA	1991	1996 0-1	1991 0-1	1996 A-1	1991 A-1	1996 2.25 m	1991 2.35 m	11,26,33

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
68.	*Puntius parrah* Day	-----	ENI	1991 UA	1878	1991 0-1	1878	1991 A-1	1878	1991 7.6 cm	1878 15 cm	1,9,11,33
69.	*Puntius punc-tatus* Day	-----	ENI	1996 UA	1878	1996 0-2	1878	1996 A-1	1878	1996 3.9 cm	1878 7.5 cm	1,11,17,24
70.	*Puntius shar-mai* Menon & Rema Devi	-----	ENL NA	1996 UA	1992	1996 0-1	1992	1996 A-1	1992	1996 2.5 cm	1992 2.7 cm	6,11
71.	*Puntius so-phore* (Ham.)	Kulla Kendai, Kurum Chelli	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-3	1878	1996 6.3 cm	1878 12.5 cm	1,9,11 Almost all Dists of T.N.
72.	*Puntius ticto* (Ham.)	Pulli Kendai	ENIS	1997 UA	1878	1997 0-3	1878	1997 A-2	1878	1973 7.5 cm	1878 10 cm	1,9,11 Almost all Dists. of T.N.
73.	*Puntius vitta-tus* Day	-----	ENIS	1997 UA	1878	1997 0-3	1878	1997 A-2	1878	1996 3.2 cm	1878 4 cm	1,9,11 Almost all Dists. of T.N.
74.	*Neolissochilus wynaadensis* (Day)	-----	ENI	1991 R	1878	1991 0-1	1878	1991 A-1	1878	1991 2.95 cm	1878 20.5 cm	1,11,33
75.	*Garra gotyla stenorhynchus*	-----	ENI	1996 R	1964	1996 0-1	1964	1996 A-1	1964	1996 5 cm	1964 15.5 cm	6,9,11,17,33
76.	*Garra hugli* Silas	-----	ENL	1972 R	1955	1972 0-1	1955	1972 A-1	1955	1972 6.5 cm	1955 7.7 cm	Recorded only from Palani hills
77.	*Garra kalakadensis* Rema Devi	-----	ENL NA	1992 UA	1992	1992 0-1	1992	1992 A-1	1992	1992	1992 6.9 cm	17, Recorded only from Kalakad

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
78.	*Garra mcClel-landi* (Jerdon)	Kallu Koravai	ENL	1996 UA	1878	1996 0-1	1878	1996 A-1	1878	1996 14.0	1878 17.5	9,11,333 & Ana-malai.
79.	*Garra mullya* (Sykes)	Kallu Koravai	ENI	1996 UA	1964	1996 0-2	1964	1996 A-2	1964	1996 15 cm	1964 17 cm	9,11 almost in all torrential waters.
80.	*Hypopth-thalmichthys molitrix* (Val.)	----	Ex	1992 I	1959	1992 0-2	1959	1992 A-1	1959	1992 27 cm	1959 82 cm	21,25
81.	*Enobarbich-thys maculatus* Day	-----	ENL	-----	1878		1878		1878		1878 3.8 cm	1,11 Extinct?
82.	*Lepidocepha-lus thermalis* (Val.)	Asarat	ENIS	1997 I	1878	1997 0-3	1878	1997 A-3	1878	1997 5.7 cm	1878 8 cm	1,9,11. In almost all Dists. of T.N.
83.	*Bhavania aus-tralis* Jerdon	-----	ENI	1997 R	1878	1997 0-1	1878	1997 A-1	1878	1996 3.5	1878 9 cm	1,17,27,11
84.	*Noemacheilus denisoni* Day	-----	ENI	1996 UA	1878	1996 0-2	1878	1996 A-1	1878	1996 4.7	1878 5 cm	1,2,11,18,26,27,33
85.	*Noemacheilus moreh*	-----	ENI	1878 R		1878 0-2		1878		1987	1878 4.4 cm	1,11
86.	*Noemacheilus monilis* Hora	-----	ENI	1942 R	1921	1942 0-1	1921	1942 A-1	1921	1942	1921 4.8 cm	1921 & 1942 by Hora
87.	*Noemacheilus nilgriensis* Menon	-----	ENL NA	1991 UA	1987	1991 0-1	1987	1991 A-1	1987	1991 5.4 cm	1987 5 cm	11,33

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
88.	*Noemacheilus pulchellus* Day	-----	ENI	1987 R	1878	0-1	1878	A-1	1878	1987	1878 4.6	
89.	*Noemacheilus semiarmatus* Day	-----	ENI	1992 UA	1878	1992 0-1	1878	1992 A-1	1878	1992 4 cm	1878 5.6 cm	1,11,33
90.	*Noemacheilus t. tambraparniiensis* Menon	-----	ENL NA	1987 R		1987 0-1		1987 A-1		1987 5.8		11
91.	*Noemacheilus t. triangularis* Day	-----	ENI	1992 UA	1878	1992 0-1	1878	1992 A-1	1878	1992 6.1	1878 5.8	1,3,11,17,33
92.	*Mystus armatus* (Day)	-----	ENI	1988 UA	1878	1988 0-2	1878	1988 A-1	1878	1988 8 cm	1878 14.5	1,3,11,18,22
93.	*Mystus bleekeri* (Day)	-----	ENIS	1996 I	1878	1996 0-2	1878	1996 A-2	1878	1996 10 cm	1878 13.5	1,5,9,11,22,26,17
94.	*Mystus cavasius* (Ham.)	Cutta vellai keletee Vazhappu keletee	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-2	1878	1996 14.2 cm	1878 45 cm	1,2,5,6,9, 11,14,15, 16,21 & 26
95.	*Mystus gulio* (Ham.)	Uppang keletee	ENIS	1996 UA	1878	1996 0-2	1878	1996 A-2	1878	1996 12 cm	1878 46 cm	1,5,7,917,21,
96.	*Mystus keletius* (Val.)	-----	ENIS	1994 R	1878	1994 0-2	1878	1994 A-1	1878	1994 6.5 cm	1878 10 cm	1,11,21,6
97.	*Mystus malabarious* (jerdon)	-----	ENI	1996 R	1878	1996 0-1	1878	1996 A-1	1878	1996 2.2 cm	1878 15 cm	1,24
98.	*Mystus montanus* (Jerdon)	-----	ENI	1996 UA	1878	1996 0-3	1878	1996 A-3	1878	1996 11.2	1878 15 cm	1, 11, 2, 6, 22, 7, 17, 3, 27, 18

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
99.	*Mystus ocula-tus* (Val)	-----	ENI	1988 UA	1878	1988 0-1	1878	1988 A-1	1878	1988 5 cm	1878 15 cm	1,11,3
100.	*Mystus punc-tatus* (Jerdon)	Setha keletee, Solang keketee	ENI	1973 UA	1878	1973 0-2	1878	1973 A-1	1878	1973	1878 45 cm	1,5,11
101.	*Mystus vitta-tus* (Bloch)	Sonanng keletee, Nattu keletee, Kattai keletee	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-3	1878	1996 11 cm	1878 21 cm	1,9,11,and most districts of T.N
102.	*Aorichthys aor* (Ham.)	Ponnai keletee Nadunthalai keletee Kam-bee Keletee	ENIS	1973 UA	1878	1973 0-3	1878	1973 A-2	1878	1973	1878 90 cm	1,9,11
103.	*Aorichthys seenghala* (Sykes)	Kuruthalai keletee	ENIS	1994 UA	1878	1994 0-2	1878	1994 A-2	1878	1994 26.5	1878 150 cm	1,9,11,25
104.	*Ompok bimac-ulatus* (Bloch)	Chetah-wahlah	ENIS	1996 UA	1878	1996 0-2	1878	1996 A-2	1878	1996 22 cm	1878 45 cm	1,2,7,17,26,33
105.	*Silurus wyn-aadensis* Day	-----	ENI	1996 R	1878	1996 0-1	1878	1996 A-1	1878	1996 24 cm	1878 30 cm	1,11,24,26 Rare
106.	*Wallaco attu* (Bloch & Schneider)	Vazhai	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-2	1878	1986 28 cm	1878 180cm	1,2,26
107.	*Pseudeutropi-us atherinoi-des* (Bloch)	-----	ENIS	1994 UA	1878	1994 0-2	1878	1994 A-1	1878	1994 4 cm	1878 12.5 cm	1,9,11,5,6
108.	*Silonia childre-ni* Sykes	Ponathtee	ENI	1973 (Rare)	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 48 cm	1,9,11 Rare in T.N.

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
109.	*Pangasius pangasius* (Ham.)	Eye keletee	ENIS	1973 (Rare)	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 120 cm	1,9,11 Rare in T.N.
110.	*Glyptothorax madraspata-nam* (Day)	-----	ENI	1973 Rare	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 11.5 cm	1,9,11
111.	*Clarius batrachus* (Linnaeus)	Karuppu thelee	ENIS	1973 R	1878	1973 0-2	1878	1973 A-1	1878	1973	1878 4.5 cm	1,9,11
112.	*Hetero-penustes fossilis* (Bloch)	Thelee	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-2	1878	1996 20.5 cm	1878 30 cm	1, 9,11, 21, 7, 17, 3, 24, 25, 18
113.	*Salmo gaird-neri gairdneri* Richardson	-----	EX.	1991 R	1909	1991 0-1	1909	1991 A-1	1909	1991 9.6 cm	1909 38 cm	33 only in W.G-Nil-giris.
114.	*Xenentodon cancila* (Ham.)	Vellai Mooral, Kokku meen	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-1	1878	1996 23.5 cm	1878 30 cm	1,5,724,9,11,17
115.	*Aplocheilus blochi* (Arnold)	Pachaimun-nd-akenni	ENIS	1996 UA	1911	1996 0-3	1911	1996 A-3	1911	1966 2.5 cm	1911 5.0 cm	11, 14, 15, 6, 21, 5, 22, 7, 17, 3, 24,
116.	*Aplocheilus lineatus* (Va-lenciennes)	Munda Kanni	ENIS	1995 UA	1878	1995 0-2	1878	1995 A-1	1878	1955 2.9 cm	1878 4 cm	1, 11, 6, 7, 21, 14, 15, 17, 3,
117.	*Oryzias melastigma* (McClelland)	Munda- Kanni	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-3	1878	1996 2.9 cm	1878 4 cm	1,11 Almost all dists. of TN.
118.	*Gambusia af-finis patruelis* (Baird and Girard)	-----	EX	1996 I	1852	1996 0-3	1852	1996 A-3	1852	1996 3.6 cm	1852 6.2 cm	- do -

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
119.	*Poecilia (Lebistes) reticulata* Peters	-----	EX	1996 UA	1908	1996 0-2	1908	1996 A-2	1908	1996 2.8 cm	1908 6 cm	7,17,14,15,21
120.	*Channa marulius* (Ham.)	Puveral, Coaree Veralavu-ree	ENIS	1996 R	1878	1996 0-1	1878	1996 A-1	1878	1996 37.5 cm	1878 120 cm	1,9,11,26
121.	*Channa orientalis* (Bloch & Schneider)	Manian Koravai	ENIS	1996 I	1878	1996 0-3	1878	1996 A-2	1878	1996 10.5	1878 32.5 cm	1,9,11 Almost all dists. of TN.
122.	*Channa punctatus* (Bloch)	Para koravai, Koravai	ENIS	1996 I	1878	1996 0-3	1878	1996 A-2	1878	1996 13.5 cm	1878 31 cm	1,9,11 in all dists. of TN
123.	*Channa striatus* (Bloch)	Viral Wrahl	ENIS	1996 I	1878	1996 0-3	1878	1996 A-2	1878	1996 19.5 cm	1878 30 cm	1, 2, 5, 7, 9, 11, 18, 14, 15, 21, 25
124.	*Ambassis commersoni* Cuvier	-----	ENIS	1992 UA	1878	1992 0-2	1878	1992 A-1	1878	1992 8.9 cm	1878 15 cm	1,11,3,21
125.	*Chanda nama* (Ham.)	Kakkachee	ENIS	1996 UA	1878	1996 0-2	1878	1996 A-2	1878	1996 8 cm	1878 10 cm	1, 9, 11, 5, 6, 21, 26
126.	*Pseudambassis ranga* (Ham.)	Kannadi-meen	ENIS	1992 UA	1878	1992 0-2	1878	1992 A-2	1878	1992 6.4 cm	1878 7 cm	1,9,11,21
127.	*Etroplus maculatus* (Bloch)	Selle kasu, Puradi	ENIS	1996 R	1878	1996 0-3	1878	1996 A-2	1878	1996 7 cm	1878 8 cm	1,9,11 and in the plains of TN.
128.	*Etroplus suratensis* (Bloch)	Seththa kendai	ENIS	1995 UA	1878	1995 0-2	1878	1995 A-1	1878	1991 10 cm	1878 19 cm	1, 9, 11, 3, 7, 21, 22, 33, Estuarin
129.	*Oreochromis mossambica* (Peters)	Tilapia, Jelebi meen	EX	1996 I	1952	1996 0-4	1952	1996 A-4	1952	1996 23.8 cm	1952 36 cm	Found in almost all dists. of TN. In hills to plains.

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
130.	*Oreochromis niloticus* Hasselquist	Tilapia	EX	1992		1992 0-1		1992 A-1		1992 16.5 cm	46 cm	
131.	*Liza parsia* (Ham.)	Madavai	ENIS	1992 UA	1878	1992 0-2	1878	1992 A-1	1878	1992 15 cm	1878 25 cm	1,5,3,9,21, Estuarine, rare in inland waters
132.	*Liza subviridis* (Val.)		ENIS	1992 UA	1878	1992 0-1	1878	1992 A-1	1878	1992 7 cm	1878 21 cm	1,21 - do -
133.	*Liza tade* (Forskal)		ENIS	1973 UA	1878	1973 0-1	1878	1973 A-1	1878	1973	1878 47 cm	1,9 - do -
134.	*Mugil cephalus* (Linnaeus)	Madavai	ENIS	1995 UA	1878	1995 0-1	1878	1995 A-1	1878	1995 17.0 cm	1878 90 cm	1,3,6,7,21,Estuarine
135.	*Rhinomugil corsula* (Ham.)	Muzhugu Meen	TR	1986 UA	1878	1986 0-2	1878	1986 A-1	1878	1986 17.0 cm	1878 45 cm	1,2,5,9,11,26,cultured in dists. of TN.
136.	*Awaous grammepomus* (Bleeker)	-----	ENIS	1988 UA	1878	1988 0-1	1878	1988 A-1	1878	1988 8 cm	1878 13 cm	1,3, Rare in inland waters of T.N.
137.	*Glossogobius giuris* (Ham.)	Uluvai	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-2	1878	1989 19.0 cm	1878 30 cm	1,9,11 and in almost all dists. of T.N.
138.	*Anabas testudineus* (Bloch)	Panai yeri Kendai	ENIS	1996 UA	1878	1996 0-3	1878	1996 A-1	1878	1989 10.5 cm	1878 22 cm	1,5,9,11,14,15
139.	*Psedosphronemus cupanus* (Val.)	Moran kendai	ENIS	1995 UA	1878	1995 0-3	1878	1995 A-1	1878	1988 4.5 cm	1878 7.5 cm	1, 5, 6, 9, 11, 14, 15, 17,

Sl. No.	Speceis	Local Name (Tamil)	End Ex.	Distribution		Occurrence		Abundance		Max size		Ref. and Remarks
				Present	Past	Present	Past	Present	Past	Present	Past	
140.	*Colisa fasciata* (Schneider)	-----	ENIS	1996 R	1878	1996 0-2	1878	1996 A-1	1878	1996 3.9	1878 12 cm	21, 24
141.	*Macrognathus aral* (Bloch)	Mona-arel	ENIS	1996 UA	1878	1996 0-2	1878	1996 A-1	1878	1996 24.5 cm	1878 38 cm	1, 9, 11, 5, 6, 14, 15, 21, 26, 18
142.	*Macrognathus guentheri* (Day)		ENI	1988 UA	1878	1988 0-1	1878	1988 A-1	1878	1988 7.2 cm	1878 23 cm	1,3,11
143.	*Macrognathus pancalus* (Ham.)	Aral	ENIS	1995 UA	1878	1995 0-1	1878	1995 A-1	1878	1995 13.2 cm	1878 18 cm	1,14,15,11
144.	*Mastacembelus armatus* (Lacepede)	Aral Kalaaral	ENIS	1995 UA	1878	1995 0-3	1878	1955 A-2	1878	1995 34 cm	1878 61 cm	1, 5, 6, 9, 11, 17, 26, 33.

End. Endemic; **ENIS** – endemic to Indian sub-continent., **ENI** – Endemic to India; **EN WG** – Endemic to Western Ghats; **ENL** – Endemic to Tamil Nadu
Ex. Exotic ; **TR**- Transplanted from other parts of India. **Distribution:-** UA – Unaltered from past records.
Occurrence: - **0-1** Sporadic to stray or scanty ; **0-2** common; **0-3** very common.
Abundance: - **A-1** very rare; **A-2** rare; **A-3** Abundant.

Status of Fish Fauna in Karnataka

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Introduction

The geographical area of Karnataka State is 192,204 sq.km., which is about 5.85% of the total area of the Indian Union. The State lies between the lattitudes 11° 2' North and 18 °12' North and longitudes 73°48' East and 78°18' East. It has a coastal line of 320 kms, from Uttara Kannada in the north to the Dakshina Kannada in the south. The area of the State, on geographical and climatic considerations, can be broadly classified into four principal regions, i.e. the coastal, the Malnad, the northern maidan and southern maidan (Fig.1).

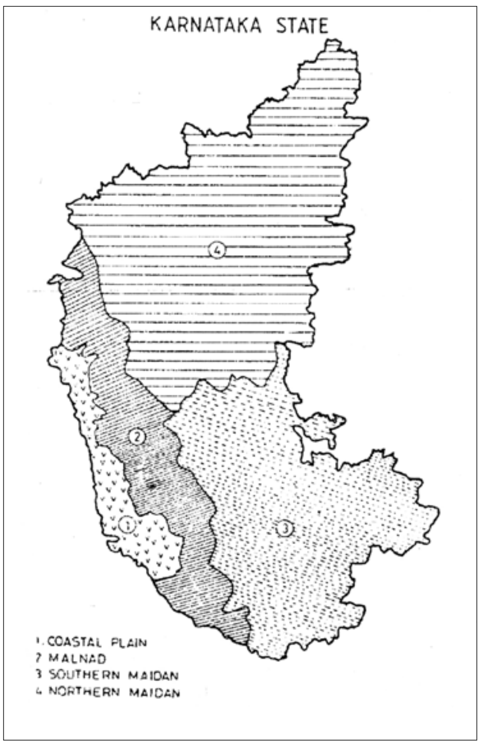

Fig.1. Karnataka State: Physiographic Regions

The climate and rainfall of a region largely determine the land use pattern and the faunistic elements available in the aquatic eco-system. On account of varying topography and elevations, the climate in the State varies from cool humid (in the Western Ghats area) to hot semi-arid (in nothern maidan). Agumbe in Shimoga District receives the highest rainfall (709 cms.), while the minimum in Bijapur District. More than 50.0% of the annual rainfall is received during the south-west monsoon but a significant proportion of it in the interior Karnataka occurs also during the north-east monsoon as well as the pre-monsoon period of March to May.

Among the states in peninsular India, Karnataka has representatives of all types of variations in topography, high mountains, plateaus, residual hills and coastal plains. A series of cross sections drawn from west to east across the western ghats exhibit generally a narrow coastal plain followed to the east by small and short plateaus at different altitudes, then suddenly rising upto great heights, exposing a long escarpment in most of the sections facing west. Then follows the gentle east and east-northeast sloping plateau. The major part of this is called Mysore Plateau in the south and northern part is known as Karnataka Plateau. The latter is relatively more dissected by northeast and east flowing rivers. Then further to the east, is step-like or gradual sloping ground merging with the Tamil Nadu upland in the south and Hyderabad upland in the north. Thus, with a coastline in the west and high mountains in the midwest, the state exhibits landforms of all types within an area of 192,204 sq.kms.

Major Water Resources

The drainage map of Karnataka presents the following conspicuous elements (Fig.2). With the Western Ghats (Sahyadri) forming a major water divide, there are short and swift flowing rivers in the west into the Arabian Sea. Notable

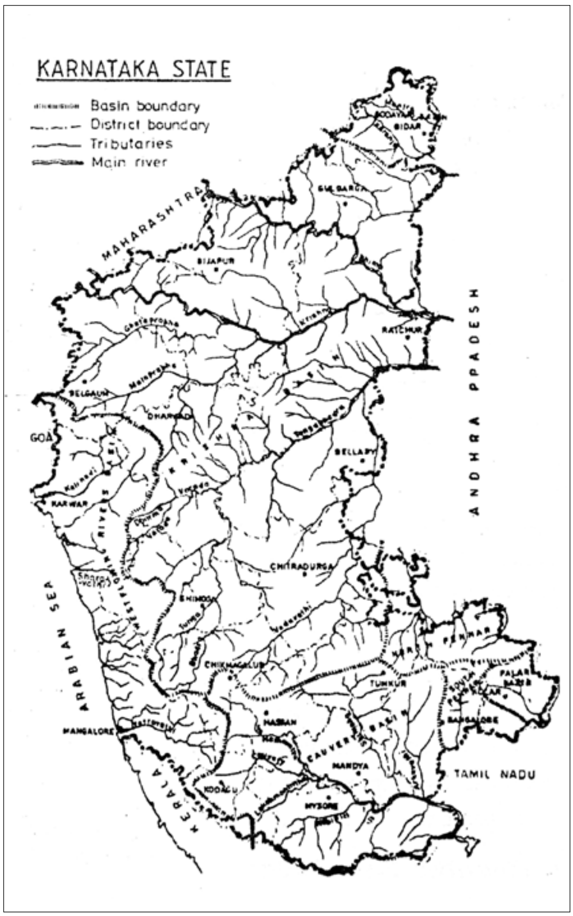

Fig.2. River Basins in Karnataka

among them are Sharavati (128 kms.), Kalinadi (184 kms.), Netravati (96 kms.), Bedti/Gangavalli (161 kms.), Aganashini (121 kms.) and Chakra (72kms.).

To the east of the major divide, flow the river Krishna, Tungabhadra and Cauvery. Two tributaries of Godavary namely, Manjira and Karanja are within the state. A major part of the upstream of Krishna and its tributaries flow through northern Karnataka, some due north-east to pass through Andhra Pradesh before joining the Bay of Bengal. The main tributaries are Bhima, Ghataprabha, Malaprabha and Tungabhadra. Over 60% of the state is served by the Krishna's catchment and tributaries especially in nothern and central districts. The Cauvery river in the south raising over Kodagu, flows down the eastern slopes of the ghats, meanders gently over the Mysore plateau, crosses it over a couple of walls, passess through Tamil Nadu upland before joining the Bay of Bengal. A few rivers on the Mysore plateau in the southern part of Karnataka (Uttara Pinakini, Dakshina Pinakini and Palar), are seasonally active, originate around Nandi Hills and pass through Andhra Pradesh or Tamil Nadu to join sea.

The data given in Table-1 on some of the above rivers points to the fact that more water flows through the short west-flowing rivers than all the rivers

Table-1: Rivers of Karnataka

No.	Name of the basin	Length in the State (km.)	Catchment area in (sq. km.)	Percentage of the total area	Estimated average flowing M. Cum.
1.	Krishna	483	1,13,271	59.06	27,500
2.	Cauvery	553	47,883	24.96	11,900
3.	Godavary	———	4,405	2.30	1,400
4.	West-Flowing Rivers	1170	26,214	13.68	57,000

(Source: Karanataka State Gazeteer, Part-I, 1982, page-38.)

flowing east within the State.

There are 65 reservoirs built across the rivers Krishna, Godavari, Cauvery and west-flowing river basins within the State of Karnataka whose utility is multi-porpse. These impoundements have a total waterspread area of 2,22,641 ha. The construction of the dams has affected the fish fauna to a considerable extent, especially, the migratory ones. The list of reservoirs along with the waterspread area is presented in Table 2.

Freshwater Fish Fauna

Depending on their ecology, fishes are adapted to various environmental conditions in the water. Some have excellent hydro-dynamic characteristics enabling them to

Table 2 : Reservoirs, drainage, location and the waterspread area in Karnataka.

Sl. No	Reservoir	River	Drainage	District	Water spread area (Ha.)
1.	Ambigola	Salurhalla	Krishna	Shimoga	446.00
2.	Anjanapur	Kumudvathi	Krishna	Shimoga	674.00
3.	Bachanki	Bachanki	West flowing river	Uttara Kannada	203.00
4.	Bethamangala	Palar	Cauvery	Kolar	317.00
5.	Bhadra	Bhadra	Krishna	Chikkamagalur	10870.00
6.	Bommanahalli	Kalinadi	West flowing river	Uttara Kannada	1836.00
7.	Borinkanva	Suvarnamukhi	Cauvery	Tumkur	1330.00
8.	Byramangala	Vrishbhavati	Cauvery	Bangalore Rural	437.00
9.	Chakra	Chakra	West flowing river	Shimoga	1228.00
10.	Chamrajasagar	Arkavathi	Cauvery	Bangalore Urban	1762.00
11.	Chandrampalli	Bhima	Krishna	Gulbarga	331.00
12.	Chikkahandigola	Ghattaprabha	Krishna	Dharwar	140.00
13.	Dharma	Dharma	West flowing river	Uttara Kannada	646.00
14.	Dhupdal	Ghattaprabha	Krishna	Belgaum	1515.00
15.	Gajnaur	Tunga	Krishna	Shimoga	1200.00
16.	Gayathri	Suvarnamukhi	Krishna	Chitradurga	780.00
17.	Gundal	Gundal	Cauvery	Mysore	96.00
18.	Hegaribammanahalli	Chikkahagari	Krishna	Bellary	1209.00
19.	Harangi	Harangi	Cauvery	Coorg	1886.00
20.	Hattikoni	Bhima	Krishna	Gulbarga	120.00
21.	Hemavathi	Hemavathi	Cauvery	Hassan	8000.00
22.	Hessarghatta	Arkavathi	Cauvery	Bangalore Urban	1160.00
23.	Hidkal	Chattaprabha	Krishna	Belgaum	7800.00
24.	Hubical Forebay	Varahi	West flowing river	Shimoga	906.00
25.	Jambadahalla	Jambadahalla	Krishna	Chikkamagalur	3890.00
26.	Kabbini	Kabbini	Cauvery	Mysore	6020.00
27.	Kanakanala	Kanakanala	Krishna	Raichur	360.00

Sl. No	Reservoir	River	Drainage	District	Waterspread area (Ha.)
28.	Karanja	Karanja	Krishna	Bidar	2000.00
29.	Kanwa	Kanwa	Cauvery	Bangalore Rural	440.00
30.	Krishnraja-sagar	Cauvery	Cauvery	Mandya	12924.00
31.	Kyragunda	Savehakalu	West flowing river	Shimoga	943.00
32.	Linganmakki	Sharavathi	West flowing river	Shimoga	40500.00
33.	Malagi	Dharma	West flowing river	Uttara Kannada	680.00
34.	Mallaghatta	Mallaghatta	Cauvery	Tumkur	240.00
35.	Mallaprabha/Renuka	Mallaprabha	Krishna	Belgaum	13440.00
36.	Mangala	Nagini	Cauvery	Tumkur	320.00
37.	Mane	Varahi	West flowing river	Shimoga	5573.00
38.	Markandeya	Palar	Cauvery	Kolar	145.00
39.	Markenhalli	Shimsha	Cauvery	Tumkur	1337.00
40.	Moti Talav	Loka Pavani	Cauvery	Mandya	518.00
41.	Muchgundi	Ghattaprabha	Krishna	Bijapur	494.00
42.	Mullamari	Mullamari	Krishna	Bidar	277.00
43.	Narayanpur (Basavasagar)	Krishna	Krishna	Bijapur	13048.00
44.	Nagathana	Nagathana	Krishna	Bijapur	128.00
45.	Narihalla	Tungabhadra	Krishna	Bellary	280.00
46.	Neersagar	Gangavalli	West flowing river	Dharwar	480.00
47.	Netkal	Cauvery	Cauvery	Mandya	95.00
48.	Nugu	Nugu	Cauvery	Mysore	1413.00
49.	Pick-up	Varahi	West flowing river	Shimoga	525.00
50.	Rakaskoppa	Markandaya	Krishna	Belgaum	360.00
51.	Savehakalu	Savehakalu	West flowing river	Shimoga	940.00
52.	Shantisagar	Hirohalla & Soppinahalla	Krishna	Shimoga	2488.00
53.	Shivasamudram	Cauvery	Cauvery	Mandya	320.00
54.	Supa	Kalinadi	West flowing river	Uttara Kannada	12900.00

Sl. No	Reservoir	River	Drainage	District	Waterspread area (Ha.)
55.	Suvarnavathi	Suvarnavathi	Cauvery	Mysore	130.00
56.	Talakalale	Sharavathi	West flowing river	Shimoga	932.00
57.	Taraka	Taraka	Cauvery	Mysore	1080.00
58.	Tattihalla	Tattihalla	West flowing river	Uttara Kannada	2700.00
59.	Teetha	Dayamangala	Cauvery	Tumkur	200.00
60.	Thippaganahhali	Tributary to Pennar	Cauvery	Kolar	300.00
61.	Tungabhadra	Tungabhadra	Krishna	Bellary	37814.00
62.	Upper Kannari	Kannari	West flowing river	Uttara Kannada	249.00
63.	Vanivilas Sagar	Vedavathi	Krishna	Chitradurga	8640.00
64.	Vote Halla	Vote Halla	Cauvery	Hassan	690.00
65.	Yegachi	Yegachi	Cauvery	Hassan	1938.00
66.	Karanja	Karanja	Godavari	Bidar	5000.00
			Total waterspread area		**2,27,643. 00ha**

swim at high speed while others lead a relatively less mobile mode of life.

Systematic classification of fish species recorded in the basins of Cauvery, Krishna, Godavari and West-flowing rivers of the State, are given in Tables 3, 4, 5 and 6 respectively.

In Krishna river basin, 101 fish species belonging to 19 families and 5 Orders were recorded which includes the introduced Indian major carp and the exotic carps. Majority of the fish species listed in this river basin are endemic to the system. Of these, 20 species are 'under threat and 8 fish species have not been recorded in the recent past.

Cauvery river basin has recorded 96 fish species under 23 families and 8 orders including the introduced Indian gangetic carps and the exotic carps. The non-predatory catfish-*Pangasius pangasius* which was available earlier, now has become exceedingly rare. Ten fish species are considered under threat from this eco-system.

Sixty fish species belonging to 13 families and 4 orders were recorded in the riverine system of Godavari basin in the State which also includes the introduced Gangetic major carp and the exotic carp. Ot these, only

Table 3. Distribution, occurrence, abundance and size range of fishes of Cauvery River, Karnataka

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
1.	*Notopterus notopterus* (Pallas)	Chappali	ENIS	1997 R	1963	0-1	0-4	A-1	A-4	250 mm	
2	*Megalops cyprinoides* (Broussonet)	Alanku	ENIS	1993 R		0-2		A-2		350 mm	
3.	*Anguilla bengalensis* bengalensis (Gray)	Hanchu	ENIS	1997 R	1964 UA	0-1	0-4	A-1	A-4	3.8 kg.	4.5 kg.
4.	*Anguilla bicolor* bicolor McClelland	Hanchu	ENIS	1997 R	1964 UA	0-1	0-4	A-1	A-4	3.8 kg.	4.5 kg.
5.	*Chanos chanos* Forsskal	Hoo-meenu	ENIS	1994 R	1968	0-1	0-2	A-1	A-2	3 kg.	
6.	*Catla catla* (Hamilton-Bu-chanan)	Catla	ENIS W.G	1997 I	1958 Introd-uced	0-4	0-2	A-4	A-2	8 kg.	50.0 kg.
7.	*Cirrhinus cirrhosa* (Bloch)	Dodda-Arja	ENI W.G	1998		0-1	0-2	A-1	0-2	2 kg.	
8.	*Cirrhinus mrigla* (Hamil-ton-Buchanan)	Mrigal	ENIS	1997 R	1958 Introd-uced	0-1	0-3	A-1	A-3	10 kg.	2.5 kg.
9.	*Cirrhinus reba* (Hamil-ton-Buchanan)	Arja	ENIS	1997 R	1963	0-1 1997	0-3 1963	A-3 1963	A-7 1997	0.10 kg.	0.2 kg.
10.	*Ctenopharyngodon idellus* (Valenciennes)	Hullu-gende	EX	1997 In-trod-uced	-----	0-1	-----	A-1	-----	1200 mm 20 kg.	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
11.	*Cyprinus carpio Linnaeus*	Common carp	EX	1997 I	1949 Introd-uced	0-4	0-1	A-4	A-1	800 mm 25 kg.	
12.	*Hypselobarbus dubius* (Day)	Koorlu	ENI W.G	1975 R	1959	0	0-2	A-0	A-2	250 mm	
13.	*Hypselobarbus micropogon* (Valenciennes)	Chitta-Koorlu	ENI W.G	1997 R		0-1	0-3	A-1	A-3		
14.	*Labeo ariza* (Hamilton-Buchanan)	Panjali	ENI W.G	1997 R	1964	0-1	0-2	A-1	A-2		
15.	*Labeo bata* (Hamilton-Buchanan)	Bata	ENIS	1997 R	1963 I	0-1	0-3	A-1	A-3	1.3 kg.	
16.	*Labeo boggut* (Sykes)	Gubali	ENIS	1997 R	1963 I	0-1	0-3	A-1	A-3	200 mm	
17.	*Labeo calbasu* (Hamilton-Buchanan)	Karae-kolasa	ENIS	- do -	1964	0-2	0-3	A-2	A-3	900 mm	
18.	*Labeo fimbriatus* (Bloch)	Kem-meenu	ENI W.G	1997 UA	1963	0-1	0-1	A-1	A-1	910 mm	
19.	*Labeo kontius* (Jerdon)	Moogi-halale	ENI W.G	1972 R		0-1		A-1		610 mm	
20.	*Labeo porcellus* (Heckel)	Kaki-dindu	ENI W.G	1997 R	1963 UA	0-0.5	0-1	A-0.5	A-1	0.2 kg.	
21.	*Labeo potail* (Sykes)	Hoobali	ENI W.G	- do -	1963 I	0-1	0-2	A-1	A-2	0.2 kg.	
22.	*Labeo rohita* (Hamilton-Buchanan)	Rohu	ENIS	1997 I	1958 Introd-uced	0-2	0-1	A-2	A-1	35 kg.	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
23.	*Neolissochilus wynaadensis*	Katli	ENI W.G	1990 R	1958 Basis	0-1	0-2	A-1	A-2	5 kg.	
24.	*Osteochilus (Osteochilichthys) brevidorsalis* Day	Kantaka	ENI W.G	1998		0-1		A-1		150 mm	
25.	*Osteochilus (Osteochilichthys) thomassi* (Day)	Kantaka	ENI W.G			0-1		A-1		320 mm	
26.	*Puntius arulius* (Jerdon)	Kempu-puthri	ENI W.G	1997 R		0-2	0-3	A-2	A-3	120 mm	
27.	*Puntius bovanicus* (Day)	Bovani	ENI W.G		1958		0-1		A-1	120 mm	
28.	*Puntius carnaticus* (Jerdon)	Koracha	ENI W.G	1998	1958	0-1	0-2	A-1	A-2	12 kg.	
29.	*Puntius cauveriensis* (Hora)	Cauvery meenu	ENI W.G	1990 R		0-0	0-1	A-0	A-1	74 mm	
30.	*Puntius chola* (Hamilton-Buchanan)	Dodda karsae	ENI	1997 UA	1964 Basis	0-2	0-2	A-2	A-2	90 mm	
31.	*Puntius conchonius* (Hamilton-Buchanan)	Chikka-karsae	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	140 mm	
32.	*Puntius dorsalis* (Jerdon)	Moothi-gende	ENIS	1997 R	1964 Basis	0-1	0-2	A-1	A-2	240 mm	
33.	*Puntius fasciatus* (Jerdon)	Karsae	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	60 mm	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
34.	*Puntius filamentosus* (Valenciennes)	Kijan	ENI W.G	- do -	- do -	0-2	0-3	A-2	A-3	175 mm	
35.	*Puntius melanostigma* (Day)	Pakke	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	80 mm	
36.	*Puntius narayani* (Hora)	Pakke	ENIW.G	- do -	- do -	0-2	0-3	A-2	A-3	83 mm	
37.	*Puntius parrah* (Day)	Pakke	ENI	- do -	- do -	0	0-1	A-0	A-1	150 mm	
38.	*Puntius puckelli* (Day)	Pakke	ENI	- do -	- do -	0-1	0-4	A-1	A-4	70 mm	
39.	*Puntius sarana subnasutus* (Hamilton-Buchanan)	Gende	ENI	- do -	1963 Basis	0-1	0-3	A-1	A-3	310 mm	
40.	*Puntius sophore* (Hamil-ton-Buchanan)	Gudda-pakke	ENIS	- do -	1964 Basis	0-1	0-4	A-1	A-4	130 mm	
41.	*Puntius ticto* (Hamilton-Bu-chanan)	Naya-paisa	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	100 mm	
42.	*Puntius vittatus* Day	Putta-pakke	ENIS	- do -	- do -	0-2	0-3	A-2	A-3	32 mm	
43.	*Tor khudree* (Sykes)	Bili-meenu	ENIW.G	1997 R	1964 Basis	0-2	0-3	A-2	A-3	22.5 kg.	
44.	*Tor mussullah* (Sykes)	Bili-meenu	ENI W.G		1950 Basis					1500 mm 90 kg.	
45.	*Salmostoma acinaces* (Valenciennes)	Malli	ENI	1997 R	1964 Basis	0-1	0-2	A-1	A-2	150 mm	
46.	*Salmostoma clupeoides* (Bloch)	Malli	ENI	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
47.	*Salmostoma horai* Silas	Malli	ENI	- do -	- do -	0-1	0-2	A-1	A-2	100 mm	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
48.	*Salmostoma phulo* (Hamil-ton-Buchanan)	Malli	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	120 mm	
49.	*Salmostoma untrachi* (Day)	Malli	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	120 mm	
50.	*Hypophthalmichthys molitrix* (Valenciennes)	Belli-gende	EX	- do -	1970	0-0.5	0-1	A-0.5	A-1		
51.	*Hypophthalmichthys nobilis* (Richardson)	Belli-gende	EX	1990 R	1989 Introd-uced	0	0-1	A-0	A-1		
52.	*Amblypharyngodon mola* (Hamilton-Buchanan)	Enapu-pakke	ENIS	1997 UA	1964 Basis	0-2	0-2	A-2	A-2	75 mm	
53.	*Barilius gatensis* (Valen-ciennes)	Agasa-gatti	ENI	1997 R	1963	0-1	0-2	A-1	A-2	150 mm	
54.	*Brachydanio rerio* (Hamil-ton-Buchanan)	Patte-meenu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	40 mm	
55.	*Danio aequipinnatus* (McClelland)	Bidrele-saslu	ENIS	1997 UA	1963 Basis	0-1	0-1	A-1	A-1	95 mm	
56.	*Esomus danricus* (Hamil-ton-Buchanan)	Meese-pakke	ENIS	1997 R	1964 Basis	0-1	0-2	A-1	A-2	80 mm	
57.	*Parluciosoma daniconius* (Hamilton-Buchanan)	Golai	ENIS	- do -	- do -	0-2	0-3	A-2	A-3	130 mm	
58.	*Rasbora caverii* (Jerdon)	Saslu	ENI W.G	- do -	- do -	0-2	0-3	A-2	A-3	70 mm	
59.	*Garra gotyla stenorhyn-chus* (Jerdon)	Kallu-korava	ENI W.G	- do -	1963	0-2	0-3	A-2	A-3	150 mm	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
60.	*Garra mcClellandi* (Jerdon)	Kallu-korava	ENI W.G	- do -	- do -	0-2	0-3	A-2	A-3	175 mm	
61.	*Garra mullya* (Sykes)	Kallu-korava	ENI	- do -	- do -	0-1	0-2	A-1	A-2	170 mm	
62.	*Balitora mysorensis* Hora	Kallu-korava	ENI	1997 R	1995	0-0	0-1	A-0	A-1	50 mm	
63.	*Nemacheilus bhimachari* Hora	Murangi	ENI W.G	- do -		0-0	0-1	A-0	A-1		
64.	*Nemacheilus kodaguensis* (Menon)	Murangi	ENI W.G	1997 UA		0-1	0-1	A-1	A-1	36 mm	
65.	*Nemacheilus pulchellus* Day	Murangi	ENI W.G	1997		0-1	0-1	A-1	A-1	46 mm	
66.	*Nemacheilus semiarmatus* Day	Murangi	ENI W.G							56 mm	
67.	*Lepidocephalus thermalis* (Valenciennes)	Murangi	ENI W.G	1997 R	1964 Basis	0-1	0-2	A-1	A-2	80 mm	
68.	*Mystus cavasius* (Hamil-ton-Buchanan)	Girlu	ENI	1997 UA	1963 Basis	0-2	0-2	A-2	A-2	280 mm	
69.	*Mystus malabaricus* (Jerdon)	Girlu	ENI W.G	1997 R	- do -	0-1	0-2	A-1	A-2	150 mm	
70.	*Mystus punctatus* (Jerdon)	Haddu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	450 mm	
71.	*Mystus vittatus* (Bloch)	Chittu	ENI	1997 UA	- do -	0-2	0-2	A-2	A-2	175 mm	
72.	*Ompok bimaculatus* (Bloch)	Godalae	ENIS	1997 R	1963 Basis	0-1	0-2	A-1	A-2	430 mm	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
73.	*Ompok pabda* (Hamilton-Buchanan)	Godalae	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	175 mm	
74.	*Ompok malabaricus* (Hamilton-Buchanan)	Godalae	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	550 mm	
75.	*Wallago attu* (Scheider)	Balae	ENIS	- do -	- do -	0	0-1	A-0	A-1	45 kg.	
76.	*Silonia childreni* (Sykes)	Bili-halathi	ENIS	- do -	- do -	0	0-1	A-0	A-1	60 mm	
77.	*Pangasius pangasius* (Hamilton-Buchanan)	Pangas	ENIS	1997		0	0-3	A-0	A-3	1500 mm	
78.	*Bagarius yarrellii* Sykes	Kurdi	ENIS	1997 R	1963 Basis	0	0-1	A-0	A-1	135 kg.	
79.	*Glyptothorax lonah* (Sykes)	Kanta	ENI W.G	- do -	- do -	0	0-1	A-0	A-1	150 mm	
80.	*Nangra itchkeea* (Sykes)	Urigan	ENI W.G	- do -	- do -	0	0-1	A-0	A-1	76 mm	
81.	*Heteropneustes fossilis* (Bloch)	Chaelu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	150 mm	
82.	*Aplocheilus lineatus* (Valenciennes)	Moogu-malli	ENIS	1997 R	1969 Basis	0-1	0-2	A-1	A-2	100 mm	
83.	*Gambusia affinis* (Baird & Girard)	Gambusia	EX	- do -	- do -	0-1	0-4	A-1	A-4	62 mm	
84.	*Pseudambassis ranga* (Hamilton-Buchanan)	Bachanike	ENI	- do -	- do -	0-1	0-2	A-1	A-2	70 mm	
85.	*Pristopepis marginata* Jerdon	Reppe	ENI	- do -		0	0-1	A-0	A-1	150 mm	

Sl. No	Species	Local Name (Kannada)	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
86.	*Etroplus maculatus* (Bloch)	Matak	ENI	- do -	1963					70mm	
87.	*Etroplus suratensia* (Bloch)	Eli-meenu	ENI	- do -	- do -	0-1	0-2	A-1	A-2	400 mm	
88.	*Oreochromis mossambica* (Peters)	Jilebi	EX	1997 I	1958 Introd-uced	0-4	0-2	A-4	A-2	0.3 kg.	
89.	*Rhinomugil corsula* (Hamil-ton-Buchanan)	Mala	ENIS	1993 R	1958 Basis	0-1	0-2	A-1	A-2		
90.	*Glossogobius giuris* (Ham-ilton-Buchanan)	Bhangi-sidda	ENIS	1997 R	1965	0-1	0-3	A-1	A-3	300 mm	
91.	*Osphronemus goramy* (Hamilton-Buchanan)	Gouramy	EX							2.5 kg.	
92.	*Channa marulius* (Hamil-ton-Buchanan)	Avalu	ENIS	1997 R	1965 Basis	0-1	0-3	A-1	A-3	12 kg.	
93.	*Channa orientalis* Bloch & Schneider	Korava	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	130 mm	
94.	*Channa punctatus* (Bloch)	Korava	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	0.25 kg.	
95.	*Channa striatus* (Bloch)	Kutchuu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	3 kg.	
96.	*Macrognathus aral* (Bloch & Schneider)	Haavu-meenu	ENIS	- do -	- do -	0	0-1	A-0	A-1	2 kg.	
97.	*Mastacembelus armatus* (Lacepede)	Haavu-meenu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	2 kg.	

Table 4. Distribution, occurrence, abundance and size range of fishes of Krishna River, Karnataka

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
1.	*Notopterus notopterus* (Pallas)	Chappali / chamari	ENIS	1997 R	1965 UA	0-1	0-4	A-1	A-4	250 mm	
2.	*Anguilla bengalensis bengalensis* (Gray)	Hanchu mennu	ENIS	1997 R	1964 UA	0-1	0-4	A-1	A-4	1200 mm	
3.	*Catla catla* (Hamilton-Buchanan)	Catla	ENIS	1997	1939 1st Introd-uction	0-4	0-2	A-4	A-2	8 kg.	50 kg.
4.	*Cirrhinus fulungee* (Sykes)	Arja	ENI W.G	1997 R	1974 Stray	0-1	0-2	A-1	A-2	150 mm	220 mm
5.	*Cirrhinus mrigala* (Hamilton-Buchanan)	Mrigal	ENIS	1997 R	1958 Stray	0-1	0-3	A-1	A-3	0.67 kg.	2.5 kg.
6.	*Cirrhinus reba* (Hamilton-Buchanan)	Arja	ENIS	1997 R	1963 UA	0-1	0-3	A-1	A-3	100 mm	200 mm
7.	*Ctenopharyngodon idellus* (Valenciennes)	Hullu	EX	1997		0-1		A-1		12 kg.	
8.	*Cyprinus carpio* Linnaeus	Common carp	EX	1997 I	1947 introd-uced	0-1	0-4	A-1	A-4	25 kg.	
9.	*Hypselobarbus kolus* (Sykes)	Kolasa	ENI W.G	1997 R	1963 I	0-1	0-4	A-1	A-4	1000 mm	
10	*Hypselobarbus pulchellus* (Day)	Haragi	ENI W.G	1997 R	1969	0-1	0-4	A-1	A-4	8 kg.	
11.	*Labeo bata* (Hamilton-Buchanan)	Bata	ENIS	1997 R	1963 I	0-1	0-3	A-1	A-3	610 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
12.	*Labeo boga* (Hamil-ton-Buchanan)	Boga	ENIS	1997 R	1963 I	0-1	0-3	A-1	A-3	300 mm	
13.	*Labeo boggut* (Sykes)	Gubali	ENIS	1997 R	1963 I	0-1	0-3	A-1	A-2	200 mm	
14.	*Labeo calbasu* (Hamil-ton-Buchanan)	Karas kolasa	ENIS	1997 R	1964 I	0-2	0-3	A-2	A-3	25 kg.	
15.	*Labeo pangusia* (Hamil-ton-Buchanan)	Pungus	ENIS	1997 R	1973 UA	0-1	0-1	A-1	A-1	600 mm	
16.	*Labeo fimbriatus* (Bloch)	Kem-meenu	ENI W.G	1997 UA	1964 UA					25 kg.	
17.	*Labeo porcellus* (Heckel)	Kaki-dindu	ENI W.G	1997 UA	1964 UA	0-1	0-1	A-1	A-1	300 mm	
18.	*Labeo potail* (Sykes)	Hoobali	ENI	1997 R	1963 I	0-1	0-2	A-1	A-2	300 mm	
19.	*Labeo rohita* (Hamil-ton-Buchanan)	Rohu	ENIS	1997 I	1958 Introd-uced	0-2	0-1	A-2	A-1	35 kg.	
20.	*Oreichthys cosuatis* (Hamilton-Buchanan)	Khavli	ENIS	1997 R	1960 I	0-1	0-2	A-1	A-2	80 mm	
21.	*Osteobrama cotio penin-sularis* Silas	Kambalgi	ENI							120 mm	
22.	*Osteobrama neilli* (Day)	Koona	ENI	1997 R	1960 I	0-1	0-2	A-1	A-2	120 mm	
23.	*Osteobrama vigorsii*	Parake	ENI							200 mm	
24.	*Osteochilus (Osteochilit-hys) thomassi* (Day)	Bagasi								320 mm	
25.	*Puntius amphibius* (Valen-ciennes)	Pakke meenu	ENIS	1997 UA	1964 Basis	0-2	0-2	A-2	A-2	200 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
26.	*Puntius chola* (Hamil-ton-Buchanan)	Dodda karse	ENIS	1997 UA	1964 Basis	0-2	0-2	A-2	A-2	90 mm	
27.	*Puntius conchonius* (Hamilton-Buchanan)	Karse	ENIS	1997 R	1964 Basis	0-1	0-2	A-1	A-2	140 mm	
28.	*Puntius dorsalis* (Jerdon)	Mooti- gende	ENIS	1997 R	1964 Basis	0-1	0-2	A-1	A-2	240 mm	
29.	*Puntius guganio* (Hamil-ton-Buchanan)	Karse	ENIS	1997 R	1964 Basis	0-1	0-2	A-1	A-2	80 mm	
30.	*Puntius sarana sarana* (Hamilton-Buchanan)	Gende	ENIS	1997 UA	1964 UA	0-2	0-2	A-2	A-2	310 mm	
31.	*Puntius sophore* (Hamil-ton-Buchanan)	Gudde- pakke	ENIS	1997 UA	1964 UA	0-2	0-2	A-2	A-2	130 mm	
32.	*Puntius ticto* (Hamil-ton-Buchanan)	Naya paisa	ENIS	1997 R	1964	0-1	0-3	A-1	A-3	100 mm	
33.	*Puntius vittatus* (Day)	Karse	ENIS	1997 UA	1964	0-1	0-2	A-1	A-2	60 mm	
34.	*Rohtee ogilbii* Sykes	Sipri	ENIS	1997 R	1964	0-1	0-2	A-1	A-2	150 mm	
35.	*Schismatorhynchus (Nukta) nukta* (Sykes)	Mukarti	ENI	1997 R	1964	0-1	0-2	A-1	A-2	300 mm	
36.	*Thynnichthys sandkhol* (Sykes)	Banga	ENIS	1997 Not found	1963	0	0-2	A-0	A-2	460 mm	
37.	*Tor khudree* (Sykes)	Bili-meenu	ENIS	1997 R	1964 Abun-dant	0-2	0-3	A-2	A-3	22.5 kg.	
38.	*Tor mussullah* (Sykes)	Bili-meenu	ENIS	1997 Not found		0-1	0-1	A-1	A-1	20 kg.	
39.	*Chela cachius* (Hamil-ton-Buchanan)	Barle	ENIS	1997 R	1964 Abun-dant	0-1	0-3	A-1	A-3	60 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
40.	*Chela laubuca* (Hamilton-Buchanan)	Barle	ENIS	1997 R	1964 Abundant	0-1	0-2	A-1	A-2	55 mm	
41.	*Salmostoma acinaces* (Valenciennes)	Bilchi	ENIS	1997 R	1964	0-1	0-2	A-1	A-2	150 mm	
42.	*Salmostoma clupeoides* (Bloch)	Chalaka	ENIS	1997 R	1964	0-1	0-2	A-1	A-2	150 mm	
43.	*Salmostoma novacula* (Valenciennes)	Bilchi	ENIS	1997 R	1964	0-1	0-2	A-1	A-2	125 mm	
44.	*Salmostoma phulo* (Hamilton-Buchanan)	Orali	ENIS	1997 R	1964	0-1	0-2	A-1	A-2	120 mm	
45.	*Hypophthalmichthys molitrix* (Valenciennes)	Belli gende	EX	1997 R	1970 Introd-uced	0-0.5	0-1	A-0.5	A-1		
46.	*Amblypharyngodon mola* (Hamilton-Buchanan)	Enapu	ENIS	1974 UA	1964	0-2	0-2	A-2	A-2	75 mm	
47.	*Aspidoparia morar* (Hamilton-Buchanan)	Ola-halale	ENIS	1997 R	1963	0-1	0-1	A-1	A-1		
48.	*Barilius barila* (Hamilton-Buchanan)	Chalake	ENIS	1997 R	1963	0-1	0-1	A-1	A-1	100 mm	
49.	*Barilius barna* (Hamilton-Buchanan)	Kere kalyani	ENIS	1997 R	1963	0-1	0-1	A-1	A-1	75 mm	
50.	*Barilius bendelisis* (Hamilton-Buchanan)	Bilchi	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	155 mm	
51.	*Danio aequipinnatus* (McClelland)	Bidar-yele-saslu	ENIS	1997	1963	0-1	0-1	A-1	A-1	150 mm	
52.	*Esomus barbatus* (Jerdon)	Meese pakke	ENI	1997 R	1963	0-0	0-1	A-0	A-1		

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
53.	*Esomus danricus* (Hamilton-Buchanan)	Meese	ENIS	1997 R	1964	0-1	0-2	A-1	A-2	80 mm	
54.	*Parluciosoma daniconius* (Hamilton-Buchanan)	Golai	ENIS	1997 R	1964	0-2	0-3	A-2	A-3	150 mm	
55.	*Rasbora rasbora* (Hamilton-Buchanan)	Saslu	ENIS	1997 R	1964	0-0	0-1	A-0	A-1	85 mm	
56.	*Garra bicornuta* Rao	Mukurti	ENIS	1997 R	1964	0-0	0-1	A-0	A-1	100 mm	
57.	*Garra gotyla stenorhyunchus* (Jerdon)	Kallu korava	ENI	1997 R	1963	0-2	0-3	A-2	A-3	150 mm	
58.	*Balitora mysorensis* Hora	Kalla	ENI W.G	1997 R	1995	0	0-1	A-0	A-1	70 mm	
59.	*Bhavania australis* (Jerdon)	Kalla	ENI W.G	1997 R	1995	0	0-1	A-0	A-1	90 mm	
60.	*Nemacheilus anguilla* Annandale	Murangi	ENI W.G	1997 R	1964	0-1	0-2	A-1	A-2	50 mm	
61.	*Nemacheilus evezardi* Day	Murangi	ENI W.G	1997 R	1964	0-1	0-2	A-1	A-2	38 mm	
62.	*Nemacheilus rubidipinnis* (Blyth)	Murangi	ENI W.G	1997 R	1964	0-1	0-2	A-1	A-2	80 mm	
63.	*Nemacheilus rueppelli* (Sykes)	Murangi	ENI W.G	1967 R	1964	0-1	0-2	A-1	A-2	74 mm	
64.	*Nemacheilus striatus* (Day)	Murangi	ENI W.G	1967 UA	1964	0-2	0-2	A-2	A-2	50 mm	
65.	*Lepidocephalus thermalis (Valenciennes)*	Hunase	ENI W.G	1997 R	1964	0-1	0-2	A-1	A-2	80 mm	
66.	*Botia striatus Rao*	Handi	ENI	1997 R	1964	0-1	0-2	A-1	A-2	95 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
67.	*Aorichthys aor* (Hamilton-Bachanan)	Kappu suragi	ENIS	1997 R	1963	0-1	0-4	A-1	A-4	1500 mm	
68.	*Aorichthys seenghala* (Sykes)	Bili suragi	ENIS	1997 R	1963	0-1	0-4	A-1	A-4	1800 mm	
69.	*Mystus cavasius* (Hamilton-Bachanan)	Girlu	ENI	1997 R	1963	0-1	0-2	A-1	A-2	280 mm	
70.	*Mystus krishnensis* Ramakrishniah	Haddu	ENI	1997 R	1963	0-1	0-2	A-1	A-2	58 mm	
71.	*Mystus vittatus* (Bloch)	Chittu	ENIS	1997 UA	1963	0-2	0-2	A-2	A-2	175 mm	
72.	*Rita kuturnee* (Sykes)	Gokra	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	200 mm	
73.	*Rita pavimentata* (Valenciennes)	Kechalu	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	220 mm	
74.	*Ompok bimaculatus* (Bloch)	Godalae	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	430 mm	
75.	*Ompok pabda* (Hamilton-Bachanan)	Godalae	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	240 mm	
76.	*Wallago attu* (Schneider)	Baalae	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	45 mm	
77.	*Eutropiichthys goongwaree* (Sykes)	Halathi	ENIS	1997 R	1963	0	0-1	A-0	A-1	640 mm	
78.	*Eutropiichthys vacha* (Hamilton-Bachanan)	Halathi	ENIS	1997 R	1965	0	0-1	A-0	A-1	1.35 kg.	
79.	*Neotropius khavalchor* Kulkarni	Ili-meenu	ENIS	1997 R	1963	0	0-1	A-0	A-1	150 mm	
80.	*Proeutropiichthys taakree taakree* (Sykes)	Halathi	ENIS	1997 R	1963	0	0-1	A-0	A-1	400 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
81.	*Silonia childreni* (Sykes)	Bili halathi	ENIS	1997 R	1963	0	0-1	A-0	A-1	4.5 kg.	
82.	*Amblyceps mangois* (Hamilton-Buchanan)	Chikka	ENIS	1997 R	1963	0	0-1	A-0	A-1	125 mm	
83.	*Bagarius yarrellii* Sykes	Kurudi	ENIS	1997 R	1963	0	0-1	A-0	A-1	135 kg.	
84.	*Glyptothorax lonah* Sykes	Bande-girlu	ENI	1997 R	1963	0	0-1	A-0	A-1	150 mm	
85.	*Glyptothorax trewavasae* Hora	Bande-girlu	ENIS	1997 R	1963	0	0-1	A-0	A-1	140 mm	
86.	*Nangra itchkeea* (Sykes)	Bande-girlu			1963	0	0-1	A-0	A-1	125 mm	
87.	*Heteropneustes fossilis* (Bloch)	Chaelu	ENIS	1997 R	1963	0-1	0-3	A-1	A-3	300 mm	
88.	*Xenontodon cancila* (Hamilton-Buchanan)	Kokkare	ENIS	1997 R	1969	0-1	0-2	A-1	A-2	300 mm	
89.	*Aplocheilus lineatus* (Valenciennes)	Moogu-malli	ENIS	1997 R	1969	0-1	0-2	A-1	A-2	100 mm	
90.	*Chanda nama Hamil-ton*-Buchanan	Bachanike meenu	ENIS	1997 R	1969	0-1	0-2	A-1	A-2	110 mm	
91.	*Pseudambassis ranga* (Hamilton-Buchanan)	Bachanike meenu	ENIS	1997 R	1969	0-1	0-2	A-1	A-2	70 mm	
92.	*Etroplus maculatus* (Bloch)	Matak	ENIS	1997 R	1969	0-1	0-2	A-1	A-2	80 mm	
93.	*Etroplus suratensis* (Bloch)	Elimeenu	ENIS	1997 R	1963	0-1	0-2	A-1	A-2	400 mm	
94.	*Oreochromis mossambica* (Peters)	Jilebi	EX	1997 I	1958	0-4	0-1	A-4	A-1	210 mm	
95.	*Glossogobius giuris* (Hamilton-Buchanan)	Bhangi-sidda	ENIS	1997 R	1965	0-1	0-3	A-1	A-3	300 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
96.	*Macropodus cupanus* (Valenciennes)	Champarke	ENIS	1997 R		0-1	0-2	A-1	A-2	75 mm	
97.	*Channa marulius* (Hamil-ton-Bachanan)	Avalu	ENIS	1997 R	1965	0-1	0-3	A-1	A-3	12 kg.	
98.	*Channa punctatus* (Bloch)	Korava	ENIS	1997 R	1965	0-1	0-3	A-1	A-3	310 g.	
99.	*Channa striatus* (Bloch)	Kuchhu	ENIS	1997 R	1965	0-1	0-3	A-1	A-3	2.5 kg.	
100	*Macrognathus pancalus* (Hamilton-Buchanan)	Havu-meenu	ENIS	1997 R	1965	0	0-1	A-0	A-1	700 mm	
101	*Mastacembelus armatus* (Lacepede)	Havu-meenu	ENIS	1997 R	1965	0-1	0-2	A-1	A-2	2 kg.	

Table 5. Distribution, occurrence, abundance and size range of fishes of Godavari River, Karnataka

Sl. No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
1.	*Notopterus notopterus* (Pallas)	Chappali chamari	ENIS	1997 R	1965 Basis	0-1	0-4	A-1	A-4	250 mm	
2.	*Catla catla* (Hamilton-Buchanan)	Catla	ENIS	1997 I	1939 In-trod-uced	0-4	0-2 1958	A-4	A-2	50 kg.	
3.	*Cirrhinus mrigala* (Hamilton-Buchanan)	Mrigala	ENIS	1997 I	- do -	0-1	0-3	A-1	A-3	25 kg.	
4.	*Cirrhinus reba* (Hamilton-Buchanan)	Arja	ENIS	1997	1963 UA	0-1	0-3	A	A-3	100 g.	
5.	*Cyprinus carpio* Linnaeus	Common carp	EX	1997 I	1947 In-trod-uced	0-4	0-1	A-4	A-1	25 kg.	
6.	*Hypselobarbus kolus* (Sykes)	Kolasa	ENI	1997 R	1968 I	0-1	0-4	A-1	A-4	1 kg.	
7.	*Labeo bata* (Hamilton-Buchanan)	Bata	ENIS	1997 R	1963 I	0-1	0-4	A-1	A-4	1 kg.	
8.	*Labeo calbasu* (Hamilton-Buchanan)	Karae kolasa	ENIS	1997 R	1964 I	0-2	0-3	A-2	A-3	25 kg.	
9.	*Labeo fimbriatus* (Bloch)	Kem-meenu	ENI	- do -	- do -	0-2	0-3	A-2	A-3	25 kg.	
10.	*Labeo potail* (Sykes)	Hoobali	ENI	- do -	1963 I	0-1	0-2	A-1	A-2	300 mm	
11.	*Labeo rohita* (Hamilton-Buchanan)	Rohu	ENIS	- do -	1958 In-trod-uced	0-2	0-1	A-2	A-1	25 kg.	
12.	*Osteobrama belangeri* Valenciennes	Kambalgi	ENIS	- do -	1960 I	0-1	0-2	A-1	A-2	380 mm	
13.	*Osteobrama cotio cunma* (Day)	Parake	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	0.15 kg.	

Sl. No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
14.	*Osteobrama cotio peninsularis* Silas	Parake	ENI	- do -	- do -	0-1	0-2	A-1	A-2		
15.	*Osteobrama dayi* (Hora & Misra)	Koera	ENI	- do -	- do -	0-1	0-2	A-1	A-2	300 mm	
16.	*Osteobrama vigorsii* (Sykes)	Parake	ENIS	1997 R	1960 I	0-1	0-2	A-1	A-2	230 mm	
17.	*Ostechilus (Ostechilichthys) godavariensis* Rao	Keeti	ENI	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
18.	*Puntius chola* (Hamilton-Bachanan)	Dodda karse	ENIS	1997 UA	1964	0-2	0-2	A-2	A-2	90 mm	
19.	*Puntius dorsalis* Jerdon	Mooti gende	ENIS	1997 R	- do -	0-1	0-2	A-1	A-2	240 mm	
20.	*Puntius sarana sarana* (Hamilton-Buchanan)	Gende	ENIS	- do -	- do -	0-2	0-2	A-2	A-2	310 mm	
21.	*Puntius sophore* (Hamilton-Buchanan)	Gudde pakke	ENIS	- do -	- do -	0-2	0-2	A-2	A-2	130 mm	
22.	*Puntius ticto* (Hamilton-Buchanan)	Naya paisa	ENIS	- do -	- do -					100 mm	
23.	*Rohtee ogilbii* Sykes	Bipsi	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
24.	*Thynnichthys sandkhol* (Sykes)	Banga	ENI	- do -	1963	0	0-2	A-0	A-2	460 mm	
25.	*Tor khudree* Sykes	Bili meenu	ENI	1997 R	1964	0-2	0-3	A-2	A-3	22.5 kg.	
26.	*Tor mussullah* Sykes	Bili meenu	ENI	- do -	- do -	0	0-1	A-0	A-1	90 kg.	
27.	*Salmostoma clupeoides* Bloch	Malli meenu	ENI	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
28.	*Salmostoma novacula* (Valenciennes)	Malli meenu	ENI	- do -	- do -	0-1	0-2	A-1	A-2	125 mm	

Sl. No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
29.	*Salmostoma phulo* (Hamilton-Buchanan)	Malli meenu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	120 mm	
30.	*Amblypharyngodon mola* (Hamilton-Buchanan)	Enapu	ENIS	1997 UA	- do -	0-2	0-2	A-2	A-2	75 mm	
31.	*Barilius bendelisis* (Hamilton-Buchanan)	Pilcha	ENIS	1997 R	1969	0-1	0-2	A-1	A-2	155 mm	
32.	*Danio aequipinnatus* (McClelland)	Bidrele-saslu	ENIS	1997 UA	1963	0-1	0-1	A-1	A-1	150 mm	
33.	*Danio devario* (Hamilton-Buchanan)	Bidrelga	ENIS	- do -	- do -	0-1	0-1	A-1	A-1	100 mm	
34.	*Danio fraseri* Hora	Bidrele-saslu	ENI W.G	- do -	- do -	0-1	0-1	A-1	A-1	100 mm	
35.	*Esomus danricus* (Hamilton-Buchanan)	Meese-pakke	ENI	1997 UA	1964	0-1	0-1	A-1	A-1	80 mm	
36.	*Parluciosoma daniconius* (Hamilton-Buchanan)	Golai	ENIS	- do -	- do -	0-2	0-2	A-2	A-2	120 mm	
37.	*Parluciosoma labiosa* Mukerji	Kolkane	ENIS	1997 R	- do -	0-2	0-3	A-2	A-3	85 mm	
38.	*Garra gotyla stenorhynchus* (Jerdon)	Kallu-korava	ENIS	- do -	1963	0-2	0-3	A-2	A-3	150 mm	
39.	*Garra mullya* (Sykes)	Kallu-korava	ENIS	- do -	- do -	0-2	0-3	A-2	A-3	170 mm	
40.	*Parapsilorhynchus prateri* Hora & Misra	Kallu-korava	ENIS	- do -	- do -	0-1	0-1	A-1	A-1	110 mm	
41.	*Nemacheilus evezardi* (Day)	Murangi	ENI W.G	- do -	1964	0-1	0-2	A-1	A-2	38 mm	

Sl. No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
42.	*Aorichthys aor* (Hamil-ton-Buachanan)	Kappu-suragi	ENIS	- do -	1963	0-1	0-4	A-1	A-4	1500 mm	
43.	*Aorichthys seenghala* (Sykes)	Bili-suragi	ENIS	- do -	- do -	0-1	0-4	A-1	A-4	1800 mm	
44.	*Mystus cavasius* (Hamil-ton-Buchanan)	Girlu	ENI	1997 R	1963	0-1	0-2	A-1	A-2	200 mm	
45.	*Rita kuturnee* (Sykes)	Gokra	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	200 mm	
46.	*Rita pavimentata* (Valen-ciennes)	Kechhalu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	220 mm	
47.	*Ompok bimaculatus* (Bloch)	Godalae	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	430 mm	
48.	*Wallago attu* (Schneider)	Baalae	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	45 kg.	
49.	*Proeutropiichthys taakree taakree* (Sykes)	Halati	ENIS	- do -	- do -	0	0-1	A-0	A-1	400 mm	
50.	*Silonia childreni* (Sykes)	Bili-halati	ENIS	- do -	- do -	0	0-1	A-0	A-1	45 kg.	
51.	*Glyptothorax lonah* (Sykes)	Kanta	ENIS	- do -	- do -	0	0-1	A-0	A-1	400 mm	
52.	*Clarias dussumieri* (Lin-naeus)	Anae-meenu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	1 kg.	
53.	*Heteropneustes fossilis* (Bloch)	Chaelu	ENIS	1997 R	1963 basis	0-1	0-3	A-1	A-3	0.4 kg.	
54.	*Chanda nama* (Hamil-ton-Buchanan)	Bachanike meenu	ENIS	- do -	1969	0-1	0-2	A-1	A-2	110 mm	

Sl. No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
55.	*Pseudambassis ranga* (Hamilton-Buchanan)	Bachanike	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	70 mm	
56.	*Oreochromis mossambica* (Peters)	Jilebi	EX	- do -	1958	0-4	0-1	A-4	A-1	0.3 kg.	
57.	*Glossogobius giuris* (Hamil-ton-Buchanan)	Bhangi sidda	ENIS	- do -	1965	0-1	0-3	A-1	A-3	0.15 kg.	
58.	*Channa marulius* (Hamil-ton-Bachanan)	Avalu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	12 kg.	
59.	*Channa striatus* (Bloch)	Kuchhu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	2.5 kg.	
60.	*Mastacembelus armatus* (lacepede)	Haavu-meenu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	2 kg.	

Table 6. Distribution, occurrence, abundance and size range of fishes of Western Ghats Rivers, Karnataka

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
1.	*Megalops cyprinoides* (Broussonet)	Alanku	ENIS	1993		0-2		A-2		1 kg.	
2.	*Anguilla bengalensis* bengalensis (Gray)	Hanchu menu	ENIS	1997 R	1964 UA	0-1	0-4	A-1	A-4	4.500 kg.	
3.	*Chanos chanos* (Forsskal)	Hoo- meenu	ENIS	1994 R	1968 UA	0-1	0-2	A-1	A-2	5 kg.	
4.	*Catla catla* (Hamilton-Buchanan)	Catla	ENIS	1997 I	1958 Introd-uced	0-4	0-2	A-4	A-2	50 kg.	
5.	*Cirrhinus mrigala* (Hamilton-Buchanan)	Mrigal	ENIS	1997 R	- do -	0-1	0-3 1962	A-1	A-3	25 kg.	
6.	*Cirrhinus reba* (Hamilton-Buchanan)	Arja	ENIS	1997	1963 UA	0-1	0-3	A-1	A-3	700 mm	
7.	*Cyprinus carpio* Linnaeus	Common carp	EX	1997 I	1947 Introe-uced	0-4	0-1	A-4	A-1	25 kg.	
8.	*Hypselobarbus curmuca* (Hamilton-Buchanan)	Koracha	ENI W.G	1997 R	1963 I	0-1	0-3	A-1	A-3	1200 mm	
9.	*Hypselobarbus kolus* (Sykes)	Kolasa	ENIS W.G	- do -	- do -	0-1	0-4	A-1	A-4	300 mm	
10.	*Hypselobarbus pulchellus* (Day)	Haragi	ENIS W.G	- do -	1969	0-1	0-4	A-1	A-4	8 kg.	
11.	*Hypselobarbus thomassi* (Day)	Thomassi	ENI W.G	- do -	1963 Basis	0	0-2	A-0	A-2	30 kg.	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
12.	*Labeo ariza* (Hamilton-Buchanan)	Panjali	ENI W.G	1997	1963					1.3 kg.	
13.	*Labeo bata* (Hamilton-Buchanan)	Bata	ENIS W.G	1997 R	1963 I	0-1	0-3	A-1	A-3	3 kg.	
14.	*Labeo calbasu* (Hamilton-Buchanan)	Karae-kolasa	ENIS	- do -	1964	0-2	0-3	A-2	A-3	25 kg.	
15.	*Labeo fimbriatus* (Bloch)	Kem-meenu	ENI W.G	- do -	1963 Basis	0	0-1	A-0	A-1	25 kg.	
16.	*Labeo nigrescens* Day	Mulvel	ENI	- do -	- do -	0	0-1	A-0	A-1	3.5 kg.	
17.	*Labeo rohita* (Hamilton-Buchanan)	Rohu	ENIS	- do - I	1958 Introd-uced	0-1	0-2	A-1	A-2	35 kg.	
18.	*Neolissochilus wynaadensis* (McClelland)	Bili-meenu	ENI W.G	1990 R	1958 Basis	0-1	0-2	A-1	A-2	5 kg.	
19.	*Osteochilus* (Kantaka) *brevidorsalis* (Day)	Keeli	EN W.G							150 mm	
20.	*Osteochilus (Osteochilichthys) nashi* (Day)	Ogari	ENI W.G							180 mm	
21.	*Puntius amphibius* (Valenciennes)	Pakke	ENIS	1997 UA	1964 Basis	0-2	0-2	A-2	A-2	200 mm	
22.	*Puntius chola* (Hamilton-Buchanan)	Dodda-karse	ENIS	- do -	- do -	0-2	0-2	A-2	A-2	90 mm	
23.	*Puntius conchonius* (Hamilton-Buchanan)	Karse	ENIS	1997 R	- do -	0-1	0-2	A-1	A-2	140 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
24.	*Puntius fasciatus* (Jerdon)	Gid- pakke	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	60 mm	
25.	*Puntius filamentosus* (Valenciennes)	Kijan	ENI W.G	- do -	- do -	0-2	0-3	A-2	A-3		
26.	*Puntius guganio* (Hamilton-Buchanan)	Gid-pakke	ENIS	1997	1964	0-1	0-2	A-1	A-2	80 mm	
27.	*Puntius puckelli* Day	Mooru-pakke	ENIS	- do -	- do -	0-1	0-4	A-1	A-4		
28.	P*untius sahyadriensis* Silas	Gende	ENI W.G	- do -	1964 Basis	0-1	0-2	A-1	A-2	70 mm	
29.	*Puntius sarana subnasutus* (Hamilton-Buchanan)	Gende	ENIS	1997 UA	- do -	0-2	0-2	A-2	A-2	310 mm	
30.	*Puntius sophore* (Hamilton-Buchanan)	Gud-pakke	ENIS	- do -	- do -	0-2	0-2	A-2	A-2	120 mm	
31.	*Puntius ticto* (Hamilton-Buchanan)	Naya-paisa	ENIS	- do -R	- do -	0-1	0-3	A-1	A-3	100 mm	
32.	*Puntius vittatus* Day	Karse	ENIS	1997 R	- do -	0-2	0-2	A-2	A-2	60 mm	
33.	*Tor khudree* (Sykes)	Bili-meenu	ENI W.G	1997 R	1964 Abundant	0-2	0-3	A-2	A-3	22.5 kg.	
34.	*Chela cachius* (Hamilton-Buchanan)	Borle	ENIS	1997	1963 Abundant	0-1	0-3	A-1	A-3	60 mm	
35.	*Chela laubuca* (Hamilton-Buchanan)	Malli	ENIS	- do -	1963 Basis	0-1	0-2	A-1	A-2	55 mm	
36.	*Salmostoma acinaces* (Valencinnes)	Malli	ENIS	- do - R	1964	0-1	0-3	A-1	A-3	160 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
37.	*Salmostoma boopis* Day	Malli	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	120 mm	
38.	*Salmostoma clupeoides* (Bloch)	Malli	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
39.	*Salmostoma untrachi* (Day)	Malli	ENIS	- do -	- do -	0-1	0-2	A-1	A-2		
40.	*Hypophthalmichthys molitrix* (Valencinnes)	Belli-gende	EX	- do -	1970	0-0.5	0-1	A-0.5	A-1		
41.	*Amblypharyngodon melettinus* (Valencinnes)	Enapu-pakke	ENIS	- do -	1964 Basis	0-1	0-2	A-1	A-2	80 mm	
42.	*Amblypharyngodon mola* (Hamilton-Buchanan)	Enapu-pakke	ENIS	1997 UA	- do -	0-2	0-2	A-2	A-2	75 mm	
43.	*Barilius bakeri* Day	Bilcha	ENI W.G	1997 R	1969 Basis	0-1	0-2	A-1	A-2	150 mm	
44.	*Barilius bendelisis* (Hamilton-Buchanan)	Bilcha	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	155 mm	
45.	*Barilius canarensis* (Jerdon)	Bilcha	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
46.	*Danio aequipinnatus* (McClelland)	Bidrele-saslu	ENIS	1997 UA	1963 Basis	0-1	0-1	A-1	A-1	150 mm	
47.	*Esomus danricus* (Hamilton-Buchanan)	Meese-pakke	ENIS	1997 R	1964 Basis	0-1	0-2	A-1	A-2	80 mm	
48.	*Parluciosoma daniconius* (Hamilton-Buchanan)	Golai	ENIS	- do -	- do -	0-2	0-3	A-2	A-3	120 mm	
49.	*Garra gotyla stenorhynchus* (Jerdon)	Kallu-korava	ENIS	- do -	1963 Basis	0-2	0-3	A-2	A-3	150 mm	
50.	*Garra hughi* Silas	Kallu-korava	ENIS W.G	1997	1964 Basis	0-2	0-3	A-2	A-3	75 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
51.	*Nemacheilus denisoni denisoni* Day	Murangi	EN W.G	- do -	- do -	0-1	0-2	A-1	A-2	50 mm	
52.	*Nemacheilus evazardi* Day	Murangi	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	38 mm	
53.	*Nemacheilus guentheri* Day	Murangi	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	56 mm	
54.	*Nemacheilus kodaguensis* Menon	Murangi	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	36 mm	
55.	*Nemacheilus moreh* (Sykes)	Murangi	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	44 mm	
56.	*Nemacheilus sriatus* Day	Murangi	ENI W.G	1997 UA	- do -	0-2	0-2	A-2	A-2	50 mm	
57.	*Lepidocephalus thermalis* (Valenciennes)	Murangi	ENI W.G	1997 R	- do -	0-1	0-2	A-1	A-2	80 mm	
58.	*Mystus cavasius* (Hamil-ton-Buchanan)	Girlu	ENIW.G	- do -	1963 Basis	0-1	0-2	A-1	A-2	280 mm	
59.	*Mystus gulio* (Hamilton-Bu-chanan)	Chinkada	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	400 mm	
60.	*Mystus malabaricus* (Jerdon)	Girlu	ENI W.G	1997 R	1963 Basis	0-1	0-2	A-1	A-2	150 mm	
61.	*Mystus montanus* (Jerdon)	Girlu	ENI	- do -	- do -	0-1	0-2	A-1	A-2	150 mm	
62.	*Mystus vittatus* (Bloch)	Chittu- girlu	ENIS	1997 UA	- do -	0-2	0-2	A-2	A-2	175 mm	
63.	*Ompok bimaculatus* (Bloch)	Godalae	ENIS	1997 R	- do -	0-1	0-2	A-1	A-2	430 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
64.	*Ompok malabaricus* (Jerdon)	Godalae	ENI W.G	- do -	- do -	0-1	0-2	A-1	A-2	510 mm	
65.	*Ompok pabda*	Godalae	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	240 mm	
66.	*Wallago attu* (Schneider)	Balae	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	45 mm	
67.	*Clarias dussumieri* Valenciennes	Anae-meenu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	750 mm	
68.	*Hyphoramphus limbatus* (Valenciennes)	Surali-kandai	ENIS	1995 R	1960 Basis	0-1	0-3	A-1	A-3	0.2 kg.	
69.	*Strongylura strongylura* (Van Hasselt)	Surali	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	400 mm	
70.	*Xenontodon cancila* (Hamilton-Buchanan)	Konti	ENIS	1997 R	1969 Basis	0-1	0-2	A-1	A-2	300 mm	
71.	*Oryzias melastigma* (McClelland)	Saslu	ENIS	- do -	1963 Basis	0-1	0-2	A-1	A-2	40 mm	
72.	*Horaichthys setnai* Kulkarni	Saslu	ENIW.G	- do -	1985 Basis	0-1	0-2	A-1	A-2	20 mm	
73.	*Aplocheilus lineatus* (Valenciennes)	Moogu-malli	ENIS	- do -	1969 Basis	0-1	0-2	A-1	A-2	100 mm	
74.	*Pseudambassis ranga* (Hamilton-Buchanan)	Bachanike	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	70 mm	
75.	*Etroplus suratensis* (Bloch)	Eli-meenu	ENIS	- do -	1963	0-1	0-2	A-1	A-2	400 mm	
76.	*Etroplus canarensis* (Day)	Eli-meenu	ENI W.G	1993R						200 mm	
77.	*Oreochromis mossambica* (Peters)	Jilebi	ENI	1997 R	1958 Basis	0-4	0-1	A-4	A-1	210 mm	

Sl.No	Scientific name	Local Name Kannada	End/ Exot.	Distribution		Occurrence		Abundance		Max. Size	
				Present	Past	Present	Past	Present	Past	Present	Past
78.	*Glossogobius giuris* (Hamilton-Buchanan)	Bhangi-sidda	ENIS	1997 R	1965 B	0-1	0-3	A-1	A-3	300 mm	
79.	*Macropodus cupanus* (Valenciennes)	Chittu	ENI	- do - UR	1969 Basis	0-2	0-2	A-2	A-2	75 mm	
80.	*Channa marulius* (Hamilton-Buchanan)	Avalu	ENIS	- do -	1965 Basis	0-1	0-3	A-1	A-3	12 kg.	
81.	*Channa orientalis* Bloch & Schneider	Korava	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	130 mm	
82.	*Channa punctatus*	Korava	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	310 mm	
83.	*Channa striatus*	Kuchheu	ENIS	- do -	- do -	0-1	0-3	A-1	A-3	450 mm	
84.	*Mastacembelus armatus* (Lacepede)	Haavu-meenu	ENIS	- do -	- do -	0-1	0-2	A-1	A-2	700 mm	

End. Endemic; **ENIS** - endemic to Indian sub-continent., **ENI** - Endemic to India; **EN WG**- Endemic to Western Ghats; **ENL** - Endemic to Karnataka.
Ex. Exotic; **TR-** Transplanted from other parts of India. **Distribution:**- **UA** - Unaltered from past records.
Occurrence: - 0-1 Sporadic to stray or scanty ; **0-2** common; **0-3** very common.
Abundance: - **A-1** very rare; **A-2** rare; **A-3** Abundant.

Thynnichthys sandkhol was observed to be very rare and 15 fish species are considered under threat.

The West-flowing rivers basin recorded 85 species belonging 19 families and 7 Orders including the introduced Gangetic and the exotic carp. *Labeo nigrescens*, *Clarias dussumieri* and *Etroplus canarensis* have almost disappeared and 9 fish species are listed as threatened.

Major Threats

In general, there is a declining trend in the fish species, their abundance and growth rates compared to 'sixtees' in all the river basins of the state. This may be attributed to various deletorious changes in environmental parameters on account of various developmental projects undertaken in the river valleys. Introduction of common carp in man-made lakes during the 'fiftees' has left devastating impact on the indigenous fish components of different river basins. In Krishnaraja-Sagar reservoir, common carp has dominated over all the other species, which are indigenous to the Cauvery river system. Similar situations are prevailing in other reservoirs and perennial tanks where stocking of common carp was resorted to inadvertent stocking of tilapia and Indian major carps has led to replacement of many endemic fish species like *Puntius carnaticus*, *P.jerdoni*, *P.pulchellus* and *Labeo nigrescens*. Some of the important pools and natural sanctuaries like 'falls' etc. where congregation of fish takes place are dynamited very frequently during the lean seasons. This has been the case in all the major rivers of the State. In addition to the above, indiscriminate fishing by the local and the migratory fishermen in every type of available waterbody has also depleted the fish fauna.

Entry of intreated industrial effluents and domestic sewage into the rivers have also contributed to the decline of all aquatic fauna, including fish species.

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Freshwater ichthyofauna of Maharashtra State

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Introduction

Faunastic survey of a region like Maharashtra State having areas infested with deep forests, difficult hilly terrains, virgin water bodies in remote places, swift flowing rivers and streams, is not an easy task to complete in a short time. This involves sustained and dedicated efforts of interested workers ready to bear the strain of this arduous task with patience. Besides keen interest this work calls for expertise to look for right type of species at the right place. For example, for *Nemacheilus* spp. one has to look in the moss matted stones and crevices of rapids and for Mahseers or *Sisor rhabdophorus* in the sandy bottom of clear streams.

The present paper is largely based on the observations made from time to time while on tour at different parts of the Maharashtra State for works related to fisheries, and also through discussions among fisheries workers. While preparing this paper, dissertations submitted by the post graduate trainees of CIFE and literature available in CIFE library on the subject also have been taken into consideration. However, the authors are of the opinion that the 100 ichthyofauna listed in this paper is far from exhaustive and several species remained unaccounted. The paper is based on the observations made by the authors during the last 20 years. Earlier records of the maximum size/weight of the reported species in Maharashtra State are not readily available. Present maximum weight of the species reported in this paper in coloumn no.11 is approximation only based on personal measurements/ observations.

Topography

Maharashtra State, located between 16°0 -20 ° 0 North latitude and 72 ° 76-80 ° 5 East longitude, spread over an area of 3,07,690 sq. km. gained its statehood in 1960. It is surrounded by Gujarat State and Union Territories of Daman, Dadra and

Nagar Haveli in its NorthWest; Madhya Pradesh in the North-East and East; Andhra Pradesh, Karnataka and Goa in the South; and 720 kms. stretch of coastline of Arabian Sea in the West. A narrow stretch of low land with an average breadth of 67 kms. along the Arabian Sea at the western border of Maharashtra is known as Konkan. Sahyadri mountain range divides the land in to Konkan on the West and plateau of Majarashtra on the East. Avarage height of Sahyadri is 450m. above sea level. The important ranges stretching eastword from Sahyadri are Balaghat, Satmala and Ajanta. In the extreme north of Maharashtra, there is a chain of mountains called Satpura.

Watersheds

The main rivers of Maharashtra are Godavari, Krishna, Bhima and Tapi together with their tributaries constitute a stretch of about 3200 kms. in total length. The basin of the river Krishna is in the extreme South (Fig.I) of Maharashtra State, the two main tributaries of the river Krishna are Koyna and Varna also flow through this basin. Bhima river basin lies above the Krishna river basin between Mahadeo and Balaghat ranges in South. Few tributaries along with Mira of Bhima also flow through this

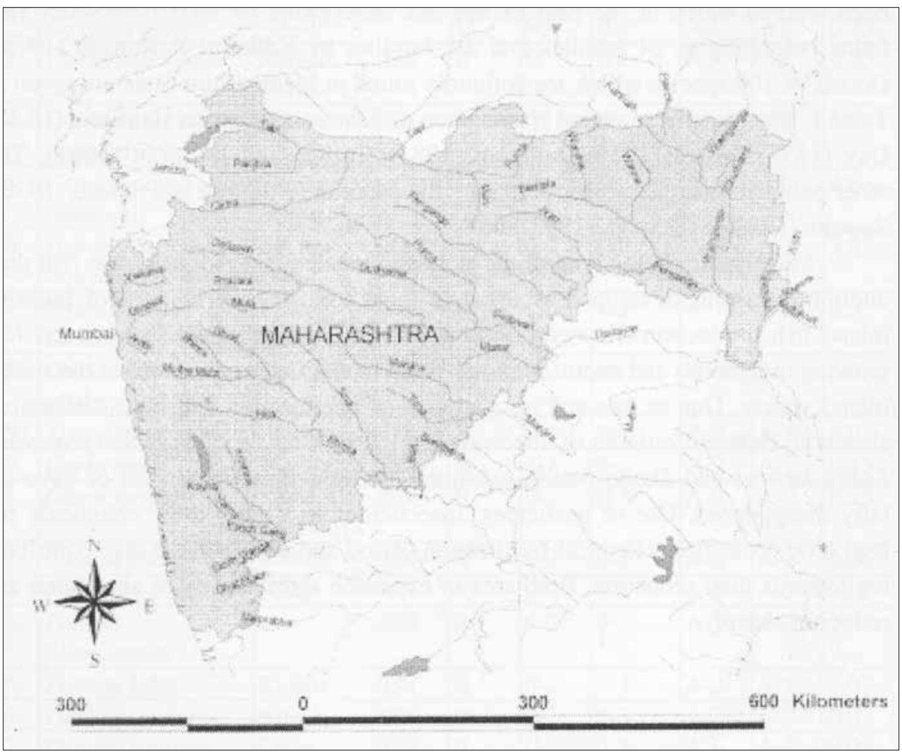

Fig.1. The Fresh Water resources of maharashtra

basin and the river joins with Krishna beyond the limit of Maharashtra. The Godavari basin is further up in between the Sahyadri in the west and the eastern limits of the state with many small tributaries. In the extreme north, Tapti river originates from Sahyadri, flows in north-west direction to empty in Arabian Sea. In addition to the rivers, Maharashtra State has about 3,00,000 ha of lentic water bodies, 61% (1,83,000 ha) of which are comprised of reservoirs having more than 200 ha of water spread area, rest is comprised of about 1,387 nos. of irrigation tanks.

Annual precipitation in the state varies from 600 cm in Amboli and Mahabaleshwar to 200-400 cm in Konkan region (Sorte, 1993). In the eastern part of the Sahyadri within a distance of 100 kms. there is a sharp decline in the rain fall from 500 cm. on the crest to about 50 cm in parts of Ahmadnagar and Solapur districts. The Marathawada region receives 60-100 cm where as Chandrapur and Bhandara districts receive about 150 cm of rainfall in a year.

Thus, because of congregation of various types of topographical, agroclimatic and hydrodynamical conditions within the boundaries of one state, the State of Maharashtra is very rich in Ichthyofauna. Unfortunately this has not been studied much in the past except one description of 167 fresh water fish fauna belonging to 24 families and sub-families by Kulkarni & Ranade (1975). Details of 100 species which are definitely found in Maharashtra State are given in Table 1. The identification and clarification of fishes are based on Hamilton (1822), Day (1878), Misra (1959), Jayaram (1981), Talwar and Jhingran (1991). The other publication referred for preparing the paper is Jhingran and Sehgal (1978) and those listed in the reference portion of this paper.

Maharashtra being a maritime state and much advanced in marine fish production, is not as developed as the land locked Northeastern states of India in inland fish production. However, with a view to develop inland fish culture, fast growing indigenous and exotic carps are being increasingly introduced in the state's inland waters. Due to this and also a result of urbanisation and industrialisation, almost all endemic varieties of uneconomical ichthyofauna such as *Labeo* porcellus, *Labeo kawrus* and *Danio fraseri* exhibited drastic decline in catches or have totally disappeared. Use of pesticides, insecticides and other toxic chemicals for land crop protection, chemical fertilization of soil and pollution are also contributing towards their reduction. Both area of existence and intensity of abundance are reducing sharply.

Table 1. Distribution, abundance, occurrence and size range of freshwater fish species of Maharashtra

Sl. No	Species	Local Name (Marathi)	End/ Exotic	Distribution		Occurrence	Abundance		Max. Size(kg)
				Present	Past	Present	Present	Past	Present
Sub family : Cyprininae									
1.	*Catla catla*	Catla	TR	I	04	01	A2	A4	40.0
2.	*Labeo rohita*	Rohu	TR	I	04	02	A1	A3	6.0
3.	*Labeo calbasu*	Kanas	EN	R	02	0-2	A3	A-3	4.0
4.	*Labeo bata*	Tambti	EN	I	02	02	A2	A-2	0.4
5.	*Labeo pangusia*	Kanas	EN	R	03	03	A3	A2	1.0
6.	*Labeo boggut*	Sandshi	EN	R	02	03	A2	A2	0.25
7.	*Labeo fimbriatus*	Tambir	EN	R	03	03	A3	A-3	2.0
8.	*Cirrhina mrigala*	Mrigal	TR	I	04	03	A2	A-3	4.0
9.	*Cirrhina cirrhosa*	-----	EN	R	01	02	A2	A2	3.0
10.	*Labeo porcellus*	Tambadki	EN	R	01	01	A1	A1	0.35
11.	*Labeo nukta*	Nakta	EN	R	01	01	A1	A1	0.1
12.	*Cirrhina reba*	-----	---	I	03	02	A2	A3	0.25
13.	*Cirrhina fulungee*	Mulich, Ganna	EX	R	02	03	A2	A3	0.25
14.	*Cyprinus carpio var specularis*	Mirror carp	EX	R	01	00	A0	A1	2.0
15.	*Cyprinus carpio var communis*	Soneri Masha	EX	I	04	00	A0	A4	4.0
16.	*Hypophthalmic-thys molitrix*	Silver carp.	EX	I	0-2	00	A-0	A-2	5.0
17.	*Thynnichthys sandkhol*	Sandkhol	EX	R	0-0	0-1	A-1	A-0	0.5
18.	*Ctenopharyng-odon idella*	Grass carp	EX	R	0-2	00	A-0	A-2	3.0
19.	*Aristichthys nobilis*	Mud carp	EX	R	0-1	00	A-0	A-1	3.0
20.	*Garra mullya*	Mullya	EN	R	0-1	0-2	A-2	A-2	0.15
21.	*Garra gotyla*	Sigha chamullya	EN	R	0-2	0-3	A-2	A-2	0.15
22.	*Puntius chola*	Khavli	EN	R	0-2	0-3	A-2	A-1	0.06
23.	*Puntius dobsoni*	Parag	EN	R	0-2	0-3	A-2	A-1	0.05
24.	*Puntius filamentosus*	-----	EN	R	0-2	0-3	A-2	A-2	0.05
25.	*Puntius kolus*	Kolshi	EN	R	0-2	0-3	A-2	A-1	0.07
26.	*Puntius sophore*	Khavli	EN	R	0-2	0-3	A-2	A-2	0.07
27.	*Puntius sarana*	Darai	EN	R	0-2	0-3	A-2	A-1	0.05
28.	*Puntius stigma*	-----	EN	R	0-2	0-3	A-2	A-1	0.035

Sl. No	Species	Local Name (Marathi)	End/ Exotic	Distribution		Occurrence	Abundance		Max. Size(kg)
				Present	Past	Present	Present	Past	Present
29.	*Puntius sahyadriensis*	Khavli	EN	R	0-2	0-3	A-2	A-1	0.035
30.	*Puntius ticto*	-----	EN	R	0-2	0-3	A-2	A-1	0.025
31.	*Puntius jerdoni*	Potil	EN	R	0-2	0-3	A-2	A-1	0.05
32.	*Puntius vittatus*	Khavli	EN	R	0-2	0-3	A-2	A-1	0.05
33.	*Puntius conchonius*	Khavli	EN	R	0-2	0-3	A-2	A-1	0.03
34.	*Puntius amphibius*	Khavli	EN	R	0-2	0-3	A-2	A-1	0.2
35.	*Tor khudree*	Mahaseer, Khadra,	EN	R	0-2	0-2	A-2	A-2	0.75
36.	*Tor mussallah*	Mashlya	EN	R	0-2	0-2	A-2	A-2	1.0
37.	*Tor putitora*	Putitora	TR	R	0-2	0-2	A-1	A-1	2.5
38.	*Amblypharyng-odon mola*	-----	EN	R	0-2	0-3	A-2	A-2	0.005
39.	*Osteobrama cotio*	Bhongi	EN	R	0-2	0-1	A-2	A-1	0.01
40	*Osteobrama vigorsii*	Phankut	EN	R	0-2	0-3	A-2	A-1	0.01
41.	*Osteobrama ogilbii*	Vatani	EN	R	0-2	0-3	A-2	A-1	0.01
Sub family : Rasborinae									
42.	*Barilius burna*	Jhorya	EN	R	0-2	0-2	A-2	A-2	0.1
43.	*Barilius bendalensis*	Jhorya	EN	R	0-2	0-2	A-2	A-2	0.1
44.	*Barilius evezardi*	Jhorya	EN	R	0-2	0-2	A-2	A-1	0.05
45	*Rasbora rasbora*	Dandai	EN	R	0-2	0-2	A-2	A-2	0.005
46.	*Danio aequipinnatus*	Balooki	EN	R	0-2	0-2	A-2	A-2	0.005
47.	*Danio devario*	-----	EN	R	0-2	0-2	A-2	A-2	0.05
48.	*Brachydanio rerio*	Pidtuli	EN	R	0-2	0-2	A-2	A-2	0.005
49.	*Rasbora daniconius*	Dondai Gana	EN	R	0-2	0-2	A-2	A-2	0.005
Sub family : Abramidinae									
50.	*Chela bacaila*	Ulkut	EN	R	0-3	0-3	A-3	A-2	0.005
51.	*Chela bopis*	Ulkut, Ambi	EN	R	0-2	0-2	A-2	A-2	0.005
52.	*Chela phulo*	Ulkut	EN	R	0-2	0-2	A-2	A-2	0.005
53.	*Chela laubuca*	----	EN	R	0-2	0-2	A-2	A-3	0.005
54.	*Esomous danrica*	Kurriya, Dahwi	EN	R	0-2	0-2	A-3	A-3	0.005

Sl. No	Species	Local Name (Marathi)	End/ Exotic	Distribution		Occurrence	Abundance		Max. Size(kg)
				Present	Past	Present	Present	Past	Present
Family : Siluridae									
55.	*Ompok bimaculatus*	Wanz, Valanj	EN	R	0-1	0-2	A-2	A-1	0.45
56.	*Ompok pabo*	Kaliwanz	EN	R	0-1	0-2	A-2	A-1	0.20
57.	*Wallago attu*	Valashivda	EN	R	0-1	0-2	A-2	A-1	4.0
Family : Schilbeidae									
58.	*Ailia coila*	-----	EN	R	0-1	0-2	A-2	A-1	0.015
59.	*Clupisoma garua*	-----	EN	R	0-1	0-2	A-2	A-1	0.60
60.	*Silonia sykesii*	Silan	EN	R	0-1	0-2	A-2	A-1	3.0
61.	*Pseudotropius athe-rinoides*	Sura	EN	R	0-1	0-2	A-2	A-1	0.005
Family : Saccobranchidae									
62.	*Heteropneustes fossilis*	Shingi	EN	R	0-2	0-2	A-2	A-2	0.20
Family : Claridae									
63.	*Clarias batrachus*	Magur	EN	R	0-2	0-2	A-2	A-2	0.35
Family : Bagridae									
64.	*Rita rita*	Ghoghrya	EN	R	0-2	0-2	A-2	A-2	0.20
65.	*Rita pavimentata*	Ghoghrya	EN	R	0-2	0-2	A-3	A-3	0.25
66.	*Mystus aor*	Shingala	EN	R	0-2	0-2	A-2	A-2	5.0
67.	*Mystus bleekeri*	Katirna	EN	R	0-1	0-2	A-3	A-2	0.020
68.	*Mystus cavasius*	Katirna	EN	R	0-1	0-2	A-2	A-1	0.030
69.	*Mystus gulio*	Shingati	EN	I	0-3	0-2	A-3	A-3	0.30
70.	*Mystus seenghala*	Shingala	EN	R	0-2	0-2	A-2	A-2	5.0
Family : Sisordae									
71.	*Bagarius bagarius*	Khirit	EN	R	0-1	0-2	A-2	A-1	0.50
72.	*Glyptothorax spp.*	Pathar chata	EN	R	0-1	0-2	A-2	A-2	0.10
Family : Anguillidae									
73.	*Anguilla bengalensis*	Aheer	EN	R	0-2	0-2	A-2	A-1	0.20
Family : Mastacembelidae									
74.	*Mastacembelus armatus*	Vam	EN	R	0-2	0-2	A-2	A-2	0.25
75.	*Mastacembelus pancalus*	Vam, Vambat	EN	R	0-3	0-3	A-3	A-1	0.15
76.	*Rhynchobdella aculeata*	Vam	EN	R	0-2	0-3	A-3	A-1	0.05

Sl. No	Species	Local Name (Marathi)	End/ Exotic	Distribution		Occurrence	Abundance		Max. Size(kg)
				Present	Past	Present	Present	Past	Present
Family : Amphipnoidae									
77.	*Amphipnous cuchia*	-----	EN	R	0-1	0-2	A-1	A-1	0.25
Family : Clupeidae									
78.	*Gudusia chapra*	-----	EN	R	0-1	0-1	A-1	A-1	0.15
Family : Notopteridae									
79.	*Notopterus chitala*	Patre, Chalat	EN	R	0-1	0-1	A-1	A-1	3.5
80.	*Notopterus notopterus*	Patre, Chalat	EN	R	0-2	0-2	A-2	A-2	0.30
Family : Channidae									
81.	*Channa leucopunctatus*	Maral	EN	R	0-2	0-3	A-3	A-2	3.5
82.	*Channa marulius*	Kalamasa, maral	EN	R	0-1	0-2	A-2	A-2	3.0
83.	*Channa punctatus*	Maral	EN	R	0-2	0-2	A-2	A-2	1.5
84.	*Channa striatus*	Mangsha	EN	R	0-2	0-2	A-2	A-2	1.0
85.	*Channa gachua*	Dokrya, Daku, Dhok	EN	R	0-1	0-1	A-1	A-1	0.020
Family : Ambassidae									
86.	*Ambassis ranga*	Kachki	EN	R	0-3	0-3	A-2	A-2	0.004
87.	*Ambassis nama*	Kachki	EN	R	0-2	0-2	A-2	A-2	0.003
Family : Anabantidae									
88.	*Anabas testudineus*	-----	EN	R	0-1	0-2	A-2	A-1	0.015
Family : Osphronemidae									
89.	*Osphronemus gourami*	Gorami	EX	R	00	0-1	A-1 1976	A-1 1976	00
90.	*Colisa lalia*	-----	EN	R	0-1	0-1	A-1	-----	0.003
Family : Gobiidae									
91.	*Glossgobius giuris*	Kharpya, Kharbi	EN	R	0-2	0-2	A-2	A-2	0.025
Family : Poecilidae									
92.	*Gambusia affinis*	Gambusia	TR	I	0-3	0-3	A-2	A-3	0.001
Family : Cyprinodontidae									
93.	*Aplocheilus panchax*	Pikoo	EN	R	0-2	0-2	A-2	A-2	0.001

Sl. No	Species	Local Name (Marathi)	End/ Exotic	Distribution		Occurrence	Abundance		Max. Size(kg)
				Present	Past	Present	Present	Past	Present
Family : Belonidae									
94.	*Xenetodon cancila*	Tokali, Kutra-masa	EN	R	0-2	0-2	A-2	A-2	0.020
Family : Cobitidae									
95.	*Lepidocephalus guntea*	Mori	EN	R	0-2	0-2	A-2	A-2	0.10
96.	*Nemacheilus botia*	Chikli	EN	R	0-2	0-2	A-3	A-2	0.005
97.	*Nemacheilus evezardi*	Chikli	EN	R	0-2	0-2	A-2	A-2	0.005
98.	*Nemacheilus poonaensis*	Chikli	EN	R	0-1	0-2	A-2	A-2	0.005
99.	*Nemacheilus striatus*	Chikli	EN	R	0-2	0-3	A-3	A-2	0.005
100.	*Nemacheilus ruppelli*	Chikli	EN	R	0-2	0-2	A-2	A-2	0.005

End. Endemic; ENIS -endemic to Indian sub-continent., **ENI** -Endemic to India; **EN WG** -Endemic to Western Ghats; **ENL** -Endemic to Maharashtra.
Ex. Exotic ; T**R-** Transplanted from other parts of India. **Distribution:-** **UA** -Unaltered from past records.
Occurrence: - **0-1** Sporadic to stray or scanty ; **0-2** common; **0-3** very common.
Abundance: - **A-1** very rare; **A-2** rare; **A-3** Abundant.

To prepare the checklist of ichthyofauna of a particular localition, the participation of students/local people will be beneficial. Students can be trained in taxonomic identification of specimens with an emphasis on endemic species and local level museums can be set up at sub-state or regional level in close association with post-graduate colleges and research departments where the specimens can be deposited. This would also strengthen our efforts to conserve and sustainably utilize the bountiful aquatic resources of our country.

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The Ichthyofauna of Northern Part of Western Ghats and its Conservation

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India is a tropical country which is one of the mega-diversity centres among 11 others, selected on the basis of possession of a fragile ecosystem. Conservation of the biodiversity of our country is an urgent need. It harbors 11% of world's total ichthyofauna comprising about 2000 fish species. Freshwater fishes occurring in Indian waters are about 650 species. This enriched piscine wealth is represented by more or less 200 species inhabiting the rivers of the Western Ghats. The Western Ghats, is selected as a "global hot spot" from the conservation point of view. By the virtue of its topography, climate and pristine habitats, an almost continuous chain of hills from Dangs District of Gujarat to Kanyakumari, forming a major watershed for Peninsular India, the Western Ghats and ichthyofauna therein offers the unique scope for study in the various disciplines of science.

The Northern region of the Western ghats *viz*. from Tapti river basin to Kalinadi, South Canara possesses 150 fish species, of which cyprinidae forms the major representatives like the genera *Chela, Salmostoma, Parluciosoma, Rasbora, Danio, Barilius, Cirrhinus, Catla, Puntius, Osteobrama, Labeo, Rohtee, Schismatorhynchus, Crossocheilus, Osteocheilus, Neolissocheilus*, *Garra, Tor* and *Parapsilorhynchus*. The last three genera are of hill stream fishes. Among the torrential streams members of the genera *Nemacheilus*, *Lepidocephalus* and *Botia* (Family : Homalopteridae) are prominent. Besides this, catfishes, perches, snake heads, belonids, eels, notopterids and representatives of minor orders like Cyprinodontidae, Mugilidae are also important fishes.

Ichthyofauna of the Western Ghats consists of transplanted food fishes like rohu, mrigal and catla and native species like mastacembelids, catfishes, snake heads etc. (total 80 spp.); game fishes like mahseer (*Tor* spp.), *Katli* (*Neolissocheilus* spp.); larvivorous fishes belonging to the genera *Chela, Salmostoma, Rasbora, Puntius* (about 32 spp.); an endemic genus *Parapsilorhynchus* comprising of 4 species; beautiful ornamental species restricted in their occurrence in the west flowing rivers like *Puntius* spp., *zebra danio, danda* (*Rasbora*), rosy barb (*Puntius conchonius*) (Ham.-Buch.), *Rohtee*, tiger loach (*Botia striata* Rao) and Swamp eel (*Monopterus indicus*).

In the Northern portion of the Western Ghats 20% fish species are endemic to this region which include species of the genera *Parapsilorhynchus, Puntius*, *Nemacheilus*, the cat fishes *Mystus, Silurus, Glyptothorax* and the swamp eel *Monopterus* (Synbranchiformes).

Although speciation and extinction are natural phenomena, human intervention has drastically deteriorated the ichthyofaunal wealth of our country. Selfish exploition of this vital entity has alarmingly increased unnatural rate of extinction of fishes and added to the number of threatened species. In the Western Ghats nearly 10% of fish species are under severe threat of extinction. These include 10 cyprinids (*Barilius evezardi* Day, *Danio fraseri* Hora and Mukerji, *Cirrhinus cirrhosa* (Bloch), *Labeo dussumieri* (Val.), *L. potail* (Sykes), *Hypselobarbus curmuca*, *Neolissocheilus wynaadensis* (McClelland), *Tor khudree* (Sykes), *T. mussullah*, *Osteobrama cotio peninsularis* Silas, *Schismatorhynchus nukta nukta* (Sykes), *Horabagrus brachysoma* and the genera of catfishes like *Bagarius, Glyptothorax, Pseudeutropius* as well as *Monopterus*. Furthermore, few species like *Puntius fraseri* Hora and Misra, *Rasbora labiosa* Mukerji are probably extinct since they have not been found from the type locality and elsewhere (Darna river, Nasik Dist.), since 1939.

Scenario of conserving the ichthyofauna is a hard task, as 70% of water bodies in our country are dried up, remaining ones are polluted. Several factors like introduction of exotic species, siltation, deforestation, salivation, use of insecticides, heavy metal toxicity, dynamiting, poisoning, unplanned irrigation and dams are all serious threats to the life of fishes.

In order to conserve precious ichthyofauna, a holistic approach and public awareness are vital factors. Conservation should be deep rooted, within the habitat (*in situ*) as well as outside their natural habitat (*ex situ*). The latter also includes cryopreservation technique (*i.e.* long term live preservation sperms and eggs of fishes) in liquid nitrogen. Prior to conservation movement, a baseline survey to identify areas of threat and finding out species dwindling in their number, is essential work. The next step is documentation and identifying the threatened species. A status of each species should be determined.

In Tata Electric Company, Lonavla, mahseers are successfully bred. Thus the vanishing species *Tor khudree* (Sykes) is saved from extinction. Similarly cryopreservation of milt of the "thooli" *Labeo dussumieri* and yellow catfish *Horabagrus brachysoma* - endemic fishes of Western Ghats was perfected by National Bureau of Fish Genetic Resources (NBFGR). The sacred groves along rivers of Indrayani river, Dehu, Bhimashankar (Maharashtra) and in southern regions of Karnataka and Kerala play a major role in protecting aquatic fauna. The Western Ghats offers a beautiful array of diverse piscine fauna. It is our most essential task to conserve and utilize sustainably the precious ichthyofauna of this mega-biodiversity area.

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* Definition: The fish species found exclusively in a country or a drainage system where it is native and described has been termed as endemic.

Fish Germplasm Inventory of Sharavati, Aghanashini, Bedti and Kali Rivers, Uttara Kannada

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Germplasm inventory of freshwater fishes in the river systems of the Uttara Kannada district of Karnataka (13°52′ to 15°30′N and 74° 5′E) have been carried out. The study sites are situated along four rivers in the district, each river having 6 sites, a total of 24 sites in all. The four rivers are, Sharavati, Aghanashini, Bedti and Kali. These four rivers originate either inside the Uttara Kannada district or just towards the west, extending to the nearby districts.

Extensive studies have been done in this part of the Western Ghats with regard to vegetation studies and work on terrestrial organisms like insects and bird species. On the other hand very little work has been done in the study of aquatic systems and the fauna found on them. This study attempts to identify the freshwater river ecosystems, the types of habitats associated with them, and the fish communities found here. The four rivers in the study are different in terms of the water quality (pollution load, types and abundances of the habitat types) as well as the extent of human disturbances to it (agriculture along the river-bank, construction of dams and reservoirs). The river Sharavati is situated in the southern part of the district. The river is relatively pristine with hardly any kind of pollution, but it is also the site of a large reservoir, due to the construction of the Linganmakki dam at the upper reaches. On the other hand, the river Anghanashini is neither polluted not has any dams and reservoirs associated with it. Also as it flows through mostly undisturbed parts of the Western Ghat forests, this river can be considered natural and undisturbed. The river Bedti, which is situated to the north of the river Aghanashini, does not have dams constructed on it; however, the impact of human habitation is observed at some places. The sewage from some nearby towns like Sirsi is drained into the river. The river Kali, at the northern most part of the district, is the most polluted and disturbed of all the fours rivers. It has a heavy pollution load at the upper sections due to the construction of mills and industries which drain their effluents into the river. There are a number of medium as well as large dams and reservoirs along the river.

The river ecosystem consists of different types of habitats-*e.g.* pools, riffles, runs cascades, falls, etc. The riparian vegetation along the river varies. Some sites have undisturbed evergreen vegetation with the canopy covering the river to a large extent (60%) while at other sites, the river flows through human habitations or plantations where the canopy cover is much less (<5%). This study deals with the spatial and temporal distribution of fish communities across different habitat types and between the river systems along their courses.

Sampling design and methodology

In all, 24 sites were chosen for collection of samples and each river had 6 sites chosen such that they cover the entire stretch of the river, from low order perennial tributaries to the lower most reaches of the river system. Samples were collected seasonally such that they cover the pre-monsoon summer (April-May), the post-monsoon (October-November) season, the winter (December-January) and the summer (February-March). Sampling has been done for a period of 20 months for these sites. Each site covers a stretch of approximately 100-200 meters along the river. For collection of the fish samples, different methods have been adopted-cast nets of varying sizes, gill nets, drag nets, hooks, etc. At places, some local methods have also been found to be useful in collection of fishes.

The method adopted at a site depends on the habitat type of the region. At sites where the habitat consists of mostly runs, gill nets have been found to be more useful. For shallower slow moving waters, drag nets have been used. Gill nets of varying sizes are arranged along river column. These are kept diagonally across the width of the river stretch, for specific amounts of time. At our site, the nets were kept for stretches of approximately 2 hours. Casts nets are useful where the flow is moderate and the river bottom is relatively less rocky and has more of sand or fine gravel. Shallow pools with silt or sandy bottom are ideal for using cast nets.

Fish inventory

Approximately 750 species of freshwater fishes have been recorded so far (Jayaram, 1981) in India, out of which about 350 species have been estimated to belong to Western Ghats. So far the fish diversity of Uttara Kannada has not been documented. The collection done till now, in the study sites has yielded 60 species and some more are yet to be identified and to be added to these list. Some of the species are endemic to the Western Ghats-*e.g. Puntius arulius, P. curmuca, P. narayani, species of loaches like Nemachielus denisoni, N. semiarmatus, N. striatus* etc. If we consider the common genera, the most abundant ones belong to the carp family (family Cyprinidae); the most common genera, the *Danio* and *Rasbora*. Another common genus is *Puntius* of which, about 11 species have been recorded in the study sites. The species abundance vary with the season. We observe that the most abundant species in all the seasons sampled is *Garra gotyla stenorhynchus*. It is also seen that this species occurs in most of the study sites. This species is specialised to feeding on attached algae (found on submerged rocks and boulders). The high abundances of this species could be because of the abundance of pools and runs with rocky substratum.

Some of the rare game species like *Tor khudree* have been recorded in the upstream sites of the river Bedti and Sharavati. A list of the species collected so far is included. Of the four rivers, Aghanashini is undisturbed also has a high diversity of habitat types in both the upghat and downghat sites. Because of this, higher fish species diversity at these sites has been found. Sharavati, which has been subjected to great alterations in their flow due to construction of dams and reservoirs, has been found to have very poor habitat diversity. There is a large reservoir built at the upper section in this river, due to which the river flow is highly regulated and is mostly in the form of fast flowing turbulent runs. This seems to have affected the fish composition to a large extent. The most common species found here belong to the family Cyprinidae and to its genus *Puntius* (*P. filamentosus*, *P. jerdoni*). The river Bedti though has a habitat diversity comparable to that of Aghanashini, is polluted by the sewage mainly from Sirsi. Though genera like *Mystus* (catfishes) and *Garra* are quite abundant here, more sensitive Cyprinidae genera are found to be lesser in abundance compared to that found in Aghanashini. On the other hand, pollution in the river Kali is due to industrial effluents and we find that here the overall diversity of species is markedly affected. This is especially evident immediately downstream of the industries, where species numbers as low as 3 has been recorded.

Comparison of species composition using Jaccard's similarity coefficient shows that the sites in the upstream stretches of Bedti and Aghanashini are more similar to each other than to downstream sites in the same river stretches (the Jaccard's index of similarity in species composition is 0.62). Similarly, the downstream sections of Aghanashini are more like downstream sections in Bedti in terms of species composition as compared to sites upstream in the same river (Jaccard's coefficient of similarity being 0.53). This could be due to similar habitat type conditions at these sites in both the rivers.

List of species identified

Family Cyprinidae	Family Bagridae
Subfamily Rasborinae	*Mystus cavacius*
Danio aequipinnatus	*Mystus oculatus*
Rasbora daniconius	*Mystus montanus*
Esomus thermoicus	*Mystus malabaricus*
Esomus danricus	Family Aplocheilidae
Barilius spp.	*Aplocheilus lineatus*
Subfamily Cyprininae	Family Cyprinodontidae
Puntius filamentosus	*Aphanius dispar*
Puntius narayani	Family Poecilidae
Puntius sahyadrensis	*Poecilia (Lebestis) reticulata*
Puntius fasciatus	Family Syngnathidae
Puntius ticto ticto	*Ichthyocampus carce*
Puntius sophore	Family Belonidae
Puntius jerdoni	*Xenentodon cancila*
Puntius sarana subnasutus	Family Ambassidae
Puntius bimaculatus	*Chanda nama*
Puntius bovanicus	*Pseudambassis ranga*
Puntius amphibius	Family Gerreidae
Puntius vittatus	*Gerriomorpha setifer*
Puntius chola	Family Cichlidae
Gonoproktopterus kolus	*Oreochromis mossambicus*
Gonoproktopterus dubius	*Etroplus suratensis*
Gonoproktopterus curmuca	Family Gobiidae
Labeo boggut	*Glossogobius giuris*
Labeo porcellus	*Periophthalmus koelreuteri*
Labeo kawrus	*Periophthalmus weberi*
Tor khudree	Family Channidae
Osteobrama bakeri	*Channa orientalis*
Subfamily Cultrinae	Family Mastacembelinae
Salmostoma boopis	*Mastacembelus armatus*
Subfamily Garrinae	Family Tetraodontidae
Garra gotyla stenorhynchus	*Tetradon spp.*
Family Cobitidae	Family Mugilidae
Subfamily Nemacheilinea	*Mugil cephalus*
Nemacheilus anguilla	Family Siluridae
Nemacheilus pulchellus	*Wallago attu*
Nemacheilus rupelli	Family Megalopidae
Nemacheilus sinuatus	*Megalops cyprinoides*
Nemacheilus semiarmatus	

Conservation and Management of Fish in Karnataka

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Peninsular India harbours rich in freshwater fishery resources. Over the years, natural stocks of some species of fish have become depleted owing to anthropogenic activities which include urbanization and industrialization construction of dams, agricultural and industrial pollution, destructive fishing methods like dynamiting, electrocution and poisoning overfishing, etc. The department of Fisheries (DOF), Government of Karnataka, very recently brought out a tentative List of Threatened Fishes of Karnataka" with a view to take up appropriate conservation and rehabilitation measures. Of these, *Bagarius bagarius* is endangered, while mahseer (*Tor spp*.), fringe-lipped carp (*Labeo fimbriatus*) and *Puntius pulchellus* are the important fishes classified under vulnerable category.

Mahseer

Mahseers are well known sport and food fishes which are our National heritage. Earlier when they were abundant they attracted the best anglers from the world over. Karnataka has been the land of large sized mahseers. The river Cauvery and its tributaries and several other rivers provide an ideal environment for the natural breeding of this majestic, unparallel game fish of India. Of the seven species of *Tor* found in India, *Tor khudree* (the Deccan Mahseer) and *Tor musullah* (the Humpback mahseer) are the only two important species available in the streams and rivers originating from the Western Ghats in Karnataka. Due to anthropogenic pressures mahseers have come under the category of threatened species.

Mahseers are omnivorous., feeding on a variety of food items and slow growing attaining weights upto 50 kg (120-125 cm) in nature. Under culture conditions, they grow to about 300-400 g in one year. Breeding season of *Tor khudree* varies, but peak season is from July to October. Fecundity ranges from 7500 to 17.500 in the wild, while it is between 1000 and 3000 in pond-reared mahseer. In captivity, males mature within on year at 26-30°C, whereas females take at least two years to mature in captivity. Hatching is prolonged upto 5 days at 22-24°C, while it is reduced to 3 ½ days at 26-28°C.

Mahseers are protected in river sanctuaries adjacent to the temples where they are worshipped for centuries. This has evolved as an effective way of conservation. There are several mahseer sanctuaries in Karnataka and they are essential not only for the protection of species but also for the preservation of genetic diversity. Presently there are approximately 10 mahseer sanctuaries located in various rivers that originate from Western Ghats in Karnataka.

Various agencies are involved in the conservation and management of germplasm of mahseer in Karnataka. The prominent are Karnataka State Department of Fisheries (DOF), College of Fisheries (COF), Mangalore, Temple Trusts and Non-Governmental Organisations (NGOs). The conservation measures taken or proposed to be taken are as follows -River water users are plenty and hence it is a difficult prevents agricultural and industrial pollution of rivers. However, measures taken by DOF to mitigate pollution in the Tungabhadra reservoir are paying dividends. Construction of fish ladders/passes along dams to facilitate breeding migration of mahseer is required. No attempt has been made so far. DOF and NGOs are involved in preventing wanton killing of mahseer, particularly brood stock. Two sanctuaries have been established on the river Cauvery, where a stretch of river is leased out to NGOs. DOF and NGOs procured about 1,80,000 fry/fingerlings of *T. khudree* from Lonavla, Maharashta and released in the river Cauvery. In 1987-88, a project entitled "Rehabilitation and development of mahseer fishery in the rivers and reservoirs of Western Ghats" under the Western Ghat Development Programme was launched. Under this programme a mahseer hatchery in an area of about 5 ha has been set up at Harangi in Kodagu district. The COF, in association with DOF, has developed a hatchery technology for *T. khudree*. During 1998-99 more than 3000 *T. khudree* fingerlings were produced from pond-raised brood stock. Realizing the advantages of cryopreservation of fish gametes, the International Foundation for Science (IFS), Sweden has funded a project on "Development of a viable protocol for the cryopreservation of *T. khudree* spermatozoa". Work conducted at COF demonstrated that *Tor khudree* spermatozoa cryopreserved and stored in liquid nitrogen upto 90 days were highly viable, producing 99-100% fertilization rates and 11-40% hatching rates. The larvae thus produced were completely normal. A combination of androgenesis and cryopreservation of fish spermatozoa would help to maintain genetic resources and conserve endangered species. Using androgenesis, the whole genome from cryopreserved spermatozoa could be recovered even if the species becomes extinct because these spermatozoa could be used to fertilize irradiated eggs from closely related species.

Labeo fimbriatus

Fringe-lipped carp (*Labeo fimbriatus*) has also been classified under the category 'vulnerable'. Its natural stocks have depleted to the extent that it may become endangered in future. *L. fimbriatus* is widely distributed throughout the Peninsular and Central India and forms an important fishery in some of the tanks and rivers in Karnataka. It is cultured in certain regions of Peninsular India where major carps do not occur in greater abundance and hence plays an important role in the rural economy of these regions. *L. fimbriatus* is herbivorous, feeding mainly on phytoplankton. It can grow to a maximum size of 3.5 kg (64.50 cm). It spawns during south-west monsoon and has been successfully induced bred with pituitary extract and ovaprim. Reciprocal hybrids between *Catla catla* and *L. fimbriatus* have been produced at UAS, Bangalore. The hybrids exhibited heterosis in terms of meat yield with higher flesh content than either of the parents. Hence, the hybrids appears to have good aquaculture potential. Since this species as well as *P. pulchellus* are also facing threat due to anthropogenic activities, there is a need to take up conservation measures to preserve genetic variation.

The following four programme are being taken by DOF and COF for conserving the fish genetic resources of Karnataka -(i) Work is in progress for establishing a sperm bank for *T. khudree* at COF. (ii) Hatchery at Harangi is being upgraded for commercial production of *T. khudree* fingerlings by DOF. (iii) Ranching of *T. khudree* fingerlings is being carried out in selected streams and rivers originating from Western Ghats. (iv) Standardization of induced breeding technique for *L. fimbriatus* is in progress in COF.

Future work

The following programmes are proposed to be taken up at DOF–(i) application of androgenesis and cryopreservation to conserve fish genetic resources, (ii) development of a protocol for cryopreservation of *T. khudree* eggs/embryos, (iii) information gathering documents on life history traits of *T. mussullah*, (iv) development of a protocol for cryopreservation of *L. fimbriatus* spermatozoa and eggs/ embryos, (v) establishment of gene bank for major carps to avoid in breeding and (vi) organizing awareness camps involving local people, other development departments and NGOs to judiciously manage fish biodiversity.

The foregoing account reveals that fish genetic diversity conservation measures taken by DOF, COF and NGOs are a step in the right direction. However, a lot needs to be done to revive the depleting stocks of mahseer, *L. fimbriatus*, *P. pulchellus*, *Bagarius bagarius* and loaches. Steps have also been taken to overcome the financial scarcity–the major constraint in conservation and management of fish genetic resources.

Fish Fauna of the Chaliyar River, North Kerala

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The Chaliyar river is one of the west flowing rivers of Western Ghats located north latitude 11° 29′ N, longitude 75° 52′ E. It has many tributaries such as Karimpuzha, Punnappuzha, Kuruvanpuzha, Tiruvanchipuzha, Cherupuzha, etc. with a catchment area of 2535 sq. km. The total discharge of the river is 7775 Mm3. The river which was in a pristine condition before 4 to 5 decades has become highly degraded in the lower stretches by the effluents of Gwalior Rayons and in the upper stretches by various anthropogenic factors like deforestation, high siltation, dynamite fishing and use of copper sulphate for fishing. During the summer months, the water in the river is very low due to high run off during the wet months. Further, a few dams proposed in the upstream will surely deal a death blow to the ecology of the river basin. It is essential that a holistic study is undertaken before we plan any project to utilize the water resources of the river.

During the period 1994 to 1997, five collection trips were made to the river Karimpuzha during the rainy season (July-August) and the dry season (March-April). Velon screen of length 3 m, 5 m and 10 m were used to collect the fishes. In addition, traps made of earthern pots, the mouth covered with cloth having a hole in the centre were also used. Such pots with prawn heads and 'atta' were kept over night in the deeper areas to collect fishes. The fishes were preserved in formalin for further studies.

A few ornamental and aquarium fishes like *Puntius melanampyx, Puntius punctatus, Garra mullya*, *Mastacembelus armatus*, etc. were transported to the Calicut Aquarium for behaviour studies. It was observed that many specimens of *Puntius* species were infected by epizootic ulcerative syndrome (E.U.S.) and mortality of these fishes were also observed during the dry months. The identified fishes were deposited in the Reference Collection Museum of the

Zoological Survey of India.

The following species were collected during the study:

Chela fasciata Silas–F.5305

Barilius gatensis (Val)- F.5308

Danio malabaricus (Jerdon)- F.4729, F.4730, F.5307

Puntius filamentosus (Val)–F.5310

Rasbora daniconius (Ham)–F.4527, F.4730, F.5307

Puntius melanampyx Day–F.4529, F.4731, F.5311

Puntius punctatus Day–F.4531d, F.5309

Garra gotyla stenorhynchus (Jerdon)–F.4732

Garra mullya (Sykes) -F.4533, F.5312.

Fish Genetic Resources of Chalakudy River System, Kerala

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Chalakudy is the fifth longest river in Kerala and its watershed lies between 10°5'to 10°35' N latitude and 76°15' to 76°55' E longitudes and located in the Ernakulam, Trissur and Palakkad districts of Kerala State. It originates from the Nelliampathi and Anamalai Hill ranges and joins Periyar river at Elanthikkara. The major tributaries of this river are Parambikkulam, Sholayar, Kurisukutty and Karappara. Chalakudy river has a catchment area of 1704 sq. km and has a total annual yield of 2033 Mm^3. Chalakudy river is one of the most important rivers in Kerala with diverse fish fauna. A total of 83 fish species were recorded from the river, during a recent survey. If the past records are included, total number of species increases upto 98. This total number includes typical primary fresh water stream fishes, the secondary fresh water fishes or migratory fishes and wetland species.

New species and records

Between 1994-97 itself 5 new species were recorded from this river, viz. *Garra surendranathanii, Osteochilichthys longidorsalis, Horabagrus nigricollaris, Travancoria elongata* and *Puntius chalakkudiensis*. This clearly indicates the richness of fish diversity of this river. *Glyptothorax lonah* from Karappara tributary of Chalakudy River was the first record of the species from Kerala. *Barilius* bendelisis from Thekkady tributary was the first report from a west flowing river in Kerala. *Macrospinosa cuja* was the first report from the freshwater of Kerala. Apart from these *Hypselobarbus kurali, Puntius dorsalis, Travancoria jonesi, Euryglossa orientalis*, *Nemacheilus guentheri*, *Ompok malabaricus* and *Tetraodon travancoricus* were reported for the first time from Chalakudy River.

Distribution of species

Of the total fishes obtained, 15 species were found to be very common and out of which, 11 had a uniform distribution throughout the river system; 32 species were common while 19 species were rare. Six species were considered very rare, they are - *Hypselobarbus thomassi, Labeo calbasu, Glyptothorax madraspatanam, Hypselobarbus kolus, Glyptothorax lonah* and *Travancoria jonesi.* Five species that have been introduced were collected. Among the introduced species *Oreochromis mossambica* has become well established and was recorded from all zones. Twelve species are secondary freshwater fishes or migratory fishes and all these fishes were collected from, low land area that lies <75m above MSL except for *Megalops cyprinoide*s and *Euryglossa orientalis,* when were reported from even 50 km away from seacoast. During the present detailed survey in Chalakudy River, we could not locate 15 species that were recorded by earlier workers. Of the total species recorded, 36 species are considered to be endemic to Western Ghats, of which 10 species are endemic to Kerala part of Western Ghats. *Horabagrus nigricollaris, Travancoria elongata* and *Osteochilichthys longidorsalis* are known only from the Chalakudy River. There are about 57 economically important species, of which 27 species can be used as food fishes while 30 species are ornamental.

A total of 61 species were recorded from low land areas (that lies <75m above MSL), 68 species from mid land (that lies between 75-500m above MSL), 36 from high land areas (that lies between 500-750m above MSL) and 14 fishes were recorded from high range areas (that lies >750m above MSL).

Major threats

As in other parts of India the tropical evergreen forest of southern Western Ghats are facing extreme anthropogenic pressure. Alteration of the forest habitat causes great change in rivers and their fish fauna. The major threats are (i) extensive forest destruction and the disappearance of riparian vegetation (ii) ever increasing soil erosion in the streams (iii) intensive agriculture in the catchment areas (iv) industrial, agricultural and domestic pollution of the river (v) extensive sand mining (vi) uncontrollable saline water intrusion (vii) a variety of problems caused through the series of reservoirs in the river (viii) indiscriminate fishing by using explosives and various poisons. (ix) introduction of exotic fishes in the reservoirs results in competition with native species for food and habitat. (x) fishing during monsoon period, which is the breeding season for most of the fishes.

Extensive deforestation and intensive agriculture in the catchment area has resulted in severe soil erosion, land slides and also drying up of streams. Some of the perennial tributaries have dried up due to these activities. Various types of pollutants affect the fishes adversely. Extensive sand mining results in habitat destruction. Construction of dams will decrease the water flow and it will be further decreased by large-scale sand mining and these ultimately result in uncontrollable saline water intrusion. To control this problem, a bund has to be constructed at the very lower reaches, which might inhibit the free movement of the secondary freshwater fishes. With construction of reservoirs, the river becomes suitable mainly for reservoir fisheries. The original fishes of the area disappear after the inundation. Introduction of exotic fishes in the reservoir will result in extinction of the local fishes due to competition.

Instead of using gill nets and line fishing, most of the fishermen are using explosives and various poisons to catch fish. These types of destructive methods will kill all the fishes including the non commercial small fishes and other organisms. Even though there is a law prohibiting catching fish during the monsoon period when fishes breed, nobody follows or enforces it.

Conservation of fish fauna of Periyar lake, Thekkady, Kerala

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Mini Santosh Lal, 2000. Conservation of fish fauna of Periyar lake, Thekkady, Kerala. pp.160 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR - NATP Publication - 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

The Periyar Tiger Reserve composed of an area of 777 sq. km which is situated in Idukki District in Western Ghats. The water spread area is 26 sq. km. The Periyar is known to support several interesting and important fishes. A study was made on the fish fauna of Periyar in the year 1996 from January to December and identified 39 species of fishes. Of these, 36 are native fishes and 3 are introduced species. The two very common exotic species of this lake are *Cyprinus carpio* var. *communis* and *Oreochromis mossambica* (Peters), which are a menace to the native fishes, and the third introduced species is *Labeo rohita*. The fisheries officials of the locality are of the opinion that the fingerlings of rohu had an accidental entry into the lake. The important endemic species of the lake are *Crossocheilus periyarensis, Gonoproktopterus curmuca, G. periyarensis* (Menon and Jacob), *Lepidopygopsis typus* (Raj), *Puntius ophicephalus* and *Menonemacheilus menoni*. The study revealed that some of the fishes that flourished well in the past have declined these days. For example, the *Channa micropeltes, C. orientalis* (Bloch and Schneider) and *C. striatus* (Bloch) could not be collected during the study revealing that the fish wealth of the lake has been diminishing. This may be due to (i) over fishing, (ii) competition with introduced species. *Tor khudree* (Sykes) which is an excellent sport fish of the lake is also exhibits a declining trend. *Gonoproktopterus micropogon* periyarensis and *Lepidopygopsis typus* need immediate conservation efforts as their resources are depleted and they are reported only from this lake in Indian subcontinent. The conservation techniques suggested are (i) banning over fishing and dynamiting, (ii) eradication of introduced species and (iii) prohibition of fishing during closed season.

Conserving Fish Diversity of Vembanad Wetlands, Kerala

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The Kerala State, covers just a little over one percent of the total geographic area of the country and given its size, it has perhaps one of the longest coastline in the country and is rich in water resources. The availability of heavy rainfall averaging 2550 mm per annum, presence of 44 rivers and a west coast canal system of continuous chain of lagoons with innumerable number of cross canals characterizes the state as a “water abundant” region. The rivers in this humid tropical region are generally short, steep, fast flowing and monsoon fed. With a wide and varied topography extending from the foothills of the Western Ghats to the Arabian Sea, the pristine aquatic eco-systems are identified as hot spots of fresh water species biodiversity and genetic variability. However, owing to high population pressure, this fragile aquatic environment is subject to persistent human interventions. Despite several enactments to protect these resources, several species are declining especially in the riverine environment. For example, *Labeo dussumieri*, *Horabagrus brachysoma*, *Wallago attu, Gonoproktopterus curmuca*, *Tor khudree*, *Channa micropeltes* etc., to name a few, are greatly threatened.

The Vembanad wetlands, known as the inland fish basket of Kerala receive inflow from six major rivers, *viz.,* Periyar, Muvattupuzha, Meenachil, Manimala, Pamba and Achankovil and convey the same to the sea through several small openings called “azhis” and “pozhis”. The construction of a barrage across this backwater in 1975 virtually divided this estuarine system into a lagoon on the northern side and a freshwater lake on the south. Several estuarine species that used to support commercial fishery in the lake disappeared from the area on the southern side. The worst affected was the fishery for giant freshwater prawn *Macrobrachium rosenbergii* as the barrage obstructed the upstream migration of larval prawns and their natural recruitment.

Another marked change that is evident is the near total decimation of fish diversity in the freshwater zones of the lake due to shrinking of the lake both in area and volume due to the reclamation of the shallow areas for rice farming on a large scale and siltation consequent to deforestation in the catchment areas. The indiscriminate use of pesticides in rice fields has also aggravated the problem. The undisturbed shallow waters of the lake were congenial for breeding and natural recruitment of pearl spot (*Etroplus suratensis*)and the most important species that supports a very lucrative fishery in the lake. However, large-scale mining of the lakebeds for fossil shells and disappearance of fringe mangroves that provided a congenial breeding habitat were detrimental to the natural recruitment of the species. As habitat destruction is the major hindrance to natural recruitment, establishment of permanent and rotational sanctuaries and fish propagation zones in the lake is suggested to protect this declining indigenous fish resource and to ensure their sustained production. Since the species is admirably adapted to both fresh and brackish waters and is an ideal candidate for culture and the genetic differences within the species also need to be quantified.

In the light of the general concern over the overexploitation of stocks of inland capture fishery of the region, there is a dire need for sound conservation and management measures. *In situ* conservation of species diversity in natural habitats holds greater promise in fisheries than for crop or livestock. Conservation of fishery resources through ranching in open waters is a recognized strategy to rejuvenate declining fisheries and to restore species diversity affected by habitat alteration and over fishing. Since the rivers adjoining the lake are steep, short and become seasonally discontinuous during summer, the deep pools in the rivers could be protected as sanctuaries for riverine species. A few such zones can be identified for threatened species such as *L. dussumieri* and *H. brachysoma* in Meenachil and Pamba rivers. In addition to the above, *in situ* and *ex situ* conservation approaches involving captive breeding and cryopreservation can also be of great support.

The state is on the threshold of a boom in aquaculture development consequent to the successful launching of integrated fish farming in the lowland rice fields in eastern and north Kuttanad. Though the Indian major carps and exotic carps were introduced in the state during late sixties, the concept of fish culture took off only after a decade. However, recently there is a serious concern over the performance of hatchery reared carp seed in the state; this is mainly due to negative selection and inbreeding as proved earlier in some Karnataka state carp hatcheries. The effect of indirect selection in small farms with no infusion of brood stock exchange from wild stock has been noticed in some of our case studies. The major carps such as *Labeo rohita* appear to exhibit dwarfing in such situations. Since replenishment of brood stock is from within the farm, the possibility of mating individuals that are related to a common ancestry appeared to be responsible for this phenomenon. The problem may become more serious in small farms with small brood stocks, which do not maintain pedigree records. This calls for an organised genetic improvement programme in the state, especially for carps, utilizing wild riverine stocks. The possibility of using cryopreserved milt collected from wild stocks needs to be probed and pursued. This is an area where *ex situ* conservation techniques can complement *in situ* efforts in maintaining biodiversity.

Management Plans to Arrest the Decline of Freshwater Fish Diversity of Kerala

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Kerala is endowed with 41 west flowing and three east flowing rivers originating from Western Ghats, with a total water spread of 85,000 ha. The rivers and streams which are roaring through mountains and high ranges, sylvan slopes and variegated valleys, harbour a rich and diversified fish fauna which are characterised by the presence of many rare and endemic forms. Streams and rivers of Kerala are treated as freshwater sites of exceptional biodiversity in the country and therefore have been demarcated as one of the hot spots in the world. Of the total 170 and odd species of freshwater fishes of Kerala, the status of 90 species was assessed as per IUCN Red list criteria (Anon 1998). Though no species falls under extinct category, 18 species were listed as critically endangered, which are facing serious risk of extinction in the wild in the near future due to alarming population decline, habitat destruction and deterioration and also due to various anthropogenic reasons. Among them, 13 are endemic to Kerala Rivers. *Channa micropeltes*, a kind of snake head is reported only from Pampa river which showed a decline of its population of the tune of 99% of its original population size due to EUS disease, dynamiting and other destructive type of fishing activities, habitat alteration, poisoning and pollution. Interestingly, the blind cat fish *Horaglanis krishnai* is found only in the subterranean channels connecting the deep wells of Kottayam and its population has drastically declined to more than 95% due to habitat destruction. Some of the other species under the critically endangered category are the sprat *Dayella malabarica, Glyptothorax davissinghi., Horabagrus nigricollaris, Lepidopygopsis typus, Monopterus eapeni, Osteochilichthys longidorsalis, Silurus wyanaadensis, Stenogobius malabaricus, Tor khudree malabaricus, T. mussullah, Travancoria elongata, Homaloptera montana, Hyporhampus xanthopterus* and *Neolissochilus wynaadensis*. Of the 31 teleosts categorisedas endangered species, 13 are endemic to Kerala waters. While *Labeo* *dussumieri* commonly called as "thooli" is found restricted to Central Travancore Rivers, species such as *Labeo dussumieri* and *Hypselobarbus kurali* are found in the central and northern rivers of Kerala. Other important species listed under this category are *Batasio travancoria, Bhavania australis, Botia striata, Garra gotyla stenorhynchus, Monopterus fossorius, Mystus malabaricus, M.punctatus, Nemacheilus keralensis, N. monilis, Osteochilus brevidorsalis, Osteobrama bakeri, Parambassis dayi, Puntius denisonii, P. fasciatus, P. ophicephalus, P. parrah, Tetraodon travancoricus,* and *Travancoria jonesi*. Some of the freshwater fishes such as *Garra hughi, Mystus punctatus, Osteochilus brevidorsalis, Nemacheilus monilis, P. arulius* and *P. fasciatus* are found in both in Kerala and Tamil Nadu. Of the 18 species assessed under vulnerable category, two are endemic to Kerala waters. The commercially important species under this category are *Clarias dussumieri dussumieri, Channa orientalis, Parambassis thomassi, Pristolepis malabarica* and *Noemacheilus semiarmatus.* The percentage decline of the population of the above species is in the range 20-70% during the last 10 years. Under threatened species of lower risk, 13 species were listed which include *Channa punctatus, Macrognathus aral, Nandus nandus, Puntius carnaticus, P. melanampyx* and *Parluciosoma daniconius*. Under lower risk of least concern category, 5 species were included were such as *Channa striatus, Nemacheilus guentheri, Nemacheilus triangularis* and *Salmostoma clupeoides*.

Biodiversity of inland fishes of Kerala is alarmingly declining primarily due to unsustainable and unethical fishing practices prevalent in the rivers and streams. A variety of destructive type of fishing activities are being practiced in the inland water bodies of Kerala such as poisoning using chemicals, insecticides and seed of plant origin, dynamiting, electric fishing, "padala" fishing and "kolli". The inland fishes of Kerala are also subject to severe the over-fishing leading to reduction in the average size constituting the fishery (size over-fishing) and massive wanton killing of spawner population with the onset of monsoon (recruitment over-fishing). Selective fishing could be responsible for predominance of weed and forage fishes in the rivers replacing many of the commercially important species. The freshwater habitat are also prone to various type of man made stresses such as construction of bunds, barriers, anicuts, weirs and dams which have eventually resulted in the loss or impairment of natural habitat of many fishes. The depth of rivers and streams of Kerala are getting alarmingly reduced mostly due to deforestation activities, siltation, sediment deposition and short term flooding. Large-scale abstraction of water from the rivers for the purpose of agriculture, irrigation, etc. has also resulted in the drying up of rivers during summer months. The freshwater fishes are also subject to various pollution hazards such as industrial effluents, pesticides and chemical fertilizers and sewage and focal disposal. It is estimated that the industrial effluents of the tune of 6.5 m^3 are discharged from 200 medium and large and about 2000 small-scale industries of Kerala. Fishes inhabiting the polluted zone may face reproductive impairment, growth retardation, morphological abnormalities apart from total destruction of eggs and larvae. Massive fish mortality due to effluent discharge from industries is a regular affair in some of the rivers like Periyar and Chaliyar in Kerala. The biodiversity of indigenous fishes of Kerala is also under strong threat due to the clandestine introduction of species like African catfish *Clarias gariepinus*, red piranha, etc. Moreover, the ranching of non-native Indian Major Carps as part of fishery enhancement in regions like Kuttanad may pose potential threat to indigenous species.

The management strategies proposed for the conservation of endangered and endemic freshwater fishes of Kerala are (i) strengthening data base on population size and distribution and undertaking extensive survey and sampling, (ii) generate precise information on migration, breeding behavior and spawning grounds and season (iii) based on the information so obtained, the possibility of habitat preservation by establishing fish sanctuaries (iv) to standardize brood stock management and captive breeding techniques of endemic and endangered species and possibility of rehabilitation of these species by large scale seed production and stocking. (v) establishment of brood stock maintenance and hatchery exclusively for indigenous endemic endangered fishes (vi) banning clandestine introduction of exotics and strict implementation of existing guidelines for the introduction of exotics (vii) discouraging non-native species like Indian major carps in ranching programmes (viii) the potential impact of exotics which have already established in the open water system require a detailed study, especially with regard to biology, habit and habitat, etc. of indigenous species (ix) adopt location specific habitat management plans such as establishment of sanctuaries, closed seasons, mesh size regulation, etc (x) initiation of people participation programme such as formation of network comprising fisheries institute, NGOs, local panchayats and grama sabha, conduct of awareness camps, preparation of posters, stickers, pamphlets, videos and slide shows.

Occurrence of *Labeo rohita* and Cirrhinus mrigala in Meenachil, Manimala and Pampa Rivers, Kerala

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Indian major carps, catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) are not native to the rivers and water bodies of Peninsular India. However, these species have been successfully transplanted to all the Southern states during early fifties, where they have been cultivated in a large scale. Many hatcheries including those owned by the state governments supply large amounts of seed of Indian major carps (IMC) to the farmers of southern states every year.

In Kerala, freshwater fish culture activities are concentrated in areas of Kottayam Alleppey, Trichur, Ernakulam and Palakkad districts. The IMC constitute the major share of all the freshwater species cultivated. The seeds were brought earlier from the State Fishery hatcheries at Malampuzha, Kerala and Bhawanisagar Dam, in Tamil Nadu and later from the hatcheries at Andhra Pradesh. As the culture activities intensified, especially in places like Kottayam and Alleppey Districts, many new hatcheries came up both in private and government sector to cater to the increased requirement of seed. The State government at the same time also initiated steps to develop the reservoir fisheries through a three pronged strategy comprising of large scale production of IMC seeds, stocking of carps and creation of breeding and raising facilities at reservoir sites. Fish farms have been constructed in eight reservoirs for raising stocking material and many reservoirs are stocked with IMC seeds (Sugunan, 1995). However, there were no reports of capture of IMCs from natural water bodies till recently. During field surveys by NBFGR in 1997 and 1998, interviews with local fishermen from Cherpunkal and Kidanpoor (Meenachil River), Kallungal (Manimala River) and Takazhy (Pampa River) revealed regular appearance of rohu and mrigal in small numbers in the catches (less than 0.1%) round the year in these rivers during the last 3-4 years.

The sizes of specimens normally caught are of 1+ year group. There were no earlier reports of landing of ripe individuals of rohu and mrigal, however during July 1997, the authors witnessed four ripe rohu females caught by gill net from Pampa river. The Kerala Government recently river ranched large number of seeds of IMC in Periyar river with a view to enhance the commercial fisheries.

Rohu and mrigal are not native to the rivers of Kerala. When they were first introduced to Kerala in 1951, the intention was to stock them in reservoirs to enhance the production. The State Government nor the private farmers nor NGOs in the State are aware of the consequences of ranching or accidental release of non-native and hatchery reared species. The non-native species when released to the natural water bodies can compete, inter-breed and contaminate the native fauna and even slowly establish in newer places. In Kerala, no attention has so far been paid to increasing the stock of endemic, commercially important species such as "Pullan" (*Labeo dussumieri*) "manjakoori" (*Horabagrus brachysoma*) and "Kooral" *Gonoproktopterus curmuca*, even though all these species fetch a much better price compared to rohu and mrigal. NBFGR's own experience in successful induced breeding of *L. dussumieri* and *H. brachysoma* indicates that breeding and larval rearing of native fishes are not difficult tasks. The State Governments, private hatcheries and NGOs may attempt to undertake the artificial breeding programme of endemic, commercially important species to ranch natural water bodies.

Appearance of rohu and mrigal specimens in the rivers of Kerala is definitely a pointer towards their chances of slow establishment. They may not grow to spawner size in the river stretches owing to low level of water in many rivers during summer months. However, the upper reaches of Vembanad Lake, which has literally become a freshwater ecosystem after construction of Thannermukkom barrage, can act as a reservoir, where they can breed and establish. Hence, caution must be taken not to ranch as well as to prevent the accidental release of non-native fish species to natural water bodies.

Decline of Endemic Fish Species in Selected Reservoirs of Western Ghats

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The reservoirs constructed on the rivers/tributaries originating from the Western Ghats harbour over fifty endemic fish species. Many of them do not attain very large size and hence, their contribution to the fishery is of a low magnitude. Several new species were introduced to the system during the 50s and 60s aiming at improving the yield from these reservoirs. This introduction, chiefly of *Catla catla, Labeo rohita, Cirrhinus mrigala, Oreochromis mossambicus, Cyprinus carpio*, and *Hypothalmichthys molitrix* resulted in a tilt of the population structure towards the exotic, and non endemic species. In Aliyar reservoir in Tamil Nadu, apart from introduced species, 44 endemic species comprised the fish fauna, of which 19 used to regularly contribute to the commercial fishery. By 1987-88, introduction of tilapia and the regular stocking with Indian major carps reduced the number of endemic species contributing regularly to the fishery to two (*Ompok malabaricus* and *Channa maruilus*) and only stray specimens of other species appeared in the catches. Since 1988 adoption of intensive stocking with advanced fingerlings of Indian major carps, common carp and the silver carp have further reduced the species spectrum in this reservoir. Species like *Gonoproktopterus curmuca, G. dubius, Puntius carnaticus, P. sarana, Ompok bimaculatus, Labeo kontius, Tor khudree, Cirrhina cirrhosa, Mastacembelus armatus, Etroplus suratensis, Notopterus notopterus* do not figure in the catch any more. Contribution by endemic species and the tilapia to Ailyar fishery was only to the extent to 1.1% of the total landings in 1990-91. In Thirumoorthy reservoir too, excessive stocking with Indian major carps and exotic species reduced the contribution of endemic species to fishery from 19.2% (4-5kg/ ha/ yr) during 1978-82 to insignificant levels by 1993-94. At least 13 species used to form the bulk of endemic species fishery in this reservoir. The reduction in their contribution to fishery obviously reflects a drastic reduction in their population in the ecosystem. Though many of these endemic species continued to form a component of the catch from these two reservoirs even when tilapia population was at its peak, systematic stocking with the major carp has brought down their population to insignificant levels with in a span of 4-5 years.

A situation similar to this is expected to be prevalent in most other reservoirs subjected to indiscriminate stocking and exploitation. Almost half of the 30 reservoirs in Kerala falls in wildlife protection area and are not accessible to regular fishery. Very little information is available to monitor the fish fauna of these reservoirs. Nevertheless, list of species available from Idukki reservoir suggests that species like *Gonoproktopterus curmuca, G. periyarensis, Rasbora daniconius, Barilius bakeri, Puntius melanampyx, Tor khudree, Ompok malabaricus* and *M. guntheri* are available in this reservoir. A survey during 1987-88 at Parappar reservoir located twenty species belonging to eight families that included *Tor khudree, Puntius dorsails, Channa micropeltes, Ompok malabaricus* and *Tor khudree* populations are reported from Parambikulam, Idukki and a few other reservoirs.

The fishery of Malampuzha reservoir consists of a good percentage of endemic species. Seventeen species including three species of *Puntius, Ompok malabaricus, Mystus armatus, Etroplus suratensis, Channa marulius* and *Anguilla* spp. formed a part of the commercial fishery. *G. curmuca* still forms a sizeable portion of the fishery. *Tor khudree* was reported up to 1988. during a In the mass mortality which occurred in Chulliar reservoir during 1988 fourteen endemic species were recorded which included *Etroplus suratensis, E. maculatus, Mystus malabaricus, M. armatus, Glossogobius giuris, Garra mcClellandi, Puntius sarana* and *Xenentodon cancila*.

It has been difficult to ascertain the qualitative and quantitative contribution of the endemic fishes in reservoir catches due to clubbing of species into groups for making the records emphasizing only revenue. A special directive is necessary to record the landings of the classified fishes to monitor the trend of their population in various reservoirs in Western Ghats. Occasional experimental fishing employing small-meshed nets is required in reservoirs that follow mesh-restrictions. Experimental fishing at regular intervals is required to record the structure and characteristics of listed fishes from reservoirs that fall under the restricted areas. At present, no serious effort is being done to evaluate the species abundance, distribution and combination of the associated riverine fish fauna of the region. A concerted effort has to be done at least once in five years for this evaluation. Selected reservoirs of the region have to be declared as bio-reserves of the endemic species and stocking of exotic species and the Indian major carps in these reservoirs should be banned. Reservoirs have a special significance in conserving the endemic fish germplasm of the Western Ghats due to their smaller size and seasonality of many rivers and tributaries of the area.

Fish Habitat and Diversity of Chittar River Basin, Tamil Nadu

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Chittar is an east-flowing river in the major Tamiraparani river basin in Southern Tamil Nadu. It has six tributaries, among which, three tributaries originate from Courtallam hills (995 m altitude) in Western Ghats. These tributaries have big falls, known as old falls, main falls and five falls and these waterfalls are popular as sacred bathing sites both during the southwest and northeast monsoon months (July–August and October–November). Due to huge crowds bathing in these periods, there is an excessive use of detergents, litter and faecal contamination, which are the major stressors in these water bodies. The fourth tributary called Gundar River, which originates at 740 m altitude in Shencottai hill ranges flows mainly through plantations (mostly clove and orchard trees). The fifth and sixth tributaries originate from Shencottai and Kadayanallur hill ranges (525 m altitude) of Western Ghats. There are no natural barriers like waterfalls and they flow through less gradient landscape. They are also less disturbed by human activities.

Ten sampling sites representing all the six tributaries including their confluence were selected for detailed study. Results presented in the study represent the dry season sampling (February–May 1997). Habitat inventory and Fish microhabitat use were assessed based on the methodology of Armantrout (1990) and Arunachalam *et al.,* (1988). Fish sampling was done using monofilamantous gillnets, dragnets and scoop nets.

Fish species richness and habitat heterogeneity were investigated. Twenty-seven species of fishes (Table 1) belonging to sixteen genera, four orders and eight families were recorded. Habitat complexity (Table 2) in all the streams showed variation in microhabitats such as substrate types, flow, depth and fish cover. Except at site 3 and 10, fish cover was uniform in almost all the sites. Riparian cover ranged from (10% at

Table 1. Abundance of fish species in Chittar river basin.

Fish species	Study sites									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Salmostoma clupeoides	-	-	-	-	-	-	-	-	-	20
Amblypharyngodon microlepis	-	-	-	-	-	-	-	-	-	119
Danio aequipinnatus	-	-	-	-	16	106	60	66	81	5
Esomus thermoicos	-	-	-	-	15	-	-	-	-	55
E. danricus	-	-	-	-	-	-	-	-	-	26
Rasbora daniconius	-	-	46	33	27	35	19	30	13	-
Rasbora caverii	-	-	-	-	5	6	-	-	-	3
Barbodes sarana sarana	-	-	-	-	-	21	14	16	16	-
Puntius bimaculatus	-	-	-	-	-	-	-	-	-	1
P. arulius tambiraparniei	-	-	-	-	-	-	-	-	-	1
P. conchonius	7	-	-	-	-	-	-	-	-	-
P. dorsalis	-	-	-	-	-	-	-	-	-	1
P. filamentosus	-	-	-	-	-	3	-	-	-	39
P. ticto	-	-	-	-	4	-	-	-	-	16
P. punctatus	-	-	-	-	-	-	-	-	-	2
P. sophore	-	-	-	-	-	-	-	-	-	2
P. vittatus	-	-	-	-	-	1	-	-	-	1
Garra mullya	131	43	52	32	22	57	39	17	21	-
Lepidocephalus thermalis	-	-	5	-	-	-	-	-	-	9
Nemacheilus triangularis	-	8	25	-	8	12	2	2	1	-
Bhavania australis	-	9	3	-	5	-	2	-	-	-
Mystus armatus	-	-	1	-	-	-	-	-	-	2
M. keletius	-	-	-	-	-	-	-	-	-	7
Etroplus maculatus	-	-	-	-	-	-	-	-	-	8
Macropodus cupanus	-	-	-	-	-	-	-	-	-	2
Glossogobius giuris	-	-	-	-	-	-	-	-	-	2

site 1) to natural cover (80%). Species richness was high in Gundar, Hanumannadhi and Karuppanadhi as evidenced by the fact that these three streams are less disturbed. Also during intermediate season, a similar condition was observed (Arunachalam *et al.,* 1997) in the basin.

Among the fish species recorded from the Chittar river basin in Western Ghats of Tamil Nadu, the following are considered as economically important and cultivable. *Barbodes sarana sarana, Glossogobius giuris*. The ornamental fishes include *Puntius* *bimaculatus, P. arulius tambiraparniei, P. conchonius, P. dorsalis, P. filamentosus, P. ticto, P. punctatus, P. sophore* and *P. vittatus.*

Table 2. Structural characteristics of nine study sites (dry period)

Study sites*	1	2	3	4	5	6	7	8	9	10
Order	3	3	3	3	4	4	4	4	4	5
Mean width (m)	26.0	14.0	4.0	50.0	3.6	4.0	5.8	3.8	7.1	63.0
Mean depth (cm)	36.1	49.0	21.8	20.0	40.8	36.1	28.1	25.0	21.0	150.5
Flow (@m/s)	0.29	0.44	0.21	31	0.66	0.41	0.39	0.19	0.21	-
Riparian cover (%)	50	60	0	60	50	60	30	20	30	-
Substrate (%)	-	-	-	-	-	-	-	-	-	-
Bedrock	20	40	40	50	50	50	50	20	20	-
Boulder	10	10	10	10	10	20	10	10	10	-
Cobble	-	10	10	10	15	10	10	10	10	-
Sand	30	30	30	20	20	10	10	40	30	100
Leaf litter	40	10	10	10	5	10	20	20	30	-
Fish Cover (nos.)	-	-	-	-	-	-	-	-	-	-
Bedrock edge	7	4	5	9	12	16	16	10	20	-
Boulder edge	3	1	-	30	2	8	9	1	3	-
Road undercut	1	1	-	2	3	3	-	2	-	-

*1. Old falls, 2. Honey falls, 3. Senbagathevi falls, 4. Orchard falls, 5. Gundar, 6. Hanumannadhi upstream. 7. Hanumannadhi downstream, 8. Karuppanadhi upstream, 9. Karuppanadhi downstream and 10. Confluence of all tributaries.

Conservation of the Endangered Freshwater Fishes of Kanyakumari District, Tamil Nadu

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In addition to being a major source of protein to many communities, freshwater fishes are of great recreational, educational and scientific value, and are important indicators of the health of aquatic ecosystems. Freshwater fishes, particularly those of the biodiversity hotspots in the tropics such as the Western Ghats, face a number of environmental threats resulting in their decline or even total extinction in several areas. It is therefore essential to assess the conservations status of fish fauna in localities where they are still holding ground, and implement programmes for ensuring their long-term survival. Kanyakumari district and environment make a fitting case for such a conservation programme.

Kanyakumari district, located at the southern tip of peninsular India, is an area of approximately 1684 sq. km., comprising of hills, plains and coastland. It has the southernmost escarpment of the Western Ghats mountain ranges. The lowland plain of the district has numerous freshwater bodies, which are sustained by rivers originating from the mountain forests, which receive the southwest and the northeast monsoons. More than 2000 large and small water bodies are listed in the official records of the district. Some of the larger and deeper water bodies are perennial and hold water even in drought-stricken years. Most of these wetlands are exploited as irrigation reservoirs. Apart from their irrigation potential, the perennial watercourses and wetlands of Kanyakumari district and environment are rich in tropical freshwater fish fauna of peninsular India. The first recorded inventory of freshwater fishes of the district was made by E.G. Silas at one of the upland rivers. T.J. Indra of Zoological Survey of India, too undertook a survey of fishes of the district. The Institute for Restoration of Natural Environment studied the freshwater fishes of two major wetlands of the district as a component of freshwater wetland ecosystems. A.J.T. Johnsingh of Wildlife Institute listed the fishes of a hill stream adjoining the district.

Altogether more than 40 species of fish, belonging to 15 families and seven orders, have been recorded here so far. At least eight of these are endemic to peninsular India, including a new genus (*Horalabiosa joshuai*), recorded in the high altitude waters of this area. The enigmatic Indian freshwater eels, *Anguilla bengalensis* and *A. bicolor* too occur here. It has been known that there is much similarity between the ichthyofauna of Peninsular India and those of Malaysia and Indonesia. Western Ghats is a repository of the tropical freshwater fishes belonging to Indo-Malay sub-region, with high degree of endemism. Whereas the previous studies have resulted in some very useful baseline data on the fishes of Kanyakumari district, no detailed survey of freshwater fishes and their ecosystems, nor examination of their conservation needs have, so far, been undertaken.

In the meantime, pressure from exotic *Tilapia mossambica* and extensive commercial fishery and rapid shrinkage of the habitat through invasion by exotic weeds *Eichornia crassipes* and *Ipomoea cornea* has considerably reduced the populations of native fish fauna in these wetlands. Qualitative observations and reports from local fishermen strongly suggest that many species have been already eliminated from the area or they are on the verge of extinction. Unless drastic conservation measures are taken up immediately, many of the native fish species will disappear from this area–even before scientists and laymen have had an opportunity to appreciate the value and significance of these species and their ecosystems.

In addition to being a repository of tropical freshwater fish fauna, the wetlands of Kanyakumari district are of considerable ecological significance being rich tropical freshwater wetlands of the peninsular India. These wetlands provide natural habitat for other aquatic life forms and for water birds. Some of the water birds that are migratory use these wetlands as their southernmost wintering grounds in the Indian sub-continent. Conservation of the ichthyofauna of Kanyakumari district and environment, along with their freshwater ecosystems, therefore is not only justified, but also a crying need. In this context, it has become extremely urgent to develop a strategy for ensuring the long-term survival of the freshwater fishes of this zoogeographic unit, through implementing the following objectives.

1. To make a detailed inventory of the freshwater fish fauna of Kanyakumari district and environment, and to document their natural habitats.
2. To prepare a genetic atlas of the freshwater fishes of Kanyakumari.
3. To determine the status of native freshwater fishes in ecosystems which are

influenced by commercial fishery and by *Tilapia mossambica*.

4. To determine the factors that affect the stability of the freshwater ecosystems, and to develop ecological methods for protecting and restoring their biodiversity without compromising their use for agriculture and traditional fishing.
5. To formulate measures to exploit recreation and eco-tourism as a means to ensure long-term conservation of the native freshwater fishes.
6. To develop one or more large freshwater ecosystems of the area as totally protected repository and gene pool of the native fishes of this biogeographic area.
7. To ensure people's participation in the conservation of freshwater fishes and their ecosystems through environmental education to selected target groups.

While the programme would cover most of the perennial freshwater wetlands, rivers, hill streams, waterfalls and even ground-level irrigation wells of the area, only a few large water bodies and watercourses would be selected for intensive study. Genetic fingerprinting of the fish fauna of the study area will be undertaken with material to be collected during the fish faunal survey. The target groups for environmental education would include a cross section of the local community, decision-makers and implementing authorities. The Institute for Restoration of Natural Environment can undertake this conservation programme in collaboration with the Institute for Coastal Area Studies, M.S. University, Tamil Nadu.

Biodiversity of Fish Species in the Lotic Habitats of Kanyakumari District

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Thampi Jeyaraj, C., 2000. Biodiversity of fish species in the lotic habitats of Kanyakumari district. pp. 177-179 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR - NATP Publication - 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

Kanyakumari, a small district in Tamil Nadu located at the southern most tip of Peninsular India has the three ecotypes *viz.* the mountains (high lands) the plains (middle lands) and the sea (low lands). The general climate of the district is pleasant due to monsoon winds, the proximity of the sea and the dwindling height of Western Ghats. About 32.4% of its total area is under forest cover. Kanyakumari district is very fertile which is due to five rivers flowing through it and the large number of ponds and lakes. The five rivers are (i) Thamiraparani River otherwise called Kuzhithuraiyar, (ii) Pazhayar River, (iii) Valliyar River, (iv) Pantivaikkal River, originally named Ponnivaikkal River and (v) Bomfurivaikkal.

The major perennial river system in Kanyakumari District is the Thamiraparani River. It has two tributaries, the Paralaiyar and Kodaiyar. River Paralaiyar originates from Asambu hills and River Kodaiyar from Muthukuzhivial mountains of the Western Ghats. Pechiparai dam is constructed across Kodaiyar and Paralaiyar is dammed at Perunchani and these two forms the major reservoirs which help to meet the water requirement of the entire district. Pazhayar originates from the south of Mahendragiri peak, passing down a steep gorge, reaches the west of Ananthapuram and supplies water to Thovalai and Agasteeswaram Taluks. Valliyar starts from Velimalai mountains, Ponnikal Vail from Puliyadicheri hills and Bomfurivaikkal originate from hills located near Valvachathottam Village.

All these rivers form the potential habitat for a vast array of fresh water fish species. Based on previous studies and surveys, the following fish and prawn species have been identified in the freshwater systems of the district.

Factors affecting species decline

Surveys undertaken and the enquiries made with local fishermen have revealed the fact that most of the fish species are disappearing from their usual habitats and the general fish population has been dwindling and the reasons for the decline of

Sl. No.	Species	Category		
		Edible	Ornamental	Others
1.	*Catla catla*	+	—	—
2.	*Chanos chanos*	+	—	—
3.	*Etroplus suratensis*	+	—	—
4.	*Etroplus maculatus*	+	—	—
5.	*Rasbora daniconius*	—	+	—
6.	*Oreochromis mossambicus*	—	—	+
7.	*Arius* sp.	—	—	+
8.	*Caranx* sp.	+	—	—
9.	*Mugil cephalus*	+	—	—
10.	*Aplocheilus lineatus*	—	—	+
11.	*Ambasis gymnocephalus*	—	—	+
12.	*Therapon* sp.	—	—	+
13.	*Mystus* sp.	—	—	+
14.	*Puntius filamentosus*	—	—	+
15.	*Glossogobius giuris*	+	—	—
16.	*Channa* sp.	+	—	—
17.	*Danio aequipinnatus*	—	+	—
18.	*Barilius bakeri*	—	+	—
19.	*Puntius melanampyx*	—	+	—
20.	*Heteropneustes fossilis*	+	—	—
21.	*Clarias dussumieri*	+	—	—
22.	*Puntius conchonius*	—	+	—
23.	*Mastacembelus armatus*	+	+	—
24.	*Macropodus cupanus*	—	+	
25.	*Puntius ticto*	—	+	—
26.	*Puntius vittatus*	+	+	—
27.	*Anguilla bicolor bicolor*	+	—	—
28.	*Macrobrachium rosenbergii*	+	—	—

the freshwater fish resources of the river are :-

1. Sand mining

Removal of sand from rivers has resulted in change of the sandy bottom into a muddy one and a shallow flowing water into deep stagnant water. This has caused the disappearance of many fishes generally requiring sandy bottom.

2. Destructive fishing

Aadivaasis and the people living on the banks of the rivers use chemical piscicides, explosives and plant fish poisons such as *Croton tiglium* that indiscriminately kill all the fishes.

3. Agricultural pesticide application

Water used for irrigation returns to the rivers in the lower reaches along with different pesticides applied in the agricultural fields. This causes elimination of many fish species inhabiting both the agricultural field and the riverine system. *Channa* sp., *Puntius* sp. and fresh water eel *Anguilla* sp. are the worst affected.

4. Effluent discharges from factories

Three rubber factories owned by the state government located on the bank of Paralaiyar and Kodaiyar discharge their raw effluents into the streams feeding the rivers. They are found to cause fish kills and reduce fish species diversity. The coconut husk retting effluent discharged into the river mouth is also known to cause mortality.

5. Reduced forest cover

Due to reduced forest cover and the resultant changes, some of the rivers have become seasonal. They become dry during summer season killing all the fishes living in them.

Studies in the Paralaiyar (upper reaches) and the river mouth of Pantivaikkal river at Rajakkamangalam reveal less fish species diversity due to poor water quality as a result of the discharge of industrial effluents.

Threatened species

Based on comparison of present fish fauna with earlier observation the following species can be considered as threatened from this district

i) *Channa species*

ii) *Anguilla species*

iii) *Glossoglobius giuris*

iv) Fresh water prawns such as *Macrobrachium rosenbergii* and other *Macrobrachium* species.

Need for Conservation

i) Fish is the common protein food for the Aadivaasis and the people who live on the banks of the rivers.

ii) Economic potential of the ornamental fishes can be exploited.

iii) For the maintenance of normal food web pattern

Sustainable Utilization of Fishes of Kanyakumari District for the Benefit of the Hill Tribe

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Kanyakumari district comprises of three natural divisions, namely mountainous remain, lowland plains and the seacoast. The mountainous terrain, which forms about a third of the district, is the southernmost limit of the Western Ghats. Four major perennial rivers flow out of the mountainous terrain, namely Chittar, Kodayar, Masupatiar, and tribal people of the hills known as Kani.

The Kanis inhabit almost all hilly areas of the district where there is natural forest. Lately, they have also been rehabilitated in locations outside the forest areas. The fishes that are frequently consumed by these tribal people include the following species: *Mastacembelus* sp., *Anguilla bengalensis, Puntius filamentosus, Belone cancila, Heteropenestus fossilis, Etroplus maculatus, P. sarana, Aplocheilus blocki, Nemacheilus pulchellus, Wallago attu, Clarias dussumieri, Glossogobius* sp., *Channa punctatus, C. striatus* and *Oreochromis mossambica*. The Kanis consume fish along with rice and tapioca.

A survey undertaken in the hilly regions by the Society for Social Development and Social Forestry division of the Forest Department revealed the following facts. The Kanis consume these fish regularly, depending upon their availability and the season. However, they have been facing severe shortage of many of these fishes, in the recent times. The *Channa* sp. for example, which was regularly available in the hill steams have not been seen by the Kanis for the past few years. The Kanis attribute the decline of the populations of edible fishes to fish disease, landslides (caused by the big floods of 1992) and over exploitation of the fish resource. Due to the increase in the population of the Kains from 5000 in the year 1981 to 7338 in 1991, and much more in the recent years, the fishes are indiscriminately hunted for their food.

So it becomes imperative to take remedial measures to conserve the fish stock for sustainable utilization. A programme is urgently needed for restoring the populations of these fishes. Propagating the native fishes by artificial breeding and river ranching are important methods to achieve this objective. Rehabilitation programme for *Channa* sp. is urgently needed. Training of the Kanis in the fish rearing and ranching programme, creating awareness among the tribal people to control the hunting of brooders and young ones and sustaining the local variety of fishes by technology intervention should be the main tasks to be considered by the proposed project.

Participation and collaboration of scientific community with social scientists and forest officials will help achieve this objective. Self-help-groups (SHG) can be formed in each tribal village. Committees consisting of village leaders, representatives from SHG, NGOS, forest officials and the university faculty can undertake programme execution.

A New Species of the Genus *Salmostoma* (Swainson) from a Man-made Lake of Peninsular India

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Jayaraj, E.G. and Krishna Rao, D.S., 2000. A new species of the genus *Salmostoma* (Swainson) from a man-made lake of Peninsular India. pp. 182-183 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR - NATP Publication-1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

A total of 14 species of *Salmostoma* are reported from Indian waters. During the course of a survey of ichthyofauna of the Nelligudda reservoir (12° N, 77° S, 740 msl), a perennial man-made lake constructed below the confluence of two seasonal streams that drain into River Arkavathi (a tributary of River Cauvery), well established population of *Salmostoma*, hitherto undescribed were recorded. The new species has been designated as *S. belachi* as the fish is popularly referred to as Belachi meaning blanched, indicating the apparent color of the species in the vernacular Kannada.

S. belachi could be easily distinguished as different from the rest of the species of *Salmostoma* in having few gillrakers (22-24), 13-14 branched anal fin rays and lateral line count of 86-89. Fresh specimens are bright, with metallic green color over the dorsal profile while formalin preserved specimens have a streak of gray running along the centre of the body and over the dorsal ridge and pale white below the dorsal line.

This minnow inhabits the open water and is a predominantly zooplanktanivorous fish. The fish breeds during the monsoon season, appears in stray numbers in the commercial catches. The fish can be exploited using small-meshed gillnets (30 mm). *S. belachi* appears in large quantities in dragnets during summer and the fish is sun dried and marketed. On an average, the fish attains 120mm and weights 5.5gm.

The specimens of *Salmostoma* collected from other reservoirs under River Cauvery system (Hemavathi, Harangi, Kabani, Nugur) were also found to fit to the description of *S. belachi*. On the other hand, specimens of *Salmostoma* from Vanivilasasagar reservoir (across river Vedavathi, a tributary of River Krishna) were found to belong to the species *S. novacula* suggesting that perhaps *S. belachi* is endemic to River Cauvery system. From the literature, it is evident that *S. belachi* is confused for S. clupeoides. The full description of the species is being published in the *Journal of Bombay Natural History of India* (1999), vol.96 (1): 113-115.

Notes on the Taxonomy and Biology of *Puntius mahecola* (Val.)

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Selvaraj, C., 2000. Notes on the taxonomy and biology of *Puntius mahecola* (Val.). pp. 184-185 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR – NATP Publication – 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

Taxonomic status

Separate species status for *Puntius mahecola* (Valenciennes) was established by Day(1878) on the basis of the presence of a pair of prominent maxillary barbels which are absent in the allied species, *Puntius filamentosus* (Valenciennes). However, the subsequent workers kept *P. mahecola* as a synonym under *P. filamentosus*. This confusion over the correct systematic position of *P. mahecola* continued till Selvaraj and Mathew (1987) restored the original species status through their detailed studies on the morphometric and meristic characters. The two species are differentiated by their conspicuous difference in the colouration of the body, the shape of the dorsal fin in males, the shape and size of the cycloid scales and the shape of pelvic and pectoral fins in the species. The mouth is almost terminal in *P. filamentosus* while it is more or less sub-terminal in *P. mahecola*. Thus, these studies conclusively established the valid species status of *P. mahecola* (Fig. 1 & 2).

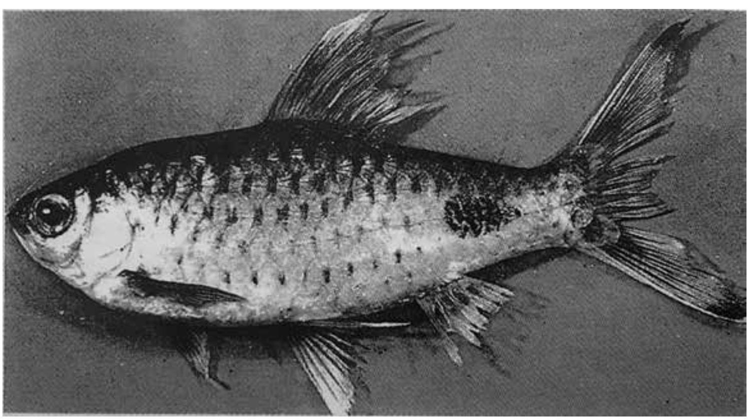

Fig.1. *Puntius filamentosus* (Male)

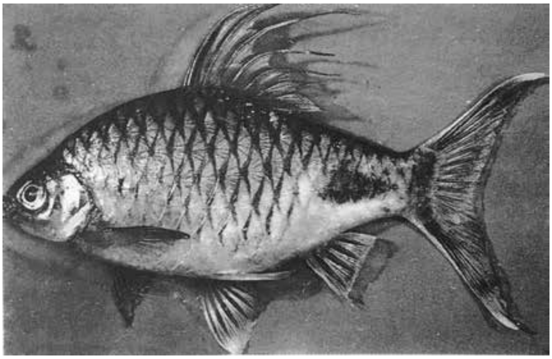

Fig.2. *Puntius mahecola* (Male)

Sexual dimorphism

The species exhibits distinct sexual dimorphism with males exhibiting presence of tubercles on the snout and the elongation of the dorsal fin rays. These characters become more pronounced during the breeding season. The males are very conspicuous with violet tinge over the body and bluish shade over the operculum, more prominent during the breeding season. The length frequency distribution of males and females reveal that the males are distinctly larger in size.

Maturity and spawning

The immature specimens are available almost throughout the year. The mature fish are available during January-May and October-December indicating two spawning peaks in the population. This has been further substantiated by the gonado-somatic index. While the smallest matured male measured 150 mm, the female was 98 mm at their first maturity. The two peaks of maturing ova are not sharply separated indicating that the spawning may be a prolonged one. The individual fish may breed only once in the season though the population may have a prolonged breeding season with two major peaks.

Food and feeding habits

The fish subsists mainly on detritus (53.64%), filamentous algae (21.81%), plant matter (15.45%) and others (diatoms, crustaceans, sand particles, etc. 9.1%). Thus it is a bottom feeder, occasionally browsing at the column of the reservoir.

Distribution

Its distribution extends to the freshwaters of south-west coastal region of India. It has been recorded in Bhavanisagar, Aliyar and Thirumoorthy reservoirs, Tamil Nadu. It is also abundant in Trichur and Palghat districts of Kerala.

Peninsular Food Fishes : Taxonomic Ambiguities

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Gopalakrishnan, A. and Basheer, V.S., 2000. Peninsular food fishes : Taxonomic ambiguities. pp. 186-187 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR - NATP Publication - 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

The aquatic resources of Peninsular India comprising of five Southern states *viz*. Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Pondicherry and two Western states-Goa and parts of Maharashtra cover about India's 20% river and canal sources, 38.6% of reservoirs, 50% of tanks and ponds and about 63% of swamp and derelict water bodies. Three major rivers Godavari, Krishna and Cauvery and a number of west flowing rivers originating from Western Ghats harbour a unique fish wealth, with high degree of endemicity. The mountains along the West coast of the peninsula-"Western Ghats" constitute one of the 18 biological "hotspots" of the world. The west facing drainages from this mountain range like the streams of Kerala (*i.e.* southern and central division of Western Ghats) has been classified by World Bank as one of the "few sites in the world showing exceptional biodiversity and high degree of endemism with respect to freshwater fishes" (Kottelat and Whitten, 1996).

The streams and rivers of Peninsular India including those originating from Western Ghats harbour many large-sized endemic food-fishes *viz. Labeo dussumieri, L. fimbriatus, Gonoproktopterus (Hypselobarbus) curmuca, Puntius pulchellus, Cirrhinus cirrhosa*, *Tor khudree* and several brilliantly coloured attractive ornamental fishes such as *Noemacheilus* spp.; *Travancoria* spp.; *Puntius arulius*, *P. filamentosus* etc. The nomenclature and systematic status of many species, solely based on morphometric and meristic characters are still in confusion indicating the urgent requirement for resolving the taxonomic disputes by making use of biochemical and molecular genetic tools as well as body measurements. The following are the cases of taxonomic ambiguities among important peninsular food and aquarium finfish species.

***Tor khudree* and *T. khudree malabaricus*:** Menon (1992) carried out the biometric analysis of populations of *Tor khudree* (from Krishna, Godavary and Cauvery rivers) and compared it with the populations (considered as *Tor khudree malabaricus*) and concluded that it is not different as the standard deviation of all characters tested overlapped between the two tested populations. But Arunachalam reported during CAMP workshop in 1997 (Anon 1998) reported that the specimens of "*Tor khudree*" collected by his team from Tambraparani River, Western Ghats did not show similarities with *Tor khudree* and considered them as *Tor khudree malabaricus*.

Tor mussullah: Menon (1992) on the basis of comparisons of standard deviations and standard errors concluded that *Tor mussullah* is same as *Tor khudree*. Jayaram (1997) critically analysed the systematic status of *Tor mussullah* and clearly stated *T. mussullah* is a distinct species, different from *T. khudree*, based on the meristic characters and presence of the characteristic hump at the occiput.

***Tor kulkarnii*:** Menon (1992) erected a new species *T. kulkarni* which is a dwarf cognate of *T. khudree*. According to him, the small head and the deeper body distinguishes this new species from all other species of mahseer. The species is confined to Darna river, Deolali, Maharashtra and apart from the type specimens no other specimen has so far been collected. The species is yet to find its place in the latest fish taxonomy books.

***Gonoproktopterus curmuca, G. kolus* and *Hypselobarbus kurali*:** Silas (1951), Talwar and Jhingran (1991), Jayaram (1981, 1991) and many others have treated *Gonoproktopterus (Puntius/Hypselobarbus) curmuca* and *G. kolus* as two distinct species based on morphometric and meristic characters. But Menon (1995) synonymised *H. kolus* and *H. curmuca* and erected a new species-*Hypselobarbus kurali* based on the curmuca barb specimens collected along the Western face of Western Ghats from Dakshina Kannada to Travancore.

***Puntius jerdoni, P. pulchellus* and *P dobsoni*:** There are the only indigenous species of carps known in India which feed up on aquatic vegetation as well as submerged grass. Even though all the above three were treated as separate species, Talwar and Jhingran (1991), Jayaram (1991) and David (1963) reported *P. jerdoni* as synonym of *P. dobsoni* and *P. pulchellus*. But Menon (1993) is of opinion that *P. dobsoni* is a distinct species and different from *P. jerdoni*.

Iso-electric Focussing as a Tool to Resolve Taxonomic Conflicts

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The systematic information in fish, including endangered and exotic species is based on measurements and counts of comparable body parts and characters. It is however, accepted that morphological characters upon which systematics are based, may be influenced by environmental conditions. The measurement of the same morphological characteristics within different populations of a species can produce different results. This often presents a dilemma to systematics when determining acceptable limits for variation of a morphological character within a taxonomic unit. For resolving the influence of environment leading to taxonomic ambiguities, genetic markers can be used. This mainly involves the analysis of deoxyribonucleic acid (DNA) or of the primary product (proteins) in order to provide information on genetic character of individuals and populations within and among taxonomic units. Iso-electric focussing (IEF) developed, as an electrophoretic separation technique that takes advantage of protein iso-electric point differences is one such tool. IEF separations tend to result in reproducible patterns. Because of the inherently high reproducibility of IEF separations, it can serve as reference for the identification of both the intra-specific and inter-specific genetic variations. IEF resolves many more bands than other electrophoretic methods and is usually able to differentiate even closely related species.

The eye lens is essentially an embryonic and avascular structure. Its bulk consists of layers formed from within outwards during the course of embryonic development. Protein extracted from sequential layers, therefore, provides a picture of ontogenetic development. Using IEF of eye lens proteins, several studies have been carried out for identification of species and phylogenetic relationship. However, the use of ultrathin IEF for resolving taxonomic conflicts is limited. At NBFGR, ultrathin isoelectric focussing (0.1 mm thin gel) of eye lens has been utilised to draw species-specific profile of over 15 species of fresh water fishes including endangered species *Tor tor* and *Tenualosa ilisha* and exotic species

Clarias gariepinus, *Cypinus carpio* and *Oreochromis mossambicus*. Haemoglobin IEF has also been found to species specific in number of fishes (*Anabas testudineus, Clarias batrachus, Heteropneustes fossilis, Channa punctatus, Puntius puntio, Cirrhinus mrigala* and *Labeo rohita*).

By using hemoglobin and eye lens proteins it is possible to assign species when standard IEF profiles of test species are available. For many Western Ghats fishes there are still taxonomic ambiguities (Gopalakrishnan and Basheer, 2000). For example while some authors indicate *Puntius jerdoni, P. pulchellus* and *P. dobsoni* as three distinct species, others are of the opinion that the three species are different. IEF will help in resolving taxonomic conflicts and help establish species identity.

Documenting Traditional Knowledge on Fish Diversity

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Basheer, V.S. and Gopalakrishnan, A., 2000. Documenting traditional knowledge on fish diversity. pp. 190-191 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR - NATP Publication - 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

Though aquatic ecosystems occupy nearly three-fourth of the surface of the earth, its biodiversity is poorly understood in comparison to terrestrial ecosystem. Aquatic ecosystem contains the greater portion of biological diversity especially in relation to species richness. As a whole the aquatic macrofauna, documented till now represents only a small portion of existing species. The working taxonomists in the species rich developing countries constitute only 6% of the world taxonomists. Hence, the species richness of these countries is often significantly under estimated. Though 2118 species of fin fishes are documented from India, information on the genetic diversity of the different fishes is still lacking even for highly commercially important species. Proper documentation and creation of database of species and genetic diversity of the fishes is necessary for husbandry and conservation point of view. Efforts have been initiated to validate this approach through preparation of biodiversity registers with local peoples' participation in few pockets like Ernakulam district, Kerala and other places . Also in the fast changing world scenario regarding 'access' and 'intellectual property' rights regarding biodiversity, these community registers can play an important part. However proper taxonomic support to these registers is required.

To document the diversity, the abundance and distribution of fishes, the knowledge of local people can be of immense support. The traditional knowledge of the local people is often found to be in helpful in documenting the species diversity. Fishermen usually notice even the slightest change in habitat, size composition, growth and migration of different species.

The traditional information provided by fishermen on the availability of wild stocks of endemic *Labeo dussumieri*, its upstream migration and breeding period were much helpful in collection of brood stock for cryopreservation of this fish by NBFGR and RARS. Similarly the knowledge of local fisherman about the abundance and spawning season of another endemic species, *Horabagrus brachysoma* is being used in collection trips by NBFGR scientists for its genetic characterisation and gene banking.

Many species often distinguished by the local people do not find a place in the latest taxonomic listing. Fishermen easily identify a mullet, locally known as "Pullikanambu" (suspected to be *Mugil poecilus*) caught occasionally in the gears along Cochin backwaters; they distinguish *Channa leucopunctatus* rarely caught from Vembanad Lake is also distinguished by them from other related species described by Day(1865). However, these two species are not listed as valid species in recent fish classification and the exact taxonomic position needs to be worked out. It is suggested that due importance should be given to fishermen's tradition knowledge and this information should be documented and analysed prior to planning and execution of fish surveys and conservation programmes.

A network of communities, colleges/universities and NGOs with research support from research organizations like NBFGR can help in documenting this rich traditional knowledge and incorporating it in local biodiversity registers. These registers can ensure that there is equitable sharing of benefits arising out biodiversity uses.

Survey of Existing Database for Endangered Species of Peninsular India

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Kapoor, D. and Dayal, R., 2000. Survey of existing database for endangered species of Peninsular India. pp. 192-193 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR-NATP Publication-1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

India is fortunate to be endowed with a bounty of natural habitats, including snow covered Himalayas, the Indo-Gangetic plains, the Deccan Plateau, Western Ghats, coastal regions and seas. Such vast areas support a broad extent of water resources, harbouring abundant fish genetic resources. Of the 24618 (Nelson, 1994) species comprising the fish genetic resources of the world, nearly 8.60% i.e. 2118 species occur in India and a database on these has been made at NBFGR.

With rapid development, population explosion and ever increasing demand for fish as food, the aquatic systems are under constant human-induced pressure resulting in decline in fishes upto an extent that many of the fishes have fallen under different threatened categories. In view of the above, NBFGR has made an exercise in 1992 to determine the conservation status of fishes of India, which is given in Table 1. The list was based on discussions with eminent scientists, naturalists, conservationists and also other published information including the papers presented at the seminar at NBFGR on Endangered Fishes of India (Dehadrai et al., 1994).

Table 1. Threatened fishes of India (Assessment by NBFGR in 1992)

Ecosystem	Endangered	Vulnerable	Rare	Indeterminate	Total
Coldwater	1	4	-	12	17
Warm water	3	13	2	28	46
Brackish water	-	2	-	4	6
Marine	-	2	-	8	10
Total	**4**	**21**	**2**	**52**	**79**

In addition to the above, one more effort with an objective to update the NBFGR's already prepared list of threatened freshwater fishes of India was made in September, 1997in a six-day Conservation Assessment and Management Plan (CAMP) workshop jointly organised by NBFGR and the Zoo Outreach Organisation (ZOO), Coimbatore.

Out of about 600 freshwater fishes, only 327 species were assessed (Table 2) due to lack of time.

Table 2. Conservation status of freshwater fishes of India as assessed in the CAMP workshop-September, 1997.

Sl. No.	Conservation status	Number of species
1.	Extinct (Ex)	1
2.	Extinct in the Wild (EW)	1
3.	Critically Endangered	47
4.	Endangered (EN)	98
5.	Vulnerable (Vu)	82
6.	Lower risk-near threatened (LRnt)	67
7.	Lower risk-least concern (LRlc)	13
8.	Lower risk-conservation dependent (LRcd)	0
9.	Data Deficient (DD)	18
	Total	**327**

Detailed investigations are needed to confirm the threatened status assigned to species in CAMP process as the workshop was based on available secondary literature and the personal experience of the participants. Gopalakrishnan and Ponniah (2000) have prepared a list of 106 ornamental freshwater species and 47 cultivable and sport fishes endemic to Peninsular India. Of these 153 species, 75 species had been evaluated in the CAMP workshop and their conservation status is given in Table 3.

Scanning the database developed by ICLARM (Fish base, 1998) revealed available information on life history traits of these species is less. To strengthen the existing database on these endangered species of Peninsular India, compilation of more information is urgently required. This will enable the researchers and planners to identify the lacuna and prioritise the activities with a view to conserve and sustainably utilise the resources of the region.

Table 3. Conservation status of freshwater fishes endemic to Peninsular India as assessed in the CAMP workshop during September, 1997

Sl. No.	Conservation status	Number of species
1.	Critically Endangered	17
2.	Data Deficient (DD)	11
3.	Endangered (EN)	31
4.	Vulnerable (Vu)	10
5.	Lower risk-near threatened (LRnt)	4
6.	Lower risk-least concern (LRlc)	2
	Total	**75**

Application of GIS Technique to develop Fishery Information System for the Western Ghats

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Sanjeev K. Srivastava and Ponniah, A.G., 2000. Application of GIS technique to develop fishery information system for the Western Ghats. pp. 194-196In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR – NATP Publication – 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

The water resources of the country are under great pressure owing to increased demand of water for irrigation and industrial purposes resulting into over exploitation of water bodies. The Western Ghats is recognized as one of the Biodiversity hotspot regions. The water bodies of Western Ghats can sustain such a diverse group of fishes only if suitable habitat is provided. Conservation of habitat is viewed as one of the immediate task that should be embarked at layer scale. For launching any such natural conservation programme it is important to have knowledge of what, where and how to conserve. In this sense it has become very essential that we develop perspective map of our water resources that are as detailed as possible and to develop atlas on all the information of the area and a common protocol for arrangement and collection of data. The information once put in the form of map will help the resource managers to communicate between their colleagues and constituents. It will also help the resource managers to visualize where the objects of interest are located such as plant type, slope, substrate type etc. to the stream. Once these occurrence will be mapped it will be possible to develop hypothesis of relation between the object and the stream and also it will be possible to develop spatial map having information about optimum habitat (Fig. 1). This type of spatial analysis is possible with the use of maps created by geographical information system.

The Geographical Information System (GIS) consists of computer hardware, software and georeferenced data. A GIS is capable of inputting, storing, manipulating, analyzing and outputting the data. The GIS coverage allows one to assess the influence of physical characteristics on biological computers of habitat. This information will provide managers with the tools to evaluate the importance of this resource to fishes. So there is a urgent need to develop a system having georeferenced database of

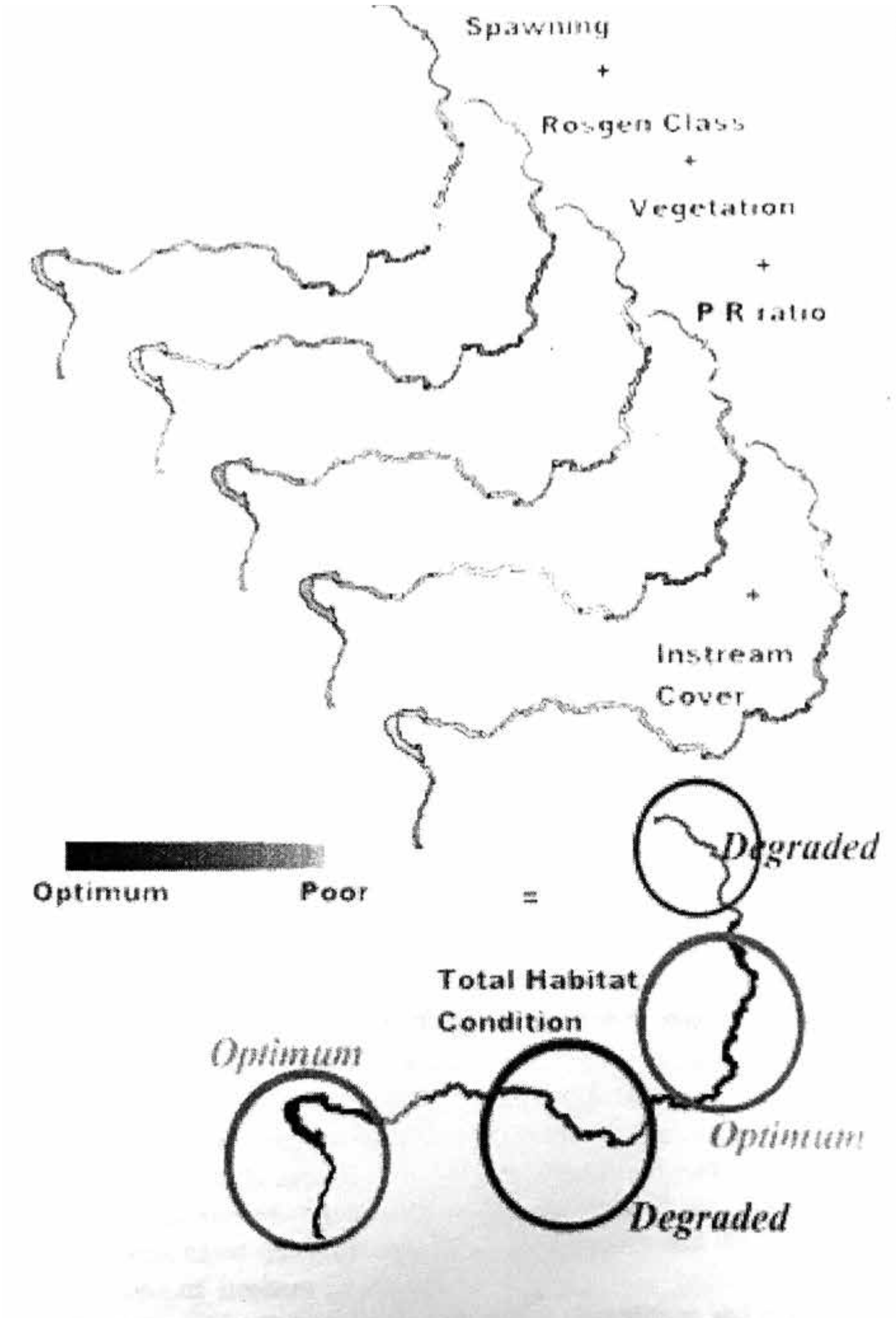

Fig.1. Determination of optimum habitat area using different layers of spatial information

overview fish and fish habitat, macro reach and lake classification data. It should include attribute data on;

- Fish distribution.
- Enhancement and management activities and objectives.
- Gradient and macro reaches.
- Land use, water use and water quality activities.
- Obstructions.
- Resource use.
- Fisheries potential and constraints.
- Escapements.
- Value and sensitivity.
- Life history traits.
- Harvest and use.

The system should be comprehensive, yearly updated and have an accessible database. It should provide georeferenced summary level of fish and fish habitat data for water bodies throughout the region. The georeferenced information has to be digitized and linked to a digital watershed atlas for use in GIS. It should incorporate a number of new design concepts such as thematic segments, water body identifier and combines streams, river and lake information into one system. Already lot of digital data is in the country with different organizations. The Space Application Centre, Ahmedabad has prepared the wetland maps of whole India and all the water bodies are available in digital form from Survey of India. These information can act as the base map over which all other scattered data associated with fishes can be overlaid. The National Remote Sensing Agency, Hyderabad is having satellite imagery all over India of different time scale, these data can provide us the status of water bodies at different time interval. The developed information will serve as a valuable too in managing natural fishery resources and undertaking development activities which affect water resources with minimal damage to fish species diversity.

Conservation of Stream Fishes : Importance of Physical Habitat Studies

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Sanjeev K. Srivastava and Sarkar, U.K., 2000. Conservation of stream fishes : importance of physical habitat studies. pp. 197-199 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR – NATP Publication – 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

The Western Ghats is recognized as one of the biodiversity hotspot in the country, with 192 endemic species of fishes. Many of these fishes have become endangered mainly due to destruction to their habitat. Various developmental activities like construction of roads and dams as well as diversion of water for agricultural purpose are the main reasons for habitat destruction.

The upland streams with their diverse flow regime, meandering nature, varying water depth, fluctuation in shade and hiding cover provide ideal conditions for all the organisms inhabiting them. The habitat of freshwater stream fishes is more dependent on physical features rather than on chemical features as in other aquatic habitats. Studies of stream fish assemblage have shown that abiotic factors such as temperature, current velocity, depth and substratum can determine distribution and abundance of individual species as well as influence community level diversity, guild composition and production.

The various habitat types found in stream have been classified into pools, riffles. cascade, fall, glide and run by Bisson *et al.* (1982). This classification had got certain deficiencies, including application of similar term to dissimilar type of habitat. Hawkins *et al.* (1993), proposed hierarchical system of classification (Fig 1.0) where at first level the stream was divided into fast water (riffle) and slow water (pool). The second level distinguished turbulent water from non-turbulent fast water units and slow water units formed by scour from those by dams. The third level of classification further subdivided each type of fast and slow water unit based on unique hydraulic characteristics and the principal kind of habitat forming structure or process.

The stream order and link magnitude reflect channel size and position in the drainage system. The stream order is incrementally increased below the confluence of two streams of equal order; the junction of two streams of unequal order does not increase the stream order. Because of irregular structure of the drainage system,

Fig.10. The hierarchical sub division of channel unit in streams as proposed by Hawkins *et al.* (1993)

the stream order is not a reliable indicator of the channel size. A more consistent index is link magnitude; each link is defined as having magnitude equal to the sum of all external links draining to it. In the low order stream, the main source of energy is allochthonous organic matter as primary production is small because of close canopies and substrate instability. In the medium order stream, because of open canopy and shallow water, the allochthonous primary production is high; the main sources of energy are macrophytes and periphyton. In the high order stream, the primary production is small because of deep and turbid water and the main energy source is fine organic particulate matter derived from upstream.

Each habitat contains different resources required by particular species. For successful completion of their life cycle the fish travels between habitats and the various life stages of fish require different physical habitats. Normally, spawning habitat differs from juvenile feeding habitat, juvenile feeding habitat differs from adult habitat and the habitat used by adult and juveniles varies among species. These feeding habitats normally consist of mosaic of various habitat types (like pools, riffle, glide, stream margins). The small fish and/or the early life stages of fish tend to be found predominantly in shallow riffle or stream margin habitat while the large fishes and/or later life stages of fishes are more abundant in deeper pools or midchannel areas.

The various developmental activities going on in the riparian zone is one of the main reasons for poor fish habitat condition. The riparian zone connects a stream with its watershed and controls within stream biological communities by influencing solar radiation, water temperature, regulating nutrient budgets, stabilizing stream banks and providing a source of organic energy. So any destruction to the riparian zone will have deleterious effect on fishes. Further in India, it is common practice to remove the fallen trees and logs for commercial purposes. The submerged fallen trees, or snags and other form of woody debris have a strong influence on the quality of food and habitat resources available to fish in a variety of aquatic systems. The snags may be used by the fishes as foraging sites, as a spawning substrates, as a protection from current or as a camouflage from predator or prey. In the small streams, the snags interact with stream hydraulic processes to influence water depth, current velocity, and substrate composition and thereby enhance the overall habitat diversity.

Another thing, which deleteriously affects the habitat, is removal of sand and boulders from streams and excess release of water in the streams. These affect the substrate type, flow rates and the hiding covers utilized by fishes. The type of cover utilised by fish depends on species, fish size, temperature, and hydrological regimes. Mostly fishes use pools, undercut banks, large wood or root wads, emergent vegetation and overhanging vegetation as hiding cover. The large woody debris serves to dissipate the energy of flowing water and creates pocket of shelter from high current water. Current velocity and water depth set physiological and physical limit to fish distribution. Physiologically important factors such as oxygen supply or temperature affect the distribution of fish species along the running water on larger spatial scale. On smaller spatial scale current velocity and water depth proved to be predictors of fish distribution in many studies. Substrate is regarded as covariate of the former two factors. The size of the substrate has been related to the standing crop of the benthic invertebrates by numerous investigators. The benthic invertebrates, which are an important food source for the fishes, decrease in number in the series rubble, bedrock, gravel and sand. The big boulders often provide fishes hiding cover.

Destruction of riparian zone and removal of sand and boulders from streams is common in hill stream of India and there is less awareness on the effect of these on stream fish. For effective restoration of fish habitat it is important to provide suitable habitat type, good hiding cover, good forest cover in the riparian zone, ideal substrate and proper flow rate. In view of the importance of various macro and microhabitat requirements, which vary with species, it is essential to determine species specific habitat requirements and to document them. This basic information is vital for habitat restoration programmes aimed at *in situ* conservation of endangered fishes.

Stream Fish Habitat Inventory Methodology

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Quantitative assessment of stream habitat and its use by fish is one of recent approach of stream fish ecologists (Bovce and Zui, 1986, Hankin and Reeves, 1988). A critical part of this process is an efficient and reliable stream habitat inventory. Although a variety of stream habitat inventories are available, the method described by Armantrout (1992) has been followed for the streams of Western Ghats because this method has been modified based on local conditions.

The first component is the profile of the stream and the second component includes the detailed habitat inventory.

Stream profile

The following parameters have to be recorded under stream profile:

1. **Stream** Name of the stream from Government of India toposheets
2. **Date** Date of the stream survey
3. **Reach** Select the reach from 1:24000 maps prior to going to field. It should have the co-ordinates of longitude and latitude; specify the start of the reach.
4. **Observer(s)** Name of the observer(s).
5. **Stream order** A first order stream is an unbranched headwater stream. Two first orders joint to form a second order and two second order streams form a third order and so on.
6. **Climate code** Use one of the two letter codes to describe the current weather, SN = Sunny, PC = Party cloudy, CD = Cloudy.
7. **Turbidity** Visibility through water (a) bottom visible (b) 1-2 m visible (c) turbid
8. **Rainfall** R1 = Light rain, R2 = Moderate rain, R3 = Heavy rain or on a scale of 0 to 3 depending on rainfall recorded 0 = no

	rain, 1 = less than 1 mm in 24 hours, 2 = 1-2 mm in 24 hours, 3 = rain over > 2 mm in 24 hours
9. **Flow rate**	Current velocity can be measured using flow meters
10. **Temperature**	Record the air and water temperature

Habitat Inventory

The second component is habitat inventory. It is meant to collect measurements, which allow us to describe a stream channel, its substrate, basic cover features and basic riparian condition. The inventory begins at a fixed point, which is designated as 0. This reference point should be readily identifiable by others with feature that will remain visible over time. These could be the confluence of two streams or an ecological feature or a major man-made structure such as a bridge or culvert. Inventory of each habitat is carried out be moving upstream. Reach length will be determined by adding up the length of habitats.

1. **Reach number:** See the description above. The reach is the identification number individual reach.
2. **Channel:** For habitats on the main channel take the main channel. Give different numbers to habitats in secondary channel.
3. **Habitat types:** F = falls, C = cascades, A = rapids, R = riffles, U = run, P = pool and G = glide
4. **Maximum width :** The widest part of the habitat, perpendicular to the main channel line is the maximum width. Measurement is for the wetted width.
5. **Mean width :** The average width of a habitat. It can be found by taking several measurements of width along the length of the habitat and computing the average. Measurement is for the wetted width.
6. **Maximum length:** Maximum length of the habitat, between its upper and lower end. The maximum length is not restricted to the main current, but can be parallel to it.
7. **Mean length:** As described under reach, the mean length is the length of the habitat as measured along the line of the main current. The mean length must equal the distance between the upper and lower reach numbers.
8. **Maximum depth:** It is the maximum depth of the habitat. Measure in centimeters and fractions of centimeters.
9. **Mean depth:** The average depth of a habitat. Calculated by taking a series of depth measurements (0.5 – 2m interval) and averaging them. Measure in cm and fractions of centimeter.
10. **Gradient :** Gradient is expressed on a scale of 1 to 5. 1 = less than 1% gradient, 2 = 1-2.5% gradient, 3 = 2.5 – 5% gradient, 4 = 5 – 10% gradient, 5 = over 10% gradient. Measurement is made by using a clinometer.

11. **Channel width:** Record the bank to bank width, perpendicular to the line of flow. While the mean width relates to wetted width; the channel width is the width of the channel at the highest (bankfull) flow. For most of Western Ghat channels, the edge of the channel is often where riparian vegetation begins.
12. **Stream shade:** Stream shade is the area of the habitat under shade between 10 AM and 4 PM expressed as percentage of the habitat that is shaded. Measurement can be made with a densitometer.
13. **Substrate:** Indicate the percentage of each substrate type. The size given for each substrate type observed along length of the longest axis of the substrate. If one type, such as bedrock has a light covering of the silt, the correct entry would be the bedrock since it is the dominant substrate type. There is a tendency to over estimate the largest size materials and to underestimate the smallest size substrate types. This is particular with regard to sand and silt, which can accumulate in between the larger substrate materials. The classification given below is based on the American Fishery Society method.

Bedrock	>610 mm	Large Boulders upto	610 mm
Small Bounder	305–609 mm	Cobble	76.1-304 mm
Small Gravel	4.81 – 76	Silt	0.03 – 4.71 mm
Fine sediment	0.83 mm or less		

14. **In stream cover:** Cover means hiding place for fish. Indicate all types of cover present in the habitat. Overhanging vegetation or logs, need not actually be in the water, but must be close enough that a fish could use it for concealment. Code are T = deep pool, B = boulder edge, L = large edge, E = enhancement structure, D = bottom edge.
15. **Bank stability:** The bank stability is rated by codes indicating visual estimation of vegetation and other structures. Right and left banks are determined by facing downstream. Codes are:

    L = Excellent. Over 80% of bank covered by vegetation

    G = Good. 50 – 70% vegetated or protected by materials that allow only minor erosion, such as larger rock and gravel.

    F = Fair. 25-49% covered by vegetation, gravel or material larger than gravel; some active erosion present.

    I = Poor. Less than 25% of bank covered by vegetation or protected by other materials. Banks usually eroded each year by high flows.
16. **Bank erosion cause:** Codes are : N = natural, M = man induced, T= farming activities, R = road, P = recreation, F = fire, O = others, X = no erosion present.
17. **Riparian shade:** Using a densitometer, measure the canopy closure of the riparian zone to determine riparian shade.

18. **Riparian encroachment:** Whether there is evidences of human encroachment on the riparian, circle the code for the dominant type of encroachment; indicate the percentage of the riparian zone affected by the encroachment, and indicate the distance from the stream bank to the encroached area.
19. **Adjacent slope:** Using a clinometer, approximate the percentage slope of the upslope area adjacent of the riparian zone for each side of the stream.
20. **Comments:** Circle the comment inclusion code, as appropriate. F = photo, L = landmark note, D = drawing can be placed on the back of the sheet.

Cultivable and Ornamental Fishes of Western Ghats Rivers of South India

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Fish faunal inventory was carried out in several streams/rivers covering 12 rivers basins representing the states of Karnataka, Kerala and Tamil Nadu part of Western Ghats. This formed part of a detailed study on fish habitats and fish assemblage structure. The states covered along with rivers are given below:

Tamil Nadu: Tamiraparani, Moyar, Gadana, Manimuthar, Chittar, Masupathi, Nambiyat, Karayar; **Kerala:** Kallar, Kabini, Bavalipuzha, Wynad, Kannathumpuzha; **Karnataka:** Aghanashini, Hemavathi, Kali, Thunga, Ekatachi.

Distribution of 83 species belonging 14 families has been documented based on our studies. The species selected as economically important/ cultivable and ornamental is based on the list prepared by Gopalakrishnan and Ponniah (2000).

Table 1. Economically Important/cultivable fishes

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
Family: Cyprinidae				
1.	*Gonoproktopterus curmuca*	EN	Krishna, Godavari and Cauvery drainages. In Kerala Pampa, Manimala, Kunthipuzha, Kallada, Malampuzha and Periyar (Menon, 1992; Talwar & Jhingran, 1991)	Tamiraparani and Moyar Rivers in Tamil Nadu
2.	*Gonoproktopterus kolus*	EN	South Canara, Chalakudy River and Krishna (Menon, 1992; Talwar & Jhingran, 1991)	Tamiraparani and Moyar Rivers in Tamil Nadu
3.	*Gonoproktopterus kurali*	EN	Rivers of South Kerala (Menon, 1992)	Kallar River, Kerala

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
4.	*Labeo calbasu*	LRnt	Pakistan, India, Burma, Nepal and South China (Talwar & Jhingran, 1991)	Tamiraparani and Moyar Rivers in Tamil Nadu
5.	*Labeo ariza*	CR	Nilgiri hills, Wynad hills and Cauvery River system (Talwar & Jhingran, 1991)	Moyar River, Tamil Nadu
6.	*Labeo boggut*	NA	Northern India and upto Cauvery River system (Talwar & Jhingran, 1991)	Moyar River, Tamil Nadu
7.	*Labeo dero*	VU	Cauvery River, Mettur dam, Himalaya, Arunachal Pradesh (Menon, 1992; Talwar & Jhingran, 1991)	Moyar and Tamiraparani Rivers, Tamil Nadu
8.	*Labeo fimbriatus*	LRnt	Cauvery and Peninsular Rivers, Narmada, Tapti, Punjab, Orissa and Krishna Rivers (Talwar & Jhingran, 1991)	Moyar River, Tamil Nadu
9.	*Labeo pangusia*	LRnt	Ganges River system, Assam, Bihar and West Bengal. Cauvery River system (Anon, 1998; Menon, 1992)	Tamiraparani and Moyar River, Tamil Nadu
10.	*Labeo rohita*	LRnt	Throughout India (Talwar & Jhingran, 1991)	Moyar and Tamiraparani Rivers, Tamil Nadu
11.	*Cirrhinus cirrhosus*	VU	Cauvery, Godavari, Krishna, Karnataka and Tamil Nadu (Anon, 1998)	Moyar and Tamiraparani Rivers, Tamil Nadu
12.	*Cirrhinus reba*	VU	Throughout India (Anon, 1998)	Moyar and Tamiraparani Rivers, Tamil Nadu
13.	*Cirrhinus fulungee*	LRnt	Maharashtra, Karnataka and some parts of Peninsular India (Anon, 1998)	Moyar River, Tamil Nadu

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
14.	*Hypselobarbus dubius*	EN	Cauvery drainage system (Menon, 1992)	Moyar and Tamiraparani Rivers, Tamil Nadu
15.	*Hypselobarbus micopogon periyarensis*	EN	Peryar and associated streams of Kerala (Anon, 1998)	Moyar River, Tamil Nadu; Bavalipuzha, Wynad, Kerala
16.	*Hypselobarbus jerdoni*	EN	Cauvery drainage system. Karnataka, Kerala, Tamil Nadu and Maharashtra (Anon, 1998; Talwar & Jhingran, 1991; Jayaram, 1991)	Aghnashini River, Karnataka and Kannathumpuzha, Wynaad, Kerala
17.	*Hypselobarbus dobsoni*	NA	Cauvery River drainage Karnataka (Menon, 1992)	Manimuthar and Gadana Rivers of Tamiraparani basin, Tamil Nadu
18.	*Barbodes carnatius*	LRnt	Periyar and Cauvery River systems (Menon, 1992)	Hemavathi River, Karnataka and Moyar River Tamil Nadu
19.	*Barbodes sarana sarana*	VU	Throughout India except Peninsular India, Krishna River system (Talwar & Jhingran, 1991)	Gadana, Tamiraparani, Moyar Rivers Tamil Nadu, Rivers of Kerala
20.	*Barbodes sarana subnasutus*	NA	Cauvery River system and Kerala (Menon, 1992; Talwar & Jhingran, 1991)	Gadana, Tamiraparani, Rivers, Tamil Nadu
21.	*Tor khudree*	VU	Madhya Pradesh, Deccan and Peninsular India, Dupthi, Mahanadhi (Talwar & Jhingran, 1991)	Samikutchi Falls, Chittar Basin, Tamiraparani, Moyar River, Tamil Nadu; Kallar River, Kerala; Aghnashini and Thunga River, Karnataka
22.	To mussullah	CR	Krishna and Godavari Rivers Kerala, Cauvery, Krishna, Poonaiyar and Godavary (Talwar & Jhingran, 1991; Menon, 1992)	Moyar River, Tamil Nadu; Thunga River, Karnataka.

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
23.	*Puntius dorsalis*	EN	Tamiraparani River, Cauvery and Krishna River systems (Rema Devi et. al., 1997; Talwar & Jhingran, 1991)	Tamiraparani, Gadana and Chittar Rivers, Tamil Nadu
24.	*Puntius parrah*	NA	Kerala, Karnataka and Tamil Nadu (Talwar & Jhingran, 1991)	Kabini River, Wynaad, Kerala
25.	*Salmostoma clupeoides*	LRlc	Eastern and Western Ghats of Maharashtra and Gujarat (Talwar & Jhingran, 1991)	Gadana and Moyar Rivers Tamil Nadu
26.	*Salmostoma boopis*	NA	South Canara and Poona (Talwar & Jhingran, 1991)	Moyar River, Tamiraparani Rivers, Tamil Nadu and Kali River, Karnataka
27.	*Osteochilichthys nashii*	NA	Western Ghats of Kerala and Karnataka (Talwar & Jhingran, 1991)	Thunga, Karnataka and Bhavalipuzha, Kerala
28.	*Chela laubuca*	LRlc	Western Ghats and Gangetic waters	Hemavathi River, Karnataka
Family: Channidae				
29.	*Channa striatus*	VU	All over India (Tamil Nadu and West Bengal)	Tamiraparani River, Tamil Nadu
30.	*Channa orientalis*	VU	Throughout India (Anon, 1998)	Kallar River, Kerala
31.	*Channa punctatus*	LRnt	All over India abundant in Terai and Duras of North Bengal and Chilka lake; Chalakudy River, Karuvannur and Chaliyar Rivers (Anon, 1998; Menon, 1992)	Tamiraparani River, Tamil Nadu
Family: Siluridae				
32.	*Silurus wynaadensis*	EN	Western Ghats of Kerala; Cauvery drainage at Virthy in Wynad (Talwar and Jhingran, 1991; Menon, 1992)	Manimuthar and Tamiraparani Rivers, Tamil Nadu; Kallar and Kabini Rivers, Kerala
33.	*Ompok bimaculatus*	EN	Cauvery rivr and Mettur Dam, Kumaradhara and Netravathi River Karnataka Bhavani and Moyar rivrs (Menon, 1992)	Tamiraparani and Moyar Rivers, Tamil Nadu

Sl. No.	Fish Species	Distribution		
		Status**	**Earlier reported**	**Our Survey**
34.	*Ompok malabaricus*	CR	Goa and Rivers of Kerala (Menon, 1992)	Moyar River, Tamil Nadu; Kabini River Karnataka
35.	*Wallago attu*	LRnt	Chalakudi River, Chaliyar River and Rivers of Kerala (Menon, 1992)	Moyar River, Tamil Nadu; Kabini River Karnataka
Family: Bagridae				
36.	*Mystus armatus*	NA	Wynad range of hills. (Talwar and Jhingran, 1991)	Masupathi, Chittar and Nambiyar Rivers, Tamil Nadu
37.	*Mystus punctatus*	EN	Tamil Nadu part of Nilgiri hills. Cauvery River basin. (Talwar and Jhingran, 1991; Jayaram, 1981)	Moyar River, Tamil Nadu
38.	*Mystus vittatus*	VU	Tamil Nadu and Kerala parts of Western Ghats (Talwar & Jhingran, 1991)	Tamiraparani River basin
39.	*Mystus gulio*	NA	Rivers of West Bengal, Orissa, Maharashtra, Kerala and Tamil Nadu (Talwar and Jhingran, 1991)	Tamiraparani River basin
40.	*Aorichthys aor**	NA	Northern India and upto the Krishna Rivers system in south	Kabini River, Wynad district, Kerala
Family: Heteropneustidae				
41.	*Heteropneustes fossilis*	VU	Common in Peninsular India (Menon, 1992)	Tamiraparani River, Chittar, Moyar River and Pechipparai reservoir
42.	*Heteropneustes microps*	NA	Sri Lanka, In India: Bihar and Uttar Pradesh (Datta Munshi and Srivastava, 1988; Arunachalam *et al,* 1999)	Tamiraparani River Tamil Nadu and Hemavathi River Karnataka.

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
Family: Claridae				
43.	*Clarias dussumieri*	VU	Wetlands of Kerala and Karnataka. Goa and Pondicherry (Anon, 1998; Talwar and Jhingran, 1991)	Kabini River Wynad district, Kerala.
Family: Gobiidae				
44.	*Glossogobius giuris*	LRnt	Uttar Pradesh, Delhi, West Bengal, North East regions, Narmatha and Tapti (Anon, 1998)	Tamiraparani, Moyar and Chittar Rivers, Tamil Nadu; Aghnashini River, Karnataka.
Family: Mastacembelidae				
45.	*Mastacembelus armatus*	NA	West Bengal, Assa, Bihar, Tamil Nadu, Kerala and Maharashtra (Talwar & Jhingran, 1991)	Masupathi River, Gadana and Moyar rivrs, Tamil Nadu; Kallar River, Kabini Rivers, Kerala
Family: Cichlidae				
46.	*Etroplus surantensis*	NA	Orissa, Andhra Pradesh, Tamil Nadu and Kerala (Talwar & Jhingran, 1991)	Tamiraparani, Gadana and Chittar Rivers, Tamil Nadu
Family: Angullidae				
47.	*Angulia bengalensis*	EN	East coast of India and Narmada and Cauvery drainages (Anon, 1998; Menon, 1992)	Tamiraparani and Moyar Rivers, Tamil Nadu
Family: Notopteridae				
48.	*Notopeterus notopeterus*	LRnt	Northern Eastern and Central Indian Rivers, reservoirs and lakes (Anon, 1998)	Moyar River, Tamil Nadu
Ornamental Fishes				
Sl. No.	**Fish Species**	**Status****	**Distribution**	**Current Distribution**
Family: Cyprinidae				
49.	*Danio aequipinnatus*	LRnt	North Eastern region, Himalaya, Krishna river and Mahanadhi rivers. India, Nepal, Bangladesh, Burma and Thailand. (Anon, 1998; Talwar and Jhingran, 1991)	Streams/rivers of Western Ghats of south India.

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
50.	*Brachydanio rerio*	LRnt	Northern India, Indo Ganges, Brahamaputra, Tapti and Mahanadhi (Anon, 1998; Talwar and Jhingran, 1991)	Hemavathi River, Karnataka and Wynad, Kerala
51.	*Rasbora danioconius*	LRnt	Throughout India (Anon, 1998)	Streams and Rivers of Western Ghats of South India
52.	*Puntius amphibius*	NA	Orissa, Madhya Pradesh and Rajasthan	Gadana River, Manimuthar, Samikutchi Falls, Tamil Nadu; Maranthadipuzha, Kerala; Aghanisishini
53.	*Puntius arenatus*	NA	Madras, Tamil Nadu (Talwar and Jhingran, 1991)	Tamiraparani River basin and Nambiyar River, Tamil Nadu
54.	*Puntius arulius*	EN	Nilgiri Biosphere reserve of Tamil Nadu and Kerala (Anon, 1998)	Moyar River in Tamil Nadu
55.	*Puntius arulius tambraparniei*	CR	Endemic to Tambraparani river (Anon, 1998; Jayaram, 1991)	Gadana, Chittar, Manimuthar, Karsyar and Servalar (Tamiraparani River basin), Tamil Nadu
56.	*Puntius bimaculatus*	NA	Sri Lanka, Kalakkad, Tamiraparani river, Tamil Nadu (Menon and Rema Devi, 1995)	Gadana River, Chittar, Manimuthar, Samikutchi Falls and Moyar Rivers in Tamil Nadu; Thunga River, Hemavathi Rivers, Karnataka
57.	*Puntius filamentosus*	NA	Goa, Karnataka, Kerala and Tamil Nadu (Talwar & Jhingran, 1991)	Gadana River, Tamiraparani River, Pechipparai reservoir and Moyar River, Tamil Nadu; Aghnishani River, Kali River, Bedti River, Karnataka.
58.	*Puntius fasciatus*	EN	Upper reaches of Cauvery drainages, Western water shed drainages of sands, Canara, Malabar and Travancore (Talwar and Jhingran, 1991)	Karayar River, Tamil Nadu; Kallar River, Sangilipuzha. Wynad and Kallada, Kenara, Ekatchi streams in Karnataka.

Sl. No.	Fish Species	Distribution		
		Status**	**Earlier reported**	**Our Survey**
59.	*Puntius melanampyx*	LRnt	Rivers of Kerala, Goa, Kali river in Karnataka (Anon, 1998; Arunachalam , 1998)	Kallar River, Sangilipuzha and streams of Wynad, Kerala; Kali River, Karnataka
60.	*Puntius ticto punctatus*	EN	Riverine wetlands of Tamiraparani riverine basin (Anon, 1998)	Tamiraparani River, Gadana, Bamatheertham and Manimuthar River, Tamil Nadu
61.	*Puntius ticto ticto*	LRnt	Pakistan, Sri Lanka, Bangladesh, In India: Western Ghats of Tamil Nadu and Orissa (Anon, 1998, Jayaram, 1991)	Moyar River, Tamil Nadu; Aghnashini River and Bedti Rivers in Karnataka
62.	*Puntius vittatus*	VU	Pakistan, Sri Lanka, In India: Goa, Karnataka, Gujarat, Krala and Tamil Nadu (Anon, 1998)	Tamiraparani River, Gadana River, Chittar and Moyar Rivers, Tamil Nadu
63.	*Puntius chola*	VU	Kerala, Tamil Nadu and North East Bengal (Anon, 1998)	Gadana, Tamiraparani and Moyar Rivers, tamil Nadu
64.	*Puntius narayani*	CR	Karnataka parts of Western Ghats and Cauvery river (Anon, 1998)	Aghnashini, Kali, Bedti and Thunga Rivers, Karnataka
65.	*Puntius conchonius*	VU	Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and Bihar (Anon, 1998)	Hemavathi and Ekatchi River in Karnataka and Vaniyar River (eastern Ghats), Tamil Nadu
Family: Balitorinae				
66.	*Nemacheilus triangularis*	LRlc	West flowing rivers of Western Ghats (Anon, 1998)	Rivers in Western Ghats of south India
67.	*Nemacheilus nilgiriensis*	EN	Rivers of Nilgiri Biosphere reserve (Anon, 1998)	Moyar River, Tamil Nadu part of Nilgiri Biosphere Reserve
68.	*Nemacheilus semiarmatus*	VU	Cauvery basin in Wynad, Nilgiris and Mysore (Anon, 1998)	Hemavathi and Ekatchi Rivers, Karnataka
69.	*Nemacheilus striatus*	DD	Kerala: Wynad and Karnataka; Shimoga (Anon, 1998)	Moyar River, Tamil Nadu

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
70.	*Nemacheilus elongates*	NA	Brahmaputra river basin (Talwar and Jhingran, 1991)	Moyar River, Tamil Nadu
71.	*Nemacheilus keralensis*	EN	Western Ghats of Kerala (Anon, 1998)	Kallar River, Kerala
72.	*Nemacheilus guentheri*	LRlc	Western Ghats of Kerala (Anon, 1998)	Panniyar (Santhamparai hills, Kerala)
73.	*Nemacheilus denisoni*	NA	Western Ghats of Kerala (Anon, 1998)	Tamiraparani River basin, Tamil Nadu; Thunga basin, Karnataka
74.	*Barilius bakeri*	VU	All rivers of Western Ghats of Kerala (Talwar and Jhingran, 1991; Anon, 1998)	Kurangani stream (Upstream of Gaigai) and Chittar, Tamil Nadu; Kallar, Ballada, Sengilipuzha and Achankovil, Kerala
75.	*Barilius bendelisis*	LRnt	India, Pakistan, Nepal, Bangladesh and Sri Lanka (Talwar and Jhingran, 1991; Anon, 1998)	Moyar River, Tamil Nadu
76.	*Barilius gatensis*	NA	Western Ghats of Maharashtra, southern Karnataka and Kerala: Niligiri hills in Tamil Nadu (Talwar and Jhingran, 1991)	Moyar River, Tamil Nadu; Thunga River, Karnataka
77.	*Barilius canarensis*	DD	Karnataka and Kerala parts of Western Ghats (Talwar and Jhingran, 1991)	Upstreams of Thunga, Karnataka
78.	*Barilius barna*	LRnt	Bangladesh, Burma and Nepal. In India: Ganga, Brahmaputra and Mahanadhi (Talwar and Jhingran, 1991; Sanjay Molur and Sally Walker, 1998)	Kallar River, Kerala; Moyar River, Tamil Nadu; Thunga River, Karnataka

Sl. No.	Fish Species	Distribution		
		Status**	Earlier reported	Our Survey
Family: Cichilidae				
79.	*Etroplus maculatus*	NA	Tamil Nadu, Kerala and south Karnataka (Talwar and Jhingran, 1991)	Tamiraparani River basin, Gadana River and Moyar River, Tamil Nadu; Thunga River, Karnataka
Family: Poecilidae				
80.	*Gambusia affinis*	Exotic	-	Hemavathi and Ekatch stream, Karnatka;
Family: Ambassidae				
81.	*Chanda nama*	NA	Pakistan, Nepal and Burma. In India: Uttar Pradesh, West Bengal and Bihar (Talwar and Jhingran, 1991)	Hemavathi River, Karnataka; Bavaiipuzha, Wynad, Kerala
82.	*Pseudoambassis ranga*	NA	India (Talwar and Jhingran, 1991)	Gadana River, Tamiraparani and Moyar Rivers, Tamil Nadu; Hemavathi River, Karnataka; Bavalipuzha, Wynad, Kerala
Family: Macropodinae				
83.	*Macropodus cupanus*	NA	Sri Lanka, Western Burma and Eastern India (Talwar and Jhingran, 1991)	Tamiraparani River, Gadana River, Tamil Nadu; Achankovil River, Kerala

** **CR** - Critically Endangered; **EN** - Endangered, **VU** - Vulnerable, **LRlc** - Low Risk Least Concern; **LRnt** - Low Risk near Threatened; **DD** - Data Deficient; **NA** - Not Assessed
* Identification to be confirmed

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Aquarium Fish Diversity in Western Ghats

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Tropical freshwater aquariums are amongst the oldest and most popular of hobbies worldwide. In India, especially in the major cities, it is easy to find a number of large aquariums selling a great diversity of fish both domesticated and wild caught. It is surprising to note, however, that except a few species, most are exotic in origin, predominantly South American.

The few Indian freshwater fish which are now domesticated and available worldwide as veil-tails and colour variants are *Puntius conchonius, Brachydanio rerio* and *Colisa lalia*. Other frequently caught from wild and sold under rather exotic names, include *Notopterus notopterus, Danio malabaricus/ aequipinnatus, Lepidocephalus thermalis*, *Botia striata, B. lohachata* and *Macrognathus pancalus*. Estuarine species that enter freshwater and are in aquariums include *Scatophagus argus, Chanda* sp., *Monodactylus agrentenus* and *Etroplus suratensis.* Evidently, all the above species have been popular for quite sometime that they feature in most aquarium books.

In the Western Ghats, including the estuarine fish that ascend streams, there are nearly 230 species of fish. Of these, the most commonly marketed aquarium species are *Puntius conchonius* and *Brachydanio rerio*. Others which are well known in their wild forms worldwide are *Danio malabaricus/aequipinnatus, Esomus danricus, Chela laubuca, Puntius melanampyx/fasciatus*, *P. filamentosus/mahecola*, *P. arulius*, *Etroplus maculates, Aplocheilus lineatus* and *A. blockii*. Several others such as *Oryzias melastigma, Etroplus canarensis, Pristolepis marginata,* many species of *Barilius, Nemacheilus, Garra, Homaloptera* and catfishes are yet to be popularised. There are certainly a number of little known, yet appealing, small to medium seized species of freshwater fish in the Western Ghats that could be popularised. These include *Macropodus cupanus, Esomus danricus, Puntius aurulius, P. narayani, P. setnai* and *Tetraodon travancoricus*.

Among the larger species, *Puntius denisonii, Horabagrus brachysoma, Puntius curmuca, P. thomassi, Pristolepis marginata, Etroplus maculatus, E. surateusis, Silurus wynaadensis, Channa gachua, Barilius* spp. and *Garra* spp. can be popularised. Current trend amongst aquarists in India is to go in for large-sized tropical freshwater fish. To this end we now have exotic fishes that grow large including sucker catfishes and a variety of others sold as 'freshwater sharks', a number of large cichlids including Oscars, and most recently Piranhas, freely being marketed in our cities. The pride in keeping large, grotesque looking and aggressive fish seems to be today's trend.

Survey of recent literature suggests that aquarium fish trade is a multi-billion dollar industry world-wide. About 98% of the aquarium fish trade is in tropical fish and 90% of all traded aquarium fish are freshwater. The increasing demand for ornamental fish throughout the world has resulted in over-exploitation of many natural stocks. Our fish reserves in the Western Ghats can soon be under pressure due to over-harvest, pollution and habitat loss. One species of the hill streams that is never seen in Indian aquariums yet collected and exported in large numbers is *Puntius fasciatus/ melanampyx*. There may be many others to add to this list. Its time we started taking stock of our fish resources with potential as aquarium species and develop strategies to conserve them both *in situ* and *ex situ*.

Cultivable and Ornamental Fishes of Western Ghats Part of Maharashtra

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As a part of the Western Ghat Biodiversity Programme, fish diversity was studied in few streams/rivers in Maharashtra part of Western Ghats. A total of 35 species belonging to 7 orders and 10 families were collected from 10 localities. Among these, 21 species are considered as economically important/cultivable and 15 will come under ornamental fishes. Current taxonomic status, earlier and present distributions along with endangered status are presented.

Table1. A: Economically important/cultivable fishes

Sl. No.	Fish Species	Status**	Distribution	
			Earlier reported	**Our survey**
Family : Cyprinidae				
1.	*Labeo calbasu*	LRnt	Pakistan, India, Burma, Nepal and South China, Tamiraparani, Gadana and Moyar Rivers, Tamil Nadu (Talwar and Jhingran, 1991; Arunachalam, 1998)	Khal River, Maharashtra
2.	*Labeo boggut*	NA	Northern India and upto Cauvery River system, Moyar River, Tamil Nadu (Talwar and Jhingran, 1991; Arunachalam, 1998)	Khal River, Maharashtra
3.	*Hypselobarbus lithopidos*	EN	Karnataka, Tamil Nadu and Kerala part of Western Ghats (Anon, 1998)	Khal River, Maharashtra

Sl. No.	Fish Species	Status**	Distribution	
			Earlier reported	Our survey
4.	*Barbodes sarana sarana*	VU	Throughout India except Peninsular India, Krishna River system, Gadana, Tamiraparani, Moyar River Tamil Nadu, Rivers of Kerala (Talwar and Jhingran, 1991)	Mondai stream and Vethaganga River, Maharashtra
5.	*Barbodes sarana subnasutus*	NA	Cauvery River system and Kerala Gadana, Tamiraparani, Rivers, Tamil Nadu (Menon, 1992; Talwar and Jhingran, 1991, Arunachalam, 1998)	Mondai stream, Khal Pej and Savitri Rivers, Maharashtra
6.	*Tor khudree*	VU	Peninsular India, Dupthi, Samikutchi Falls, Chittar Basin, Tamiraparani, Moyar River, Tamil Nadu, Kallar River, Kerala. Aghnashini and Thunga River, Karnataka (Talwar and Jhingran, 1991, Anon, 1998; Arunachalam, 1998)	Dhom reservoir and Kandala falls, Maharashtra
7.	*Megalops cyprinoides*	NA	Indo-west Pacific, coastal pelagic species, entering lagoons, estuaries and freshwaters (Talwar and Jhingran, 1991)	Khal River, Maharashtra
8.	*Salmostoma clupeoides*	LRlc	Western Ghats of Maharashtra and Gadana and Moyar Rivers, Tamil Nadu (Talwar and Jhingran, 1991; Arunachalam, 1998)	Mondai stream and Dhom reservoir, Maharashtra
9.	*Salmostoma boopis*	NA	South Canara and Poona. Moyar River, Tamiraparani rivers, Tamil Nadu and Kali River, Karnataka (Talwar and Jhingran, 1991)	Mondai stream, Dhom reservoir and Vasishti River, Maharashtra
10.	*Salmostoma sardinella*	NA	Orissa, Ganga and Brahmaputra drainages (Talwar and Jhingran, 1991)	Mondai stream, Maharashtra (new record to Maharashtra; Arunachalam et. al., 1998)
11.	*Salmostoma novacula*	LRnt	Upper Krishna, Godavari and Tamil Nadu (Anon, 1998)	Khal River, Maharashtra

Sl. No.	Fish Species	Status**	Distribution	
			Earlier reported	Our survey
12.	*Chela laubuca*	LRlc	Western Ghats and Hemavathi River, Karnataka (Anon, 1998; Arunachalam, 1998)	Mondai stream and Khal River, Maharashtra
Family : Channidae				
13.	*Channa marulius*	LRnt	Andhra Pradesh, West Bengal (Talwar and Jhingran, 1991)	Mondai stream and Vasishti River, Maharashtra
Family : Siluridae				
14.	*Silurus wynaadensis*	EN	Western Ghats of Kerala; Cauvery drainage at Virthy in Wynad, Manimuthar and Tamiraparani Rivers, Tamil Nadu; Kallar and Kabini Rivers, Kerala (Talwar and Jhingran, 1991; Menon, 1992; Arunachalam, 1998)	Mondai stream, Maharashtra
15.	*Wallago attu*	LRnt	Chalakudi River, Chaliyar River and Rivers of Kerala; Moyar River, Tamil Nadu; Kabini River Karnataka (Menon, 1992, Arunachalam, 1998)	Khal River in Maharashtra
Family : Bagridae				
16.	*Mystus malabaricus*	EN	Moyar River, Tamil Nadu; Kabini River, Karnataka (Anon, 1998)	Mondai stream, Maharashtra
17.	*Mystus bleekeri*	VU	Kerala and Karnataka (Anon, 1998)	Mondai stream, Maharashtra
18.	*Mystus vittatus*	VU	Tamil Nadu and Kerala parts of Western Ghats, Tamiraparani River basin (Talwar and Jhingran, 1991, Arunachalam, 1998))	Vasishti River and Pansad stream, Maharashtra
Family : Cobidae				
19.	*Glossogobius giuris*	LRnt	Uttar Pradesh, Delhi, West Bengal, North East regions, Narmatha and Tapti. Tamiraparani, Moyar and Chittar Rivers, Tamil Nadu; Aghnashini River, Karnataka. (Anon, 1998, Arunachalam, 1998)	Vasishti River, Pansad stream and Dhom reservoir, Maharashtra

Sl. No.	Fish Species	Status**	Distribution	
			Earlier reported	Our survey
20.	*Stigmatogobius oligactis*	NA	Streams and Rivers of Java (Weber and Beautert, 1953)	Dhom reservoir, Maharashtra (new record to India; Arunachalam *et al.*, 1998)
Family : Mastacembelidae				
21.	*Mastacembelus armatus*	NA	West Bengal, Assa, Bihar, Tamil Nadu, Kerala and Maharashtra. Masupathi River, Gadana and Moyar Rivers, Tamil Nadu; Kallar River, Kabini Rivers, Kerala (Talwar and Jhingran, 1991, Arunachalam, 1998)	Vasishti River and Dhom reservoir, Maharashtra
B. Ornamental Fishes				
Family : Cyprinidae				
22.	*Danio aequipinnatus*	LRnt	North Eastern region, Himalaya, Krishna River and Mahanadhi Rivers. India, Nepal, Bangladesh, Burma and Thailand. Streams/ Rivers of Western Ghats of south India. (ANON, 1998; Talwar and Jhingran, 1991)	Khal and Gundalika Rivers, Maharashtra
23.	*Rasbora daniconius*	LRnt	Throughout India Streams and Rivers of Western Ghats of south India (Anon., 1998; Arunachalam, 1998)	Mondai stream, Pej River, Dhom reservoir, Kandala falls, Pansad, Vethaganga, Savitri and Gundalika Rivers, Maharashtra
24.	*Puntius sophore*	LRnt	Uttar Pradesh, Bihar, Haryana, Madhya Pradesh Delhi, Stream and rives of Tamil Nadu (Anon., 1998; Arunachalam, 1998)	Savitri River, Maharashtra
25.	*Puntius sahyadriensis*	NA	Yenna River, Satara District, Maharashtra (Jayaram, 1991; Talwar and Jhingran, 1991)	Mondai stream and Gundalika River, Maharashtra
26.	*Puntius amphibius*	NA	Orissa, Madhya Pradesh and Rajasthan Gadana River, Manimuthar, Samikutchi Falls, Tamil Nadu, Maranthadipuzha, Kerala, Aghnashini and Karnataka (Talwar and Jhingran, 1991; Arunachalam, 1998)	Mondai stream and Gundalika River, Maharashtra

Sl. No.	Fish Species	Status**	Distribution	
			Earlier reported	Our survey
27.	*Puntius bimaculatus*	NA	Sri Lanka Kalakkad, Tamiraparani River, Tamil Nadu Gadana River, Chittar, Manimuthar, Samikutchi Falls and Moyar Rivers in Tamil Nadu. Thunga River, Hemavathi Rivers, Karnataka (Menon and Rema Devi, 1995, Arunachalam, 1998)	
28.	*Puntius ticto ticto*	LRnt	Pakistan, Sri Lanka, Bangladesh, In India : Western Ghats of Tamil Nadu and Orissa Moyar River, Tamil Nadu, Aghnashini River and Bedti Rivers in Karnataka (Anon, 1998, Jayaram, 1991; Arunachalam, 1998)	Mondai stream and Savitri River, Maharashtra
29.	*Puntius conchonius*	VU	Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh and Bihar Hemavathi and Ekatchi River in Karnataka and Vaniyar River (Eastern Ghats), Tamil Nadu (Anon, 1998; Jayaram, 1991, Arunachalam, 1998)	Dhom reservoir, Maharashtra
Family : Balitorinae				
30.	*Lepidocephalus thermalis*	NA	Coastal districts of Kerala, Karnataka, Maharashtra. Tamiraparani River, Tamil Nadu (Arunachalam, 1998; Talwar and Jhingran, 1991)	Dhom reservoir, Maharashtra
31.	*Nemacheilus ruppelli*	NA	Western Ghats of Maharashtra and Karnataka (Talwar and Jhingran, 1991)	Mondai stream, Vasishti River, Dhom reservoir, Pansad and Vethaganga Rivers, Maharashtra
32.	*Nemacheilus evezardi*	NA	Kaohat Toi River (Upper Indus) (Talwar and Jhingran, 1991)	Dhom reservoir, Maharashtra
33.	*Nemacheilus denisoni densoni*	NA	Peninsular India, Chota Nagpur (Bihar) and Madhya Pradesh (Talwar and Jhingran, 1991)	Khal, Vasishti, Pansad and Vethaganga Rivers, Maharashtra

Sl. No.	*Fish Species*	Status**	Distribution	
			Earlier reported	Our survey
34.	*Nemacheilus denisoni*	NA	Peninsular India, Bihar and Madhya Pradesh. Tamirapa-rani Riverine basin, Tamil Nadu; Thunga basin, Karnataka (Talwar and Jhingran, 1991; Arunachalam, 1998)	Vasishti River, Maharashtra
Family : Ambassidae				
35.	*Chanda nama*	NA	Pakistan, Nepal and Burma. In India : Uttar Pradesh, West Bengal and Bihar. Hemavathi River, Karnataka; Bavalipuzha, Wynad, Kerala (Talwar and Jhingran, 1991; Arunachalam, 1998).	Mondai stream, Maharashtra

** **CR** – Critically endangered; **EN** – Endangered, **VU** – Vulnerable, **LRlc** – Low risk least concern; **LRnt** – Low risk near threatened; **DD** – Data deficient; **NA** – Not assessed

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Cultivable, Sport and Ornamental Fishes of the Karnataka Hilly Region

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In Karnataka State the hilly region constitutes 12.5 per cent of the total geographical area This region is a narrow belt between coastal and transitional zones and lies on the summits and the eastern and western slopes of the Western ghats. The hill region

Table 1 : Economically important food (F) and ornamental (O) fishes of Hemavathy and Yagachi rivers, Karnataka.

Sr. No.	Species	Common name	Type	Distribution
1.	*Tor khudree*	Mahseer	F	H
2.	*Puntius pulchellus*	Indian Grass carp	F	H
3.	*Puntius sarana*	Olive barb	F	H
4.	*Cirrhina reba*	White carp	F	H
5.	*Puntius ticto punctatus*	Ticbo barb	O	H and Y
6.	*Barilius spp.*	River carp baril	O	H and Y
7.	*Danio spp.*	River carp baril	O	H and Y
8.	*Garra mullya*	Garra	O	H
9.	*Nemacheilus evezardi*	---	O	H
10.	*Lepidocephalus thermalis*	---	O	H and Y
11.	*Esomus spp.*	Flying barb	O	H and Y
12.	*Glossogobius giuris*	---	O	H
13.	*Parambasis thomassi*	Western Ghat glassy fish	O	H
14.	*Mystus cavasius*	Freshwater catfish	F	H
15.	*Ompok bimaculatus*	Feather back	F	H
16.	*Notopterus notopterus*	---	F	
17.	*Clarias dussumieri*	Magur	F	H
18.	*Channa marulius*	Snake head	F	H
19.	*Aplocheilus spp.*	Dwart, Killie	O	H and Y
20.	*Lebistes reticulatus*	Guppy	O	Y
21.	*Macrognathus guentheri*	Fresh water spiny eel	O, F	H and Y

T – Tungabhadra, H – Hemavathy River, Y – Yagachi River

Table 2 : Cultured and potentially cultivable fishes in ponds of the hill zone of Karnataka.

Sl. No.	Species	Common name	Max. size	Category
1.	*Catla catla*	Catla	5 kg in 3 years in the ponds of hill zone (research station and also in farmers ponds)	Transplanted cultivable food fish. Grows well in hilly zone with fertilization and feeding.
2.	*Hypophthal-mict-hys molitrix*	Silver carp	5 kg in 3 years in the ponds of hill zone (Research Station and also farmers ponds)	Exotic cultivable food fish. Grows well in hill zone with fertilization and feeding.
3.	*Ctenopharyn-go-don idella*	Grass carp	3 kg in 2 years in the ponds of hill zone	Exotic cultivable food fish. Grows well in hill zone when fed with local weeds.
4.	*Labeo rohita*	Rohu	2.75 kg in 3 years in the ponds of hill zone	Transplanted cultivable food fish grows well.
5.	*Labeo fimbriatus*	---	400-500 gms in 7 months	Potential cultivable species for hill zone.
6.	*Clarias dussumieri*	Magur	Upto 120 gms in 4 months	Potential cultivable fish. Native of hill zone.
7.	*Channa spp.*	Snake head	---	Potential cultivable fish; grows well in hill zone. People prefer the fish.
8.	*Tor khudree*	Mahseer	---	Sport fish and potential cultivable; studies on stocking and culture are urgently needed.
9.	*Lepidocephalus thermalis*	Loach	---	Tasty food fish, can be cultured.

of Karnataka has as many as 14,130 major and minor tanks ranging from seasonal to perennial types covering a water spread area of about 1,13,118 hectares and 9 reservoirs. Rivers like Hemavathy, Yagachi, Netravati and Tunga flow in hill zone. In addition, there are several ponds located in the coffee plantations.

During the preliminary study during 1997-98 on 'Fish and Fisheries of hill zone of Karnataka' more than 35 fish species were caught in the hill zone waters. The fish fauna of the zone consists of carps, catfishes, air-breathing fishes and other fishes. There is Mahseer fishery below the Gorur dam. Tables 1 and 2 show the fish species of the hill zone of Karnataka. From the preliminary study on Fish and Fisheries of hill zone, it was observed that the Hemavathy River is found to be productive and harbors different fish species. Cold water fishes like *Barilius* spp. were regularly found in the Hemavathy and Yagachi Rivers. Sport fish, Mahseer is caught during the months February-March in the large pools of the Hemavathy River. *Puntius* spp. and loaches and other small fishes are harvested during monsoon season by employing traps. *Chanda nama* (Glass fish) an ornamental fish has increased in Hemavathy River in recent years.

An intensive study on the life history of the fishes of the hill zone of Karnataka is needed to decide about the future development of the hill zone fisheries. There is an urgent need to take up breeding of fishes like *Lepidocephalus thermalis*, Mahseer, *Clarias* spp., ornamental and other cultivable fishes in the hill zone of Karnataka.

Cultivable and Ornamental Fishes from Hemavathi and Ekachi Rivers, South Karnataka

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Hemavathi is a major east flowing river, which joins with Cauvery river. It has a tributary called Ekachi, which originates from Mudigere hills of Chikmanglur district of Karnataka and joins with Hemavathi river. During a recent survey under Western Ghats biodiversity programme, we collected sixteen species of fishes belonging to three families. Of these a big sized barb, *Barbodes carnaticus* and *Nemachilus semiarmatus* are important for culture purposes. Eight other species recorded from this river can be grouped under ornamental fishes

Barbodes carnaticus:

Common names: Gidpakke gendai (Karnataka), kavery kenta (Malayalam), poaree candee, salcandee, shellee, pauvri kendai, palli kendai (Tamil).Conservation Status: Lower Risk-near threatened (Anon, 1998) Taxonomic Status: The species has been placed in the genus *Barbodes*. The generic status of the peninsular large carp needs further study. Distribution: Found in Cauvery River, Bhavani, Moyar, Periyar river and reservoirs (Menon, 1992) Kolli hills and Kabini River of Western Ghats. The present report is based on collection of the species from Hemavathi river of Chikmagulur district, Karnataka. Habitat and Ecology: It prefers large pools and riffles of rapid rivers and streams. Adults prefer pools and are observed to hide under bedrocks, boulders and undercuttings. Juveniles prefer riffles. It feeds mostly on allochthonous fallen leaves and seeds. It has been introduced into lakes and reservoirs of Periyar and Cauvery drainage system. Size range: Maximum size 60 cm length; 12 kg in weight (Menon, 1992) and in our ongoing research programmes, we recorded specimens with a length range of 25 to 40 cm (0.5 to 3 kg weight).**Reproduction:** Spawns in July-August and fry are available in September to December (Menon, 1992). This species undergoes spawning migration to upstreams and spawns in rivers after monsoon showers. **Threats:** Dynamiting and other destructive fishing along with loss of habitat are the major threats. Declining trend in all south Indian reservoirs is due to the introduction of non-native fish species. **Research and Conservation Action:** According to Tamil Nadu Fisheries Act, fishing is prohibited 200 m on either side of all dams. Research programmes on field survey, monitoring and captive breeding are needed. Major pools in Moyar River of Cauvery basin should be selected and declared as sanctuaries for the protection of the species.

***Nemachilus semiarmatus*:**

Conservation Status: Vulnerable (Anon, 1998). **Distribution:** Kabini and Bhavani rivers (Cauvery basin) and Eastern side of Periyar river (Anon 1998), Wynad, Nilgiris, Mysore and Silent valley (Talwar and Jhingran, 1991). The present report of the species is from Hemavathi River and its tributaries (sub-basin of Kabini). **Habitat and Ecology:** As a bottom dwelling species, it prefers slow flowing riffle and run habitats of streams. It is also found in lowland and wet hollows (Arunachalam, 1998). It feeds mostly on detritus and debris matter. **Threats:** Major threats are pollution and habitat loss. **Reproduction:** It spawns mostly in backwater pools and stagnant water bodies, after the monsoon rains. **Recommendation:** Systematic study, field survey and captive breeding are needed. **Culture potential:** This species is most popularly used for culture purpose by the local people. They collect juveniles from river and stock in earthen pits and ponds. The collected water is used for dry season spraying of coffee plants. Hence the hydroperiod in these storage tanks/ponds is used for the culture of *Nemachilus semiarmatus* providing an additional income to the farmers.

Ornamental fishes

Barilius gatensis, Puntius faciatus fasciatus, Puntius conchonius, Puntius bimaculatus, Danio aequipinnatus, Brachydanio rerio, Chela labuca and the glass fishes *Chanda nama* and *Pseudambasis ranga* are the most popular aquarium fishes. They are most popularly used for ornamental purposes because of their attractive body colouration, bands and blotches in body. From our field studies it is evident that viable populations of these species exist in the Western Ghats streams in South and North Karnataka.

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Ornamental Fish Diversity of the Nilgiri Biosphere Reserve

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Ornamental fishes are gaining importance not only because of their aesthetic value, but also due to their immense commercial value in the export trade. As many as 95 percent of all ornamental fishes are from freshwater rather than the ocean. Heavy fishing, habitat loss and other dangers, rather than commercial trade threatens many ornamental fishes.

The Western Ghats exhibit a rich biodiversity and endemicity. Of the 486 primary freshwater fishes known from India, 287 species are found in Western Ghats (Shaji, Easa and Gopalakrishnan, 2000) and 126 species are found in Nilgiri Biosphere Reserve. The Nilgiri Biosphere Reserve (NBR) harbours rich number of endangered, vulnerable rare and endemic and colourful ornamental fishes. While studying the fish fauna of the Nilgiri Biosphere Reserve, 16 species ornamental fishes were recorded. Of these, 6 species are endangered, 6 species are vulnerable and 4 species are lower risk near threatened as per the CAMP workshop held in 1997 (Anon, 1998). Captive breeding programme can improve their population in the wild.

The following ornamental fishes were recorded during the present study and the locality is given against each species.

Endangered species

1. *Osteobrama neilli* (Day)-Bhavani and Moyar rivers (Tamil Nadu).
2. *Osteochilus* (*Kantaka*) brevidorsalis-Moyar river, (Tamil Nadu).
3. *Puntius arulius* (Jerdon)-Nulpuzha, Wynaad (Kerala); Bhavani river (Tamil Nadu); Chikkala and Bandipur (Karnataka).
4. *Puntius fasciatus* (Jerdon)-Siruvani, Nadunkani, Bhavani, Kunjapanai (Tamil Nadu) and New Amarampalam (Kerala).
5. *Puntius melanostigma* (Day)-Avarahalla, Kakkan halla, Manin halla (Tamil Nadu); Nulpuzha (Kerala).

6. *Batasio travancoria* Hora and Law-Nulpuzha and Wynaad (Kerala).

Vulnerable species

1. *Puntius conchonius* (Ham.)-Bhavani, Kabini, Kulithurai Rivers of Mudumalai (Tamil Nadu).
2. *Puntius filamentosus* (Valenciennes)-Kabini (Karnataka); Karimpuzha, Silent Valley (Kerala); Moyar river (Tamil Nadu).
3. *Puntius mahecola* (Valenciennes)-Bhavani and Moyar rivers (Tamil Nadu).
4. *Barilius canarensis* (Jerdon)-Awarahalla, Mavin halla (Kerala) and Kallar tributary of Bhavani River (Tamil Nadu).
5. *Barilius gatensis* (Val.)-Noyil Situvari, Moyar and Sinkara (Tamil Nadu); Hemavathi, Nugu, Wynaad (Kerala).
6. *Etroplus maculatus* (Bloch)-Kallar tributary of Bhavani River (Tamil Nadu).

Lower risk near threatened species

1. *Puntius ticto* (Ham.)-Moyar, Mudumalai (Tamil Nadu); Nulpuzha and Wynaad (Kerala).
2. *Barilius bendelisis bendelisis* (Ham.)-Noyil, Bhavani, Moyar (Tamil Nadu) and Karimpuzha, Silent valley (Kerala).
3. *Danio aequipinnatus* (McClelland)-almost all streams/rivers of NBR.
4. *Parluciosoma daniconius* (Ham.)-almost all the river and stream of NBR.

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Potential Endemic Ornamental Freshwater Fishes of Kerala

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Freshwater fishes of Western Ghats have attracted the attention of ichthyologists the world over due to their rich diversity and high degree of endemism. The information on the fish fauna of the region is available in compilations of Day (1865, 1878), Jayaram (1981, 1999) and Talwar and Jhingran (1991). Majority of the studies on Western Ghat fishes are mainly focussed on documentation of species (Silas, 1950, 1951 & 1952: Easa and Basha, 1995; Shaji *et al.*, 1996); however, a few studies have also dealt with the habitat characteristics (Arun, 1997). Though these attempts have contributed to the knowledge on piscine resources, they were not directly useful in sustainable exploitation of native fauna.

At the same time, there was introduction of exotics for increasing the food production and for ornamental purposes. The European carp (*Cyprinus carpio communis*) and Tilapia were introduced as food fishes and rainbow trout for sport. Later, there have been transplantations of species from north Indian River systems (e.g. Indian major carps). The impact of these introductions on the native fauna of Kerala is yet to be studied in detail, but exotics were found to replace endemic species like *Cirrhinus cirrhosa* and *Puntius dubius* in Tamil Nadu (Natarajan and Menon, 1989). The aquarium industry in the state is fully dependent on the exotics. This state of affair is mainly due to the lack of information on the ornamental fishes in the inland waters of the state and due to the poor knowledge of breeding and rearing techniques. This paper is an attempt to identify ornamental species available in the state, which could be considered for breeding and rearing.

Out of the 196 teleost species reported from Kerala, forty one species are suggested for breeding and rearing in aquarium (Table 1). The selection of these species is based on their size, behaviour, colour and hardiness. The authors tried to rear species like *Puntius denisonii, P. conchonius, P. filamentosus, P. arulius, Horabagrus nigricollaris, Nemacheilus guentheri, N. triangularis* and *N. denisonii* in aquarium. All of them survived in community tanks for more than six months with minimum care.

Table 1. Freshwater fishes suggested for aquarium.

Sl.No.	***Ornamental Species***	Endemicity
1.	*Chela laubuca* (Ham.)	
2.	*Rasbora daniconius ham-Buch*	
3.	*Esomus thermicos* (Valenciennes)	
4.	*Danio aequipnnatus McClelland*	
5.	*Danio (Brachydanio) rerio* (Hamilton-Buchanan)	
6.	*Barilius bakeri* Day	EW
7.	*Barilius bendelisis* Ham.	
8.	*Barilius canarensis* (Jerdon)	EW
9.	*Barilius gatensis* (Val.)	
10.	*Puntius amphibius* (Val.)	
11.	*Puntius arulius* (Jerdon)	EW
12.	*Puntius bimaculatus* (Bleeker)	
13.	*Puntius conchonius* (Ham.)	
14.	*Puntius denisonii* (Day)	EW - K
15.	*Puntius filamentosus* (Val.)	EW
16.	*Puntius melanampyx* (Day)	EW
17.	*Puntius ticto* (Day)	
18.	*Nemacheilus denisonii* Day	EW
19.	*Nemacheilus guentheri* Day	EW
20.	*Nemacheilus keralensis* Rita & Nalbant	EW - K
21.	*Nemacheilus monilis* Hora	EW
22.	*Nemacheilus semiarmatus* Day	EW
23.	*Nemacheilus moreh* Day	EW
24.	*Nemacheilus striatus* Day	EW - K
25.	*Nemacheilus triangularis* Day	EW - K
26.	*Nemacheilus petrubanarescuei* Menon	EW
27.	*Nemacheilus nilgiriensis* Menon	EW
28.	*Lepidocephalus thermalis* (Val.)	EW
29.	*Horabagrus nigricollaris* Pethiyagoda & Kottelat	EW - K
30.	*Horabagrus brachysoma* Guenther	EW - K
31.	*Mystus vittatus* (Bloch)	EW
32.	*Glyptothorax anamalaiensis* Silas	EW - K
33.	*Glyptothorax annandaeli* Hora	
34.	*Glyptothorax madraspatanum* (Day)	EW - K
35.	*Aplocheilus lineatus* (Val.)	
36.	*Chanda ranga* (Ham.)	
37.	*Parambssis thomassi* (Day)	
38.	*Parambassis dayii* (Day)	

39.	*Etroplus maculatus* (Bloch)	EW
40.	*Macropodus cupanus* Val	
41.	*Tetraodon travancoricus* (Hora & Nair)	EW - K

EW - Endemic to Western Ghats; **K** - Endemic to Kerala.

The common *Rasbora daniconius* thrives and is well behaved in aquariums. Its brilliant colour of basic blue on the flanks with dark black stripe makes the species attractive for aquarium keeping. The Danios (*Danio* spp.) are brilliant blue coloured species and with maximum size of less than 10 cm. are ideal species for aquariums due to their active behaviour. Barils (*Barilius* sp.) are larger compared to Danios. The three species selected are with blotches/bars. These bars are blue coloured against a silvery background. These hill stream fishes survive well in tanks. *Puntius denisonii*, *P. arulius*, *P. filamentosus* and *P. conchonius* are the most beautiful among barbs. A prominent scarlet stripe above the longitudinal line on the flanks along with iridescent scales and colourful fins gives an aristocratic appearance to *Puntius denisonii*. The other *Puntius* spp. are also attractive, through their colour pattern varies according to the season.

The Nemachiline (*Nemacheilus* sp) species are the most beautiful of the torrential fishes. All are small sized (<10cm). Their colour varies from greenish to dark brown. Blotches, bars or saddle shaped bands, interrupt the base colour. Most of them are bottom dwellers and are herbivore/ algivore/ detritivore. Their food habits will help to keep the aquarium clean to some extent. *Glyptothorax* sp. (sucker cat fishes) is specific to torrential waters. These species are black on the dorsal side and flesh coloured on the ventral side. The black background on the dorsum is with longitudinal/transverse yellow or white bands. Most of them are algivore and adapted enough to cling on to the vertical surface. This habit helps in keeping clean the glass surface. But the survival of these species is doubtful and no attempts have been made so far to rear them in aquarium.

Among the catfishes, *Horabagrus brachysoma*, *Horabagrus nigricollaris* and *Mystus vittatus* are selected mainly due to their beautiful colour pattern. *Horabagrus* spp. have a golden yellow body with dark blotch or band on the branchial or nape region. *Horabagrus brachysoma* has already been reared in aquariums and its captive breeding technique has been perfected by Cochin Unit of NBFGR. *H. nigricollaris* is a new species and the information on its feeding and breeding is not available. Our attempt to rear the latter in aquarium was successful and it survived for more than 3 months without much care. *Macropodus cupanus* is attractive due to its phosphorescent nature. The edge of the fins is luminescent. *Etroplus maculatus, Aplocheilus lineatus* and *Parambassis thomassi* are also being used in the aquarium trade in a small scale.

Potential Ornamental Killi Fishes of the Family Cyprinodontidae

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In the family cyprinodontidae there are many potential ornamental fishes. Cyprinodontidae includes 50 genera with 300 species. Among these, the species which deposit their eggs in the substratum (bottom spawners) and whose life lasts only a year or less are of special significance as ornamental fishes. The members of the family are small sized egg laying toothed carps of minnows. They are quite active, hardy, prolific, graceful and are beautifully coloured. The two genera found in India are *Aplocheilus* and *Aphanius*. The Indian killi fishes are local candidates for small aquaria.

The males of genus *Aplocheilus* are longer than females often with fin extensions. Usually the pigment pattern exhibits difference between sexes in all species. Males exhibit a spot at the anterior base of caudal fin. They are surface living species and do well in captivity. Their larvicidal ability is utilized in mosquito eradication programmes. Four species of *Aplocheilus* are being used as ornamental varieties. The most popular one is *Aplocheilus* blocki (Arnold). This is the smallest and prettiest of all killifishes and commonly known as dwarf panchax. This has a distribution in Tamil Nadu, Kerala, Karnataka and can be bred easily in captivity. *A. dayi* is another species of ornamental value enjoining a wider range of distribution almost in all parts of Indian subcontinent.

A. lineatus (Val.) commonly known as Malabar killifish inhabits hilly region and reservoirs of highest altitudes as well as rivers, swamps and estuaries of Peninsular India. This is the largest and prettiest of the Asiatic members of the genus which grows to a length of 10 cm. Owing to its brilliant hue, it is one of the popular exotic fish in American aquaria. Breeding of this species is reported to be rather easy. *A. panchax* (Hamilton and Buchanan) is distributed in Indian subcontinent, Burma, Malaysia etc. This is a medium-sized species with a characteristic double-bordered and oval shaped caudal fin in males. The species is a prolific perennial breeder and is used for both larvicidal and ornamental purposes.

Aphanius dispair is the only species under the genus *Aphanius* available in Indian waters. This is a beautiful coloured ornamental species, kept in large shallow aquaria. Basically brackish water species, it survives well in freshwater also. They attain a length of 8 cm and their favorite spawning media are roots of water hyacinth or other floating plants. Under captivity, the breeders are removed after spawning and the young ones are reared in large aquaria fed with daphnia, brine shrimp and micro-worms.

Publicity about these fishes through articles in aquarium journals is needed to bring about an awareness and reduce impacts on wild populations and their habitats. Aquaculture techniques and commercial hatcheries for these species may be developed.

Vulnerable Peninsular Carps-Assessment of Potential Species for Culture

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The rivers, Cauvery and Krishna along with their major and minor tributaries form the principal river systems of Karnataka. Apart from this, the state is having 74 large and medium reservoirs (0.2 million ha area) and about 4,500 major and medium irrigation tanks (0.2m ha area), supporting a rich fish fauna. Among carps the indigenous fishery of these water bodies, comprises mainly of larger and medium sized fish species, such as *Labeo fimbriatus, L. kontius, Cirrhinus cirrhosa, Puntius pulchellus, P. kolus, P. sarana* and *Tor* spp. The fishery has changed considerable during the last three or four decades and the abundance of many of these species is falling dangerously low while others are on the verge of extinction This is mainly due to over exploitation of fisheries and also because of habitat pollution. Indiscriminate stocking of Indian major carps (IMC) and the exotic common carp have also contributed to the loss of some species and badly affected their diversity within the region. The brief account of some important vulnerable carp species of Karnataka and their distribution and biology are listed:

P. carnaticus: It is popularly known as Cauvery carp, reported to have formed a major fishery in Krishnarajasagar reservoir during 1970's with a maximum size reaching 600 mm in length and weight of 8 kg; the size reported in some tanks and reservoirs was upto 1.2 kg. It feeds on a detritus matter, algae and planktonic organisms. Breeding is during monsoon months, from July to September.

P. pulchellus: It is an important native carp of Deccan Plateau. It formed once a major fishery in Tunga, Bhadra and Tungabhadra rivers, prior to the construction of dams across these rivers. The fishery had dwindled subsequently and the species formed only a stray occurrence in fish catches (David *et al.* 1969). A maximum size of 780 mm in length and weight up to 8 kg was recorded in major rivers. Now 0.5

to 1.8 kg groups are available, though less in number, from Tungabhadra, Gajanur, Bhadra and Anjanapur reservoirs and also in the upper reaches of their respective rivers. It is considered to be the only indigenous fish consuming aquatic weeds and submerged grasses and the species could be used in controlling aquatic vegetation in reservoirs and tanks and in irrigation canals. It has got a prolonged breeding season lasting from August to December in rivers and reservoirs.

C. cirrhosa: It is a popular and fast growing Cauvery carp. Earlier good population of fishes weighing 0.8 to 6.0 kg have been recorded in both rivers and reservoirs, but now the species is very rarely encountered in fish catches.

L. fimbriatus: The species formed a major fishery in all the rivers of Karnataka before the construction of dams across the rivers at different stretches. The fish yields have showed a declining trend in Tungabhadra reservoir (22.1-5.3%) when the fish catches from 1950 to 1970 were examined. Though the fish is known to reach a maximum size of 600 mm in length and 5 kg in weight in lotic water bodies, the fish catch records from these bodies have showed a size group ranging from 0.3 to 3.2 kg in weight.

L. kontius: In the earlier years (1950-60), it formed as important fishery in the river Cauvery with a maximum size of fish recorded had been 600 mm, weighing 10 kg. The species is fast dwindling from this river system.

Attempts to culture these species have been limited due to lack of knowledge about their seed production and also biology. This is also partly due to their slow growth rate in comparison to IMC and non-availability of induced bred seed for stocking. But these indigenous species may have more suitable characteristics for survival and growth under the natural conditions found in different water bodies. The Peninsular Aquaculture Division of Central Institute of Freshwater Aquaculture is currently evaluating the potential of some of these species for aquaculture and the possibility of using *P. pulchellus* as a future substitute for exotic grass carp.

Urgent measures are called for conservation of the resources including the fish-diversity and their rehabilitation by artificial propagation and judicious stocking in different water bodies and by creation of sanctuaries and gene banks, particularly for the endangered species. It might be useful to point out at this juncture that full inventory or at least one time listing of the entire fish diversity of Karnataka State including Western Ghats part is urgently required for the future long term strategic planning.

Economically Important and Cultivable Fishes of the Nilgiri Biosphere Reserve

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The Nilgiri Biosphere Reserve (NBR) is the first Biosphere Reserve that was set up in India under the National Man and Biosphere programme. It covers an area of 5520 km2 in three states viz., Karnataka, Kerala and Tamil Nadu. In India, the traditional approach to wildlife conservation has focused on the charismatic large vertebrates and their habitats, with neglect of the other species such as fishes. The NBR has a unique fish fauna partly due to geology and partly due to the fact that species tend to become isolated within drainage, resulting in distinct populations and subspecies. Nearly 33% of the Western Ghats fishes are found in the Nilgiri Biosphere Reserve.

An extensive survey was carried out to document the fish fauna of the Nilgiri Biosphere Reserve during 1995-1998. The study was carried out in westward (Chaliyar, Kadalundi and Bharathapuzha) and eastward flowing river basin (Noyil, Bhavani and Kabani). A total of 118 species (which includes 2 species described by the authors) belonging to 7 orders 47 genera and 22 families were recorded. Among these, 14 species are endemic, 7 species are critically endangered (CR), 37 are endangered (EN), 36 are vulnerable (VU), 23 are lower risk near threatened (LRnt) and 16 are lower risk least concern (LRlc), based on the assessment in Conservation Assessment and Management Plan (CAMP) Workshop held at NBFGR in September 1997 (Anon., 1998).

From ecological and biodiversity angle every species is unique. But it is very difficult to conserve all the species. On a prioritization basis the critically endangered, vulnerable and endemic species are most important. But all these species may not have economical value.

Due to lack of the current fish distributional knowledge we could not even locate the species for further study. A particular place for a particular species may not have viable population, but the same species will have very good populations in some other areas. For example *Tor khudree* (Sykes) has been termed as an endangered species, but it is very common in Karimpuzha, Mancheri, Nilambur and Rivers of Kerala.

The following are the economically important and cultivable big sized fishes

Species	Locality
Critically Endangered Species	
Labeo ariza (Ham)	Bhavani River, Tamil Nadu, Wynad, Kerala
Neolissochilus wynaadensis (Day)	Kakkan halla, Moyar River, Kallar tributary of River Bhavani, Tamil Nadu
Endangered Species	
Anguilla bengalensis (Gray & Hardw)	Bhavani, Moyar, Tamil Nadu; Karimpuzha, Kunthipuzha; Arikayam puzha, Kerala
Clarias dayi Hora	Ombatta, Mudumalai, Tamil Nadu
Hypselobarbus curmuca	Moyar, Thenkumarada, Tamil Nadu
Hypselobarbus dubius (Day)	Throughout Moyar River and the confluence of Bhavani and Siruvani Rivers
Hypselobarbus lithopidos (Day)	South Canara, Karnataka
Hypselobarbus micropogon	Nulpuzha, Wynaad, Kerala
Labeo fimbriatus	Bhavani River, Tamil Nadu and Kerala
Labeo kontius (Jerdon)	Bhavani River, Tamil Nadu
Mastacembelus armatus (Lacepede)	Moyar, Chammanaar, Tamil Nadu, Karimpuzha, Arikayam puzha
Mystus malabaricus (Jerdon)	Wynaad, Kerala, Nool puzha
Mystus punctatus (Jerdon)	Ombatta swamp, Bhavani River, Tamil Nadu
Neolissochilus wynaadensis (Day)	Kallar stream, Moyar River, Bhavani River, Tamil Nadu
Ompok bimaculatus (Bloch)	Moyar, Tamil Nadu, Wynaad, Kerala
Ompok malabaricus (Valenciennes)	Noolpuzha, Mavinhalla, Kerala
Osteobrama (Osteichthys) nashii (Day)	Moyar, Tamil Nadu
Puntius jerdoni (Day)	Wynaad, Kerala
Tor khudree (Sykes)	Abhayaranayam, Moyar, Tamil Nadu : Panna puzha, Arikayam puzha, Karim puzha, Kerala
Tor mussullah (Sykes)	Bhavani, Tamil Nadu
Wallago attu (Schneider)	Bhavanisagar, Tamil Nadu
Vulnerable Species	
Channa orientalis (Schneider)	Kakkanhalla, Chammanaar, Bhavani, Tamil Nadu
Cirrhinus reba (Ham) Moyar	Bhavani River, Tamil Nadu
Clarias dussumieri (Linn.)	Mundumalai, Tamil Nadu

Species	Locality
Heteropneustes fossilis (Bloch)	Ombatta stream, Mudumalai, Tamil Nadu
Mystus armatus (Day)	Begur puzha, Maravanthadi, Kerala
Mystus bleekeri (Day)	Ombatta swamp, Moyar, Bhavani River, Tamil Nadu
Mystus vittatus (Bloch)	Bhavani River, Tamil Nadu
Puntius sarana sarana (Ham)	Moyar, Thengumarad, Bhavani, Pillur, Tamil Nadu
Lower Risk Near Threatened Species	
Channa marulius (Ham)	Mavanhalla, Mudumalai, Tamil Nadu
Channa punctatus (Bloch)	Bhavani River, Tamil Nadu; Wynaad, Kerala
Channa striatus (Bloch)	Bhavani, Tamil Nadu
Glossogobius giuris (Ham)	Moyar, Kallampalayam, Tamil Nadu
Labeo bata (Ham)	Moyar, Bhavani rifver, Tamil Nadu
Labeo boggut (Sykes)	Bhavani, Moyar, Tamil Nadu
Mystus cavasius (Ham-Buch.)	Moyar, Tamil Nadu
Puntius carnaticus (Jerdon)	Moyar, Bhavani, Ombatta Swamp, Sinkam, Kunithurai, Tamil Nadu
Xenentodon cancila (Ham)	Kallar, Bhavani, Moyar, Tamil Nadu
Notopterus notopterus (Pallas)	Bhavani sagar, Tamil Nadu
Exotic Species	
Cyprinus carpio communis Linn.	Pykara dam, River and Kamaraj sagar, Ooty
Cyprinus carpio specularis Linn.	Pykara dam, Pykara River and Kamaraj sagar Ooty, Tamil Nadu

Cultivable and Ornamental Fishes in Rivers of Wynad District, Kerala

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A survey of freshwater fishes and their habitat features was conducted in 3 east flowing steams/ rivers (Cauvery basin) and 4 west flowing rivers in Wynad district of Kerala during May 1998. Thirty-seven species including 12 economically important cultivable species, 13 important ornamental fishes were recorded. Current taxonomic status, habitat and ecology were evaluated.

Economically important cultivable species

1. *Wallago attu:* Habitat and ecology: Prefers turbulent rivers and reservoirs, mostly hides under holes in the river banks and canals. Predatory in habit feeding mostly on small fishes Status: Lower risk–near threatened (Anon, 1998). Distribution: Cauvery drainage, Chaliyar River (Menon, 1992, Arunachalam et al., 1997). Threat: Hunting for food, poisoning, siltation. Size range: From our ongoing research programme we collected specimens of 30-45 cm length and 250-800 g weight. Recommendation: Induced breeding(difficult).
2. *Clarias dussumieri*: Habitat and Ecology: Prefers lower reaches of streams/rivers, and canal with muddy bottom. Commonly found in ponds, swamps and paddy fields. Predatory in habit, it feeds on small fishes and insects. Status: Vulnerable (Anon, 1998). Distribution: Moyar, Bhavani River and Mettur dam in Tamil Nadu, Periyar drainage in Kerala (Menon, 1992). During a survey in May, 1998, we recorded it from Kabini river, Wynad. Threat: Dynamite and other destructive fishing, loss of habitat, over exploitation, diseases. Recommendation: Studies on taxonomy, biology and induced breeding trials.
3. *Aorichthys aor*: Habitat and Ecology: It inhabits large rivers and canals. Predatory in habit, it feeds on small fishes and worms. Status: Not assessed due to data deficient. Distribution: Ganga, Yamuna, Krishna and Godavari river systems (Talwar and Jhingran, 1991). During a recent survey (May, 1998) we recorded

the species from Kabini river in Wynad. **Threat:** over exploitation, pollution and destructive fishing. **Recommendation:** Taxonomic, field survey and distribution studies.

4. *Heteropneustes fossilis*: **Habitat and Ecology:** It prefers muddy and clay bottom of rivers, ponds, reservoirs, swamps and marshes. Carnivorous and detritus feeding. **Status:** Vulnerable (Anon, 1998). **Distribution:** Commonly found in Western Ghat rivers of Tamil Nadu, Kerala and Karnataka (Menon, 1992; Arunachalam, 1997). **Threat:** Loss of habitat, pollution, diseases. **Recommendation:** Captive breeding since induced breeding and artificial fertilization techniques are available.
5. *Heteropneustes microps*: **Habitat and Ecology:** It prefers muddy and clay bottom of rivers, ponds, reservoirs, swamps and marshes. Carnivorous in feeding habit. **Status:** Not assessed due to lack of information. **Distribution:** It is found in Sri Lanka with very restricted distribution in India in Uttar Pradesh and Bihar. (Datta Munshi and Srivastava, 1988). Recently we recorded it from Western Ghat Rivers (Kabini and Tamiraparani rivers, Arunachalam et al., 1999). **Threat:** Destructive fishing, pollution, diseases. **Recommendation:** Taxonomy studies, field survey and monitoring.
6. *Ompok bimaculatus*: **Habitat and Ecology:** It is common in ponds, rivers and wetlands. Carnivorous and accepts biowastes like chicken and animal intestine. **Status:** Endangered (Anon, 1998). **Distribution:** Tamiraparani River (Arunachalam, 1997a; Rema Devi et al., 1997). Moyar, Bhavani and Kabini river of Cauvery basin (Menon, 1992), Kal River in Maharasta (Arunachalam et al., 1997). **Threat:** Over exploitation, destructive fishing, pollution, habitat loss. **Recommendation:** Taxonomy, field survey, captive breeding and monitoring.
7. *Ompok malabaricus*: **Habitat and Ecology:** It is common in rivers and wetlands. Piscivorous feeding mostly on other small fishes. **Status:** Critically Endangered (Anon, 1998). **Distribution:** Moyar River in Tamil Nadu part of Nilgiri Biosphere Reserve (Arunachalam, 1998; Singh et al., 1996). During survey in May 1998 we recorded it from Kabini River in Wynad. **Threat:** Destructive fishing, loss of habitat, pollution. **Recommendation:** Field survey, taxonomy and captive breeding.
8. *Silurus wynaadensis*: Habitat and ecology: Prefer fast flowing rivers, canal and streams (mostly hides in holes on rocks) where it feeds on small fishes and crustaceans. **Status:** Critically Endangered (Anon, 1998). **Distribution:** Tamiraparani river (Arunachalam, 1998; Rema Devi et al., 1997). Moyar, Bhavani, Kabani River–Wynad (Menon, 1992). **Threat:** Habitat loss, siltation, destructive fishing. **Recommendation:** Taxonomy, field survey, habitat management and captive breeding.
9. *Hypselobarbus micropogon*: Habitat and ecology: Prefers rocky pools and riffles of streams and fast flowing rivers. Bottom and column feeding group, feed on

debris and plant matter. **Status:** Endangered (Anon, 1998). **Distribution:** Kabani Rivers of Cauvery basin (Menon, 1992; Arunachalam, 1998). During a recent survey (May, 1998) we recorded it from Bavalipuzha in Wynad (Cauvery basin). **Threat:** Over exploitation, destructive fishing, habitat loss, pollution. **Recommendation:** Taxonomy, field survey, biology and captive breeding.

10. *Hypselobarbus jerdoni*: **Habitat and Ecology:** It prefers deep pools in the fast flowing streams. Column and bottom feeder and it feeds on debris, leaf litter and other plant matter. **Status:** Endangered (Anon, 1998). **Distribution:** Thungabhadra River, Karnataka, Cauvery River, Tamil Nadu (Talwar and Jhingran, 1991; Jayaram, 1991) Aganashini River of Karnataka (Arunachalam et al., 1997b). During a recent survey (May 1998) we recorded it from Kannathumpuzha, a west flowing stream in Wynad district. **Threat:** Destructive fishing, habitat loss, siltation. **Recommendation:** Taxonomy, field survey, biology, captive breeding.
11. *Mastacembelus armatus*: **Habitat and Ecology:** Commonly found in rivers, canals, streams, lake, reservoirs and ponds (Arunachalam, 1997a). It is piscivorus in habit. **Status:** Not assessed. **Distribution:** Commonly found in Western Ghats streams and rivers (Talwar and Jhingran, 1991; Arunachalam, 1998; Menon 1992). During a recent survey (May 1998) we recorded it from Kabani River in Wynad. **Threat:** Over exploitation, siltation, habitat loss, destructive fishing. **Recommendation:** Studies on biology, captive breeding and habitat improvement.
12. *Channa striatus*: **Habitat and Ecology:** It inhabits shallow water bodies of rivers, ponds, reservoirs, swamps, and marshes. Carnivorous and predatory in behaviour feeding mostly on small fishes. **Distribution:** Commonly found in rivers of Tamil Nadu, Kerala and Karnataka (Arunachalam, 1997a; Arunachalam, 1998). **Threat:** Over exploitation, disease especially epizootic ulcerative syndrome. **Recommendation:** Captive breeding as induced breeding techniques are available.

Minor important food fishes of tribals

Three important species namely *Osteochilichthys nashii, Puntius parrah* and *Puntius amphibius* are commonly used for food by local and tribal people in and around Wynad district. **Threat:** Over exploitation, habitat loss, pollution and destructive fishing. **Recommendation:** Research management on biology and habitat conditions.

Ornamental fishes

These fishes have attractive colour with stunning bands. Smaller species attain 5 to 10 cm and are easily acclimated to aquarium conditions. Among the 13 species, 4 species are in the endangered status (Anon, 1998). *P. fasciatus fasciatus* has three black bands and they are common in west flowing rivers of Kerala. *P. parrah* is found only in Cauvery drainage system (Endemic to Cauvery river, Jayaram , 1991).

The hill stream loach *Bhavania australis* is a small bottom dwelling, loach mostly found in turbulent stream and are common in southern part of Western Ghats (Arunachalam, 1998). The glass fishes *Pseudambassis ranga* and *Pseudambassis baculis* are important as ornamental fishes. Threat: Loss of habitat, pollution, Dynamite fishing. Recommendation: Research management, field survey, biology and captive population maintenance.

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Some Economically Important and Cultivable Fishes in Gadana River, Western Ghats

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Anguilla bengalensis bengalensis

Common name: Indian long fin eel. **Conservation status:** Endangered (Anon, 1998). **Identification:** Body elongate. Head conical, flattened dorsally. Mouth terminal, angle of mouth appreciably behind posterior margin of eye; lips prominent; teeth small inconspicuous, multi serial forming relatively narrow bands on jaws, but in an anterior broad band on vomer; vomerine band narrows conspicuously before its mid length. Dorsal fin inserted nearer anus than gill opening. Vertebrae 106 to 112. D-250-305 P-18 A-220-250. **World Distribution:** India, Pakistan, Sri Lanka, Burma and the East Indies (Talwar and Jhingran, 1991). **Distribution and abundance in South India:** Gadana river, south Tamil Nadu. (Arunachalam and Sankaranarayanan, 1998), some wethollows of Tamiraparani riverine basin (Arunachalam, 1997) and in Moyar river of Nilgiri Biosphere reserve (Arunachalam, 1998). Found abundantly in Gadana river and some wethollows in Tamiraparani riverine basin. **Threats:** Over fishing. **Size range:** Talwar and Jhingran (1991) recorded the length of 120 cm in standard length. But in our collections we recorded the maximum size of 530 mm in standard length. **Conservation action:** Needs monitoring to evaluate status. Thorough and detailed studies are needed on ecological and genetic aspects. Upstream habitats of this species may be declared as fish sanctuary. **Remarks:** It is much prized as a food fish and is supposed to have special nutritional value. In villages, rice or wheat flour is mixed with fish mucous, in live condition and this flour mix is used as medicine for arthritis.

Ompok bimaculatus

Common name: Indian butter-cat fish. **Conservation status:** Endangered (Anon, 1998). **Identification:** Body elongate and strongly compressed. Eyes moderate, its lower border below level of cleft of mouth. Mouth large and oblique; teeth in villiform bands on jaws. Vomerine teeth in two oval patches. Barbels two pairs; maxillary barbels long and extend to or slightly beyond anal fin origin, the mandibular pair very short. Anal fin long, inserted well behind dorsal fin. Pectoral spine moderately strong feebly serrated at its inner edge. Caudal fin deeply forked, with pointed lobes. D-4 P-i/12-14 V-i/7-8 A-ii-iii/57-58. **World Distribution:** Afghanistan, Pakistan, India, Bangladesh, Thailand, Java, Sumatra and China (Talwar and Jhingran, 1991). **Distribution in South India:** Gadana river, south Tamil Nadu (Arunachalam and Sankaranarayanan, 1998; Arunachalam, 1998). **Threats :** Over fishing. **Size range:** Talwar and Jhingran (1991) recorded the length of 15 cm in standard length. But in our collections we recorded the maximum size of 310 mm in standard length. **Conservation action:** Needs monitoring. A thorough and detailed study on ecological and genetic aspects is under way. Upstream habitats of this species may be declared as fish sanctuary. **Remarks:** It is much prized as a food fish and is caught in fairly good quantities in India. (Talwar and Jhingran, 1991).

Puntius sarana orphoides

Common name: Javaen barb. **Conservation status:** Not assessed. **Identification:** Body deep; Eyes moderate. Mouth small and terminal. Barbels two pairs. Dorsal fin inserted nearer to base of caudal fin than to tip of snout. Last unbranched ray in dorsal fin osseous, strong and finely serrated behind. Scales moderate. Lateral line complete with 28-43 scales. D-iv/8 P-i/14-16 V-i/8 A-ii/5. **World Distribution:** Manipur, Thailand, Borneo, Burma and Java. (Talwar and Jhingran, 1991). **Distribution in South India:** First record from Gadana river and Western Ghats. (Arunachalam and Sankaranarayanan, 1998; Arunachalam, 1998). **Size range:** Talwar and Jhingran (1991) reported the length of 25 cm in standard length. But in our collections we recorded the maximum size of 220 mm. **Threats:** Over fishing. **Conservation action:** Induced and captive breeding is necessary to conserve the species.

Puntius sarana subnasutus

Common name: Peninsular Olive barb. **Conservation status:** Not assessed. **Identification:** Body oblong and fairly deep. Head fairly small. Eyes moderate. Mouth moderate. Barbels two pairs. Maxillary pair much longer than orbit, rostral pair slightly shorter. Dorsal fin inserted equidistant between tip of snout and base of caudal fin. Scales moderate. Lateral line complete with 28-31 scales. D-iii/8 P-i/16 V-i/7 A-ii/5. Distribution: Krishna and Cauvery river systems. (Talwar and Jhingran, 1991). Gadana river, south Tamil Nadu. (Arunachalam and

Sankaranarayanan, 1998; Arunachalam, 1998) and also recorded in some wet hollows in Gadana river basin (pers. obsv.). **Threats:** Over Fishing. **Size range:** Talwar and Jhingran (1991) reported the length of 25 cm. But in our collections we recorded the maximum size of 111 mm in standard length. **Conservation action:** Needs monitoring. A thorough and detailed study is on the way on the ecological and genetic aspects.

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Cultivable and Ornamental Fishes of Manimuthar River, Tamil Nadu

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Manimuthar river is one of the sub basins of the major east flowing river Tamiraparani in Tirunelveli District of Tamil Nadu. During a recent survey under fish diversity programme, about 75 species of fishes were recorded among which 20 are economically important/cultivable and 10 are of ornamental value. Species of *Labeo* and *Cirrhinus* are already being cultured by the fisheries department of Tamil Nadu in Manimuthar reservoir.

1. *Tor khudree:* Common name : Deccan mahseer. Habitat and Ecology: It prefers rapid rivers and streams with rocky substrate. Adults prefer deep pool habitat and hide under bedrock under and cuttings; juveniles are mostly found in riffle region. Status: Vulnerable (Anon, 1998). Maximum size: About a metre in length with a weight of 22.6kg (Menon, 1992). Distribution: Periyar river (Menon, 1992), Vedaganga, Maharashtra, Aghanashini, Thunga rivers (Arunachalam *et. al.,* 1998). Biology: Kulkarni (1977) have published details of the spawning habit, eggs and early development of this species. It spawns after the monsoon, when the river gets stabilized and frys are available during January to May (per. obs.). Threats: Damming, dynamite, poisoning and other destructive fishing; loss of habitats and over exploitation. Protective measures taken: Protective measures have already been taken for artificial propagation and rehabilitation of *Tor khudree* in the hydel lakes of Tata Electric Company at Lonavala district, Pune, Maharashtra. (Kulkarni and Ogale, 1978); Captive breeding is also practiced in Malampuzha reservoir in Kerala. A nature reserve should be established for its protection in Thunga river, Sringeri in Southern Karnataka where it has been observed in rich density of about 650 adults in 100 m stretch of the river. This population is kept without any disturbance under the control of Sringeri Mutt. A highly dense and

viable population exists in this temple sanctuary. This reserve can be used to protect endangered Deccan Mahseer, and another Mahseer species *Tor neilli*. **Conservation recommendation:** Taxonomic, morphological and genetic studies; translocation, survey and monitoring; habitat management and life history studies.

2. *Tor khudree malabaricus* : **Habitat and Ecology:** It prefers deep pool habitat of streams with rocky substance. Omnivores in feeding habit; mostly feeds on allochthonous plant materials and debris. **Status:** Critically Endangered (Anon, 1998). Menon (1996) synonimized this species with *Tor khudree*. But specimens collected by us from Tamiraparani river system showed much similarity to *Barbus malabaricus* as described by Day (1878). The taxonomic ambiguity is yet to be resolved. **Distribution:** Small fragmented population exists in Tamiraparani river system only (Arunachalam, 1998). **Threats:** Habitat loss, siltation due to removal of riparian vegetation; decimation of the whole population during dry season; slaughtering in reservoirs. **Protective measures taken:** Already the stream reaches and streams where this species occur are under Kalakadu-Mundanthurai Tiger Reserve and are protected. **Conservation recommendation:** Taxonomy and morphology and genetic studies, translocation, survey, genetic management, habitat management and captive breeding.
3. *Hypselobarbus curmuca*: **Habitat and Ecology** : It prefers rapid rivers or streams. Mostly found in deep pool region with rocky substrate, where it feeds on allochthonous food materials like plant matter and debris. **Status:** Critically endangered (Anon, 1998). Menon (1995) synonimised it with H. kurali; however, in our collections we recorded specimens which are distinct and hence the taxonomic ambiquity is yet to be resolved. **Distribution:** Found in the Krishna, Godavari and Cauvery drainages. At present, it occurs in low numbers in the Nagarjunasagar reservoir, Chaliyar, Achankovil, Pambar and Periyar rivers in Kerala (Menon, 1992), Moyar, Manimuthar and Tamiraparani rivers in Tamil Nadu (Menon, 1992; Arunachalam, 1997; Arunachalam, 1998). **Threats:** Damming, destructive fishing, siltation and habitat loss. **Protective measures taken:** Habitats are under Kalakad Mundanthurai tiger reserve. **Conservation recommendation:** Field survey, taxonomy study, habitat management and captive breeding.
4. *Hypselobarbus dubius*: **Habitat and Ecology:** It prefers deeper pools with clear, fast flowing large streams and rivers; also recorded in reservoirs and check dams. Omnivorous in feeding habit; it feeds mostly on allochthonous plant materials, seeds, terrestrial insects (red ants and spiders), *Chironomous* larvae and small benthic molluscs (per. obs.). **Status:** Endangered (Anon, 1997). **Distribution:** Restricted distribution in Nilgiris (Moyar and Bhavani Rivers) and in Tamiraparani River basin, Tamil Nady (Arunachalam, 1997 ; Arunachalam,

1998). Threats: Destructive fishing, poisoning, siltation and habitat loss. Protective measures taken: Habitats are under Kalakad-Mundanthurai tiger reserve; however, the reservoir and lowland riverine populations are caught regularly. Conservation recommendation: Taxonomy, field survey, genetic management, life history studies and captive breeding. As the distribution of this species in highly restricted and fragmented, induced breeding and conservation is very essential.

5. *Hyselobarbus dobsoni*: Habitat and Ecology: It prefers rocky pools in the streams/ rivers. Adults mostly hide under bedrocks and boulders; juveniles prefer riffles and shallow water regions. It feeds mostly allochthonous plant materials and debris. Distribution: Known only from Deccan, in the Krishna river system, (Menon, 1992). At present it has been recorded from Gadana and Tamiraparani river systems (Arunachalam, 1998 and Arunachalam and Sankaranarayanan, 1998). Status: Not assessed, hence kept under data deficient. Maximum size: 90 to 120 cm in length. In our ongoing research programmes we collected specimen in the length range from 25 to 45 cm in length; 500g to 1kg in weight. Biology: It breeds after the monsoon, when the river gets stabilized and fries are available during February and March (per. obs.). Threats: Over fishing, siltation, habitat loss and destructive fishing. Conservation recommendation: Distribution study, taxonomy, habitat management, captive breeding.
6. *Barbodes sarana subnasutus*: Habitat and Ecology: Commonly found in pools and lower reaches or river. Omnivorous in feeding habit, feeds mostly allochthonous drift materials and debris. Status: Not assessed due to data deficiency. Distribution: Bhavani, Moyar River, Chittar and Tamiraparani rivers (Menon, 1992; Rema Devi *et. al.,* 1997; Arunachalam, 1997; Arunachalam *et. al.,* 1998). Threat: Poisoning, siltation and habitat loss. Conservation recommendation: Field survey, monitoring, and captive breeding.
7. *Anguilla bengalensis*: Habitat and Ecology : Migratory fish which is found in the entire stretches of streams, rivers and wetlands (Arunachalam, 1997). It prefers rock holes and crevices in streams, reservoir, check dams and sandy loam soil in wetlands. Status: Endangered (Anon, 1998). Distribution: East coast of India; Ganga, Mahanadi, Narmada (Anon, 1998). Arunachalam, (1997) recorded this species from the tributaries of Tamiraparani river system (Gadana and Manimuthar) and in the river associated wetland of these two rivers. Maximum size: In our ongoing research programme we recorded the size of 1.5 m length and 3.5 kg in weight. Biology: It migrates to sea for spawning. Fries are available in the down reaches of rivers and estuaries (per. obs). Threats: Construction of dams and check dams in the stretch of river affects the spawning migration of this species; hunting and poisoning.

Conservation recommendation: Field survey, monitoring, life history studies and captive breeding.

8. *Etroplus suratensis*: **Habitat and Ecology:** Commonly found in lower reaches of rivers, reservoirs and backwaters. Omnivorous in feeding habit; feeds mostly on benthic organic matter and debris. **Status:** Not assessed hence kept under data deficient. **Distribution:** Common in Kerala Rivers, Cauvery River system and Gadana, Manimuthar Rivers of Tamiraparani River basin (Arunachalam, 1998). Threat: Over fishing, pollution and habitat loss. Research recommendation: habitat improvement, field survey and captive breeding.
9. *Heteropneustes fossilis*: **Habitat and Ecology:** It prefers muddy and clay bottom of rivers, ponds, reservoirs, swamps, marshes. Carnivorous. **Status:** Vulnerable (Anon, 1998). **Distribution:** Commonly found in Western Ghats rivers of Tamil Nadu, Kerala and Karnataka (Menon, 1992 ; Arunachalam, 1998). Threat: Loss of habitat, pollution, diseases. **Conservation recommendation:** Captive breeding; Induced breeding and artificial fertilization techniques are available.
10. *Heteropneustes microps*: **Habitat and Ecology:** It prefers muddy and clay bottom of rivers, ponds, reservoirs, swamps, and marshes. Carnivorous in feeding habit. **Status:** Not assessed due to lack of information. **Distribution:** It is a Sri Lankan form, with a restricted distribution in India in Uttar Pradesh and Bihar (Dutta Munshi and Srivastava, 1998) and recently we recorded it from Kabini and Tamiraparani rivers of Western Ghats (Arunachalam *et. al.,* 1998). Threat: Destructive fishing, pollution, diseases. **Conservation recommendation:** Taxonomy, field survey and monitoring.
11. *Ompok bimaculatus*: **Habitat and Ecology:** It is common in ponds, rivers and wetlands. Piscivorous, accept bio-waste like chicken intestine and animal wastes (per. obs.). **Status:** Endangered (Anon, 1998). **Distribution:** Tamiraparani river (Arunachalam, 1997; Rema Devi et al., 1997) Moyar, Bhavani and Kabini rivers (Menon, 1992), Kal River in Maharashtra (Arunachalam *et. al.,* 1997). Threat: Over exploitation, destructive fishing, pollution, habitat loss. **Conservation recommendation:** Taxonomy, field survey, captive breeding and monitoring.
12. *Silurus wynaadensis*: **Habitat and Ecology:** Prefer fast flowing rivers, canal and streams; mostly hide in between rocks where it feeds on small fishes and crustaceans. Status : Critically Endangered (Anon, 1998). **Distribution:** Tamiraparani river (Arunachalam, 1998; Rema Devi *et. al.,* 1997), Moyar, Bhavani and Kabini rivers (Menon, 1992). Threat: Habitat loss, siltation, destructive fishing. **Conservation recommendation:** Taxonomy, field survey, habitat management and captive breeding.
13. *Mastacembelus armatus*: **Habitat and Ecology:** Commonly found in river, canals,

streams, lake, reservoirs and ponds (Arunachalam, 1997). It is piscivorous in habit. **Status:** Not assessed. **Distribution:** Commonly found in Western Ghats streams and rivers (Talwar and Jhingran, 1991). Tamiraparani, Moyar and Bhavani rivers (Arunachalam, 1998). During a recent survey (May, 1998) we recorded from Kabini River in Wynad. Threat: Over exploitation, siltation, habitat loss, and destructive fishing. **Conservation recommendation:** Biology, captive breeding and habitat improvement.

14. *Channa straitus*: **Habitat and Ecology:** It inhabits shallow water bodies of rivers, ponds, reservoirs, swamps, marshes; Carnivorous, predatory in behaviour; feeds mostly on small fishes. **Status:** Low risk–least concern (Anon, 1998). **Distribution:** Commonly found in rivers of Tamil Nadu, Kerala and Karnataka (Arunachalam, 1997; Arunachalam, 1998). Threat: Over exploitation and diseases especially Epizotic Ulcerative Syndrome. **Conservation recommendation:** Captive breeding; induced breeding techniques are available.
15. *Labeo calbasu*: **Habitat and Ecology:** It prefers rivers with rocky substrate, where it feeds on periphytic filamentous algae and diatoms. **Status:** Low risk–near threatened (Anon., 1998). **Distribution:** Widely distributed, Uttar Pradesh, West Bengal, Punjab, Himachal Pradesh, Bihar, Kerala and Tamil Nadu. We recorded it from Manimuthar River and lower reaches of Tamiraparani River (Arunachalam, 1998). **Threats:** habitat loss, pollution, and siltation. **Protective measures taken:** Fisheries Department of Tamil Nadu established earlier captive breeding in Manimuthar reservoir. Currently there is no captive programme in the reservoir. **Conservation recommendation:** Genetic improvement, monitoring and captive breeding.
16. *Labeo dero*: **Habitat and Ecology:** It prefers rivers with rocky substrate, where it feeds on periphytic filamentous algae and diatoms. **Status:** Low risk–near threatened (Anon., 1998). **Distribution:** Upland and coldwater of Northern and North East Himalayas (Anon, 1998; Talwar and Jhingran, 1991). Currently, Rema Devi et al., (1997) and Arunachalam, (1997) recorded this species from Manimuthar. **Threats:** Habitat loss, siltation and pollution. **Conservation recommendation:** Habitat management, field survey, genetic improvement and captive breeding.
17. *Labeo pangusia*: **Habitat and Ecology:** It prefers deep and rocky pools in the rivers, also found in wetlands, check dams and reservoirs. It feeds mostly on algae and diatoms. **Status:** Low risk–near threatened (Anon, 1998). **Distribution:** Ganges river system. Assam, Bihar, West Bengal and Tamiraparani river system in Tamil Nadu (Anon, 1998; Rema Devi *et. al.,* 1997). **Threats:** Over exploitation, pollution, Habitat loss and siltation. **Conservation recommendation:** Field survey, monitoring, genetic improvement and captive breeding.

18. *Glossogobius giuris* : **Habitat and Ecology:** It prefers sandy and loamy soil of less flowing river, reservoirs, check dams and reservoirs. Mostly it hides under stable bank holes and mud. Predatory in behaviour; it feeds on other small fishes and aquatic insects. **Status:** Lower risk–near threatened (Anon, 1998). **Distribution:** Uttar Pradesh, Bihar, West Bengal, Delhi, Northeastern region, Narmada, Tapti (Anon, 1998), Aghanshini River, Karnataka (Arunachalam *et. al.,* 1997), Chittar and Tamiraparani river (Arunachalam *et. al.,* 1997; Arunachalam *et. al.,* 1997). **Threats:** Habitats loss, disease, pollution and hunting. High mortality observed during summer (per. obs.). **Conservation recommendation:** Field survey, monitoring and captive breeding.
19. *Cirrhinus cirrhosus*: **Habitat and Ecology:** It thrives in reservoir and check dams but breeds in swift rivers. It is a planktonic feeder, but also browses on algae in marginal shallow areas. (Talwar and Jhingran, 1991). **Status:** Vulnerable (Anon, 1998). **Distribution:** East flowing rivers of Peninsular India from Godavari to Cauvery (Talwar and Jhingran, 1991). Rema Devi et al. (1997) and Arunachalam, (1997) recorded from Tamiraparani river basin. **Maximum size:** 61 cm in length; 1-2 kg weight in two years (Talwar and Jhingran, 1991). **Threats:** Human interference, loss of habitat, pollution and over exploitation. **Conservation recommendation:** Captive breeding and genetic improvement.
20. *Cirrhinus reba*: **Habitat and Ecology:** It prefers fast flowing rivers, column and bottom feeders, feeds mostly on plankton and debris. **Status:** Vulnerable (Anon, 1998). **Distribution:** Throughout India (Anon., 1998). Moyar, Bhavani and Tamiraparani rivers in Tamil Nadu (Menon, 1992; Arunachalam, 1998). **Threats:** Loss of habitat, over exploitation, pollution and siltation. **Conservation recommendation:** Habitat management, genetic improvement and captive breeding.
21. **Minor Fishery Important Fishes** : Seven species such as *Channa punctatus, Puntius dorsalis*, P. amphibius, *P. filamentosus, P. arenatus*, *Mystus gulio* and *M. keletius* are commonly used as food by local people in and around Tirunelveli district. They attain 50 to 100 g in weight. Threat: Over exploitation, habitat loss, pollution destructive and over fishing. **Conservation recommendation:** Research management on biology and habitat conditions.
22. *Ornamental Fishes*: Smaller species attain 5 to 10 cm which cab be easily acclimated to aquarium conditions. Among the 10 species, 4 species are in the endangered status (Anon, 1998). The hill stream loach *Bhavania australis,* is a small bottom dwelling fish mostly found in turbulent and clear water stream and are common in Southern part of Western Ghats (Arunachalam, 1998). Other fishes like *Pseudambassis ranga, Puntius chola, P. dorsalis, P. vittatus, P. arulius tambraparniei*,

P. fasciatus, P. sophore, P. ticto punctatus, P. bimaculatus and *Danio aequipinnatus* are important as ornamental fishes. Threat: Loss of habitat, pollution, Dynamite fishing. Conservation recommendation: Research management, field survey, biology and captive population maintenance.

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Export Potential of some Ornamental Species from Western Ghats

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Fishes belonging to the *Genus Botia* form around 40% of export in terms of numbers exported. We have several species in India but only two are found in Central/South India. *viz*. *Botia straita* and *B. macrolineata*. None of the *Botia* sp. has been bred in commercial quantities. There are some unconfirmed reports about breeding *Botia lohachata*. A minimum floor price for exports @ US$10:00 per 100 is recommended. This will help in the effective control on the numbers collected from the wild for the next 5 years or more and could ensure a sustainable yield from nature. This should be the strategy for all the native *Botia* species commercially exploited today from wild.

Puntius arulius is being bred in far eastern countries like Malaysia, Singapore etc. These bred fish have better color and some mutant varieties are also available. Hence there is hardly any interest in the wild collected fish for export on a regular basis. All these species though exported to the far-east do not form a very significant part of Indian exports to merit conservation measures. Their commercial exploitation is sustainable. Same is the case with several other species which have a noted interest in the aquarium trade and could be bred in commercial quantities like *Puntius fasciatus*, *P. setnai* confused with *P. narayani*, *Chela dadyburjori*, *Macropodus cupanus dayi* etc.

All the *Aplocheilus* species are exported in small numbers and do not warrant special conservation attention. The attractive golden mutant strain has considerably reduced the export of *A. lineatus*. Among the *Barilus* species there are some beautifully colored fish species especially during breeding season. There are generally difficult to acclimatize. If strains are developed to retain the colors through out year, it should have reasonably good export potential.

Most of the loaches belonging to genera *Balitora, Travancoria, Nemacheilus* and *Lepidocephalus* are not of much importance for export. The algae eaters if attractively marked or shaped could be of significant value for export. None of the *Garra* spp. I have seen are really attractive/colorful. *Homaloptera montana* should be interesting. *Glyptothorax* spp. are generally difficult to acclimatize being from fast flowing waters. So there are not very significant for the trade and are only sort of collectors item like *Horabagrus* sp. *Nangra itchkeea* is interesting from the trade point of view, but not easy to acclimatize. It is seasonally abundant. Efforts should be made to breed these. Home bred fish will be more amenable to aquarium and should have a good potential.

Etroplus canarensis as well as *Puntius denisonii*, *Monotretus travancoricus* found in parts of Kerala should be good for export. *Scatophagus argus* (variety rubrifrons) and *Monodactylus argenteus* are quite important though estuarine. Efforts should be made to breed, so steady supply all round the year could be obtained.

The Marine Products Export Development Authority (MPEDA), Cochin have the following figures in rupees for the past four years and the equivalent in US$ is given at the prevailing exchange rate:

1994/95	Rs. 65,03,000	@ Rs. 31.27	$ 2,07,963
1995/96	Rs. 81,67,000	@ Rs. 34.62	$ 2,35,904
1996/97	Rs. 1,08,34,000	@ Rs. 35.60	$ 3,04,325
1997/98	Rs. 79,42,000	@ Rs. 36.50	$ 2,17,589

The MPEDA introduced a cash incentive scheme for the first time during the period 1996/97. This resulted in an unsustainable competition and over exploitation of natural resources though the exports rose. This can be seen from the figures for export during 1996/97.

The incentive scheme to promote ornamental fish export is to be discouraged. Instead, attempts should be focussed on developing infrastructure for ornamental fish trade and to understand breeding behaviour and requirements of endemic ornamental species. The above efforts would lead to establishment of mass-scale breeding and assured supply of fishes. This will give a boost to the export figures of these species.

Survey of Existing Database for Potential Ornamental Fishes of Peninsular India

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Dayal, R. and Kapoor, D., 2000. Survey of existing database for potential ornamental fishes of Peninsular India. pp. 256-258 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR – NATP Publication – 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

Attractive colouration, small size, suitability for keeping in captivity and adaptability for living in confined spaces have attracted people all over the world to keep ornamental fishes in aquarium as a hobby. Hundreds of fish species with vibrant colours and shapes have reached hotels, restaurants and drawing room of millions of people. This has led to thousands of entrepreneurs adopting it as a trade. World trade for ornamental fishes is 85% for freshwater and rest for marine fishes, invertebrates and fishes of coldwater and brackish waters. The trade of ornamental fishes is growing steadily all over the world with a total value of US $ 4.5 billion. Japan, Middle East countries, Australia and USA are the markets and South East Asia, Singapore and Hong Kong being the main suppliers. The largest market is the USA with an import over US $ 500 million worth followed by Europe and Japan (Dey, 1993).

Domestic market of India is quite promising for tropical ornamental fishes with demand exceeding the supply. Calcutta, Bombay, Madras, Cochin and Madurai have emerged as major ornamental fish breeding centres of the country. There are more than 150 full-time and 1500 part-time breeders in India. Country's annual overall trade of ornamental fishes is more than Rs. 10 crores with Madras alone accounting for over Rs. 1.5 crore annually (Dey, 1993). There are more than 100 varieties/ species of ornamental Indian fishes, some of them are internationally known and kept in Europe and America for over many decades.

The Western Ghats of India is a gold mine of fish biodiversity. A comprehensive list of 106 ornamental fishes endemic to Peninsular India with special reference to Western Ghats has been prepared by Gopalakrishnan and Ponniah (2000). These species belong to 19 families with the maximum number in Cyprinidae followed by Balitoridae. The break up of 106 species as per taxonomic family is given below with number of species in brackets : Ambassidae (2), Aplocheilidae (3), Bagridae (2), Balitoridae (31), Belontiidae (1), Cichlidae (2), Claridae (1), Cobitidae (5), Cyprinidae (42), Gobiidae (1), Hemiramphidae (1), Horaichthyidae (1), Mastacembelidae (1), Nandidae (1), Scatophagidae (1), Schilbeidae (1), Sisoridae (7), Syngnathidae (1) and Tetraodontidae (2).

The existing database of NBFGR on fish biodiversity of India covers taxonomic positions, habit and habitat and distribution of 2118 fin fishes. For overall management and sustainable utilisation of ornamental fishes of Western Ghats, the database should be updated by adding information on age at maturity, breeding season, micro level distribution, food and feeding habits, life span, diseases, temperature tolerance, maximum size, reproduction, maturity, fecundity, spawning behaviour, migration, depth preference, population dynamics, feeding and breeding habits, larval developments, age, growth and its preference as an ornamental fishes as well as local, international trade and population genetics. Out of 106 ornamental fishes reported from Peninsular India, 48 fishes are assessed in the Conservation Assessment and Management Plan (CAMP) workshop held at NBFGR, Lucknow in September, 1997 (Anon, 1998), the details of which are given in Table 1.

Table 1: Conservation status of potential freshwater ornamental fishes endemic to Western Ghats as assessed in CAMP workshop.

Sl. No.	Status	Number of species
1.	Critically endangered (CR)	9
2.	Endangered (EN)	19
3.	Vulnerable (VU)	7
4.	Lower risk-near threatened (LRnt)	2
5.	Lower risk east concern (LRlc)	2
6.	Data deficient (DD)	9
Total		48

On scanning the database developed by ICLARM (Fish Base, 1998), it is found that information on biological studies of these fishes is very limited primarily due to non-availability of data. Out of the 106 ornamental fishes reported (Gopalakrishnan and Ponniah, 2000) only 53 fishes are included in Fish Base with limited information on biological parameters.

There is a need for compilation of scattered data through networking of fish biologists, taxonomists, researches, field workers, farmers, trades, entrepreneurs and other non-governmental organizations working in the same field. This will also help in the identification of problems and threats of freshwater ecosystems in the region. Collection of information of a GIS platform is also suggested. Studies on present status of some of the commercially important ornamental fishes are also necessary because there is a likelihood that some of the species might have reached the endangered level due to over exploitation, degradation of general habitat and breeding grounds and other anthropological factors. Based on thee, a list of priority species for undertaking *in situ* and *ex situ* conservation needs to be drawn. The efforts made in this direction will open new avenues for sustainable production, conservation and maintenance of ornamental fishes of Western Ghats.

Survey of Existing Databases for Potential Economically Important Fish Species of Peninsular India

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The Western Ghats is the richest region in India with respect to endemic freshwater fishes. 192 species are endemic to this bio-geographic region with 15 more taxa sharing their distribution with adjacent areas. East coast river system drains nearly 75% of the Indian peninsular south of Satpura range and eastern slopes of Western Ghats. The four major rivers *i.e.* Mahanadi, Godavari, Krishna, Cauvery have a combined length of 6437 km. and a catchment of 121 million ha. West coast river system having 3 major rivers *i.e.* Narmada, Tapti and Mahi and also 600 small rivers, covers only 3 % of the river basin area in India. As much as 14% of the country's water resources flow through them. These rivers drain the narrow peninsular belt east of Western Ghats and further north with they include the basins of Narmada and Tapti to the South of Vindhya-Satpura range. So far about 95 fish species have been reported from Narmada, 56 from Tapti and 34 from Sabarmati.

NBFGR has synthesized the scattered published information on fish of all ecosystem and regions of India. This database on fish genetic resources of India, covers taxonomic position, habitat and distribution in India and abroad. Out of 2118 finfish of India, about 47 fishes of commercial/ cultivable importance are endemic to Western Ghats. In the CAMP Workshop (Anon., 1998) the conservation status of 327 freshwater fishes out of about 600 freshwater fishes reported was assessed. Of the 47 commercially important cultivable species endemic to Western Ghats, 7 were categorized as critically endangered (CR), 6 endangered (EN), 3 vulnerable (VU), 1 data deficient (DD), 1 lower risk near threatened (LRnt) and 17 species were not evaluated (NE) (Fig 1).

Fish Base developed by the International Centre for Living Aquatic Resources Management (ICLARM) is the largest database on fin fishes. A review of it indicates that only 1496 Indian fish species have been included and of these full biological information is restricted to very limited number. Important endemic peninsular fishes such as *Horabagrus nigricollaris*, *Channa leucopunctatus* have not been documented in Fish Base. Several checklists of freshwater fishes have been compiled in India and still there is disparity with regard to number of fishes reported from each water body as well as taxonomic ambiguities.

Drainage-wise fish distributions, abundance, catch and age composition, population dynamics and habitat requirements also need to be included in the database. Further, mechanisms need to be developed for incorporating unpublished information available with different organizations and individual research workers. There is a lack of published information about the threats and problems in different freshwater bodies. This may be more due to lack of linkages between organizations studying Indian fishes, than to paucity of data. A comprehensive database on fish germplasm (commercial/cultivable) can form the documentary evidence to stake India's claim in international bodies about disputes over benefits derived from fish germplasm. By incorporating data on biology, status of threat, genetics, climate and human utilization in the database, it will be possible to determine the current status of fish resources and to predict further trends. Information about the species would be useful in drawing up research programmes and formulating management plans.

Lack of proper database on fish germplasm resources is one of the greatest impediments for proper utilization and safeguarding our germplasm resources. Development of a fish biologists and taxonomists network for collection and compilation of data on a GIS platform is required.

Comments on the NBFGR list of Cultivable, Sport and Ornamental Freshwater Fishes Endemic to Peninsular India with special reference to Western Ghats

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National Bureau of Fish Genetic Resources (NBFGR) has prepared a consolidated list of potential cultivable, ornamental and sport fishes endemic to Western Ghat region (Gopalakrishnan and Ponniah, 2000). Based on the extensive surveys conducted by the Zoological Survey of India and our personal observations, the list was critically evaluated and the following additions/deletions and modifications are suggested.

A. Additions

I. Cultivable/Sport fishes endemic to Western Ghats/Peninsular India

	Species	Distribution
1.	*Labeo kawrus* (Sykes)	- Pune, Maharashtra
2.	*Tor kulkarnii* Menon	- Pune, Maharashtra
3.	*Hypselobarbus dobsoni* Day	- Krishna, Cauvery
4.	*Hypselobarbus jerdoni* Day	- South Canara and Kerala
5.	*Hypselobarbus kurali* Menon & Rema Devi	- Kerala, Tamil Nadu (Tambaraparni)
6.	*Hypselobarbus periyarensis* Raj	- Periyar lake, Kerala
7.	*Cirrhinus fulungee* (Sykes)	- Maharashtra, Karnataka
8.	*Crossocheilus periyarensis* Menon & Jacob	- Periyar lake, Kerala

II. Potential ornamental freshwater fishes endemic to Western Ghats

	Species	Distribution
1.	*Salmostoma acinacea* (Val.)	- Cauvery & Thungabhadra
2.	*Salmostoma boopis* (Day)	- Karnataka, Maharashtra, Kerala
3.	*Salmostoma horai* (Silas)	- Karnataka
4.	*Salmostoma novacula* (Val.)	- Cauvery, Godavary, Krishna
5.	*Amblypharyngodon melettinus* (Val.)	- Western Ghats
6.	*Osteochilichthys nashii (*Day)	- Karnataka, Kerala
7.	*Osteochilichthys brevidorsalis* (Day)	- Nilgiris
8.	*Danio fraseri* (Hora)	- Maharashtra
9.	*Parluciosoma labiosa* (Mukerji)	- Maharashtra
10.	*Puntius arulius tambraparnei* Silas	- Tambraparni system
11.	*Puntius chalakudiensis Menon, Rema* Devi & Thobias	- Chalakkudy River, Kerala
12.	*Noemacheilus pambarensis Rema* Devi & Indra	- Idukki district
13.	*Noemacheilus triangularis tambraparniensis* Menon	- Tambraparni river
14.	*Noemacheilus kodaguensis* (Menon)	- Nilgiris and Coorg
15.	*Noemacheilus denisoni mukambhikaensis* (Menon)	- Karnataka
16.	*Noemacheilus denisoni pambarensis* Menon	- Kerala
17.	*Botia macrolineata Tengels* De Vos & Snocks	- Maharashtra
18.	*Botia striata* Rao	- Karnataka, Maharashtra
19.	*Pangio goaensis* (Tilak)	- Goa, Kerala
20.	*Horaichthys setnai* Kulkarni	- Cochin, Trivandrum, Kerala
21.	*Horalabiosa joshuai* Silas	- Kalakkad, T.N.
22.	*Horalabiosa palaniensis* Rema Devi & Menon	- Palani hills, T.N.
23.	*Garra bicornuta* Rao	- Maharashtra, Karnataka
24.	*Garra menoni Rema* Devi & Indra	- Silent valley, Kerala
25.	*Garra kalakadensis* Rema Devi	- Kalakkad, T.N.
26.	*Homaloptera pillaii* Indra & Rema Devi	- Silent valley, Kerala
27.	*Noemacheilus anguilla* Annandale	- Maharashtra

B. Other Suggestions

- The following ones listed as Ornamental varieties in NBFGR list are rare and inhabiting torrential streams, hence not suitable for aquarium purpose:

1) *Garra hughi* Silas
2) *Garra mcclellandi* (Jerdon)
3) *Garra surendranathanii Shaji,* Arun & Easa
4) *Garra gotyla stenorhynchus* (Jerdon)
5) *Balitora mysorensis* (Hora)
6) *Bhawania australis* (Jerdon)
7) *Homaloptera montana* Herre
8) *Travancoria jonesi* Hora
9) *Travancoria elongata* Pethiyagoda & Kottelat
10) *Glyptothorax anamalaiensis* Silas
11) *Glyptothorax housei* Herre
12) *Glyptothorax madraspatnam* (Day)

- The blind catfish *Horaglanis krishnai* is restricted to muddy wells of Kottayam District, Kerala and not suitable for aquarium.
- 1). *Labeo* potail (Sykes), 2) *Labeo* porcellus (Heckel), 3) *Etroplus canarensis* Day, and 4) *Puntius pulchellus* (Day) are valid species. The first two are recorded from Godavari, Krishna, Cauvery and Pennar Rivers, third from South Canara and fourth from west flowing rivers of Western Ghats.
- *Hypselobarbus kolus* (Sykes) is a synonym of *H. curmuca* (Hamilton) and *H. kurali* Menon & Rema Devi is a valid species.
- *Hypselobarbus jerdoni* and *H. dobsoni* Day are valid species. The former is reported from South Canara and Kerala and the latter from Krishna and Cauvery Rivers.
- *Esomus barbatus* (Jerdon) is a synonym of *E. thermoicos* (Valenciennes).
- Culture of *Hypselobarbus* sp. to be encouraged instead of Gangetic carps in the region and aquaculture techniques to be developed without disturbing the natural populations in their habitats.

Editors' Comments:–The cultivable, sport and ornamental species suggested by Rema Devi et al. have been added to the NBFGR base list. But four species under genus Salmostoma were not included in the ornamental list, as the fish hobbyists found them not attractive. The authors also suggested fishes belonging to genera *Garra, Balitora, Bhawania, Homaloptera, Travancoria* and *Glyptothorax* are inhabitants of torrential streams, hence not suitable for aquarium keeping. However, the local traders of ornamental varieties indicated survival of these species in aquarium and their acceptance by customers. Hence these species are retained in the list. To settle taxonomic ambiguities and to examine the validity of certain species under dispute (Section B) in-depth studies will have to be carried out with the help of genetic markers. Until then, generic/specific names and taxonomic position mentioned in standard books like Talwar & Jhingran (1991) and Jayaram (1999) will be followed.

Some Biological Aspects of Three Commercial Catfishes Endemic to Peninsular India

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Mystus krishnensis Ramakrishniah

The giant cat fish, *M. krishnensis* that is endemic to the Krishna river system, has long eluded ichthyologists and it has been described only recently. It is difficult to understand how such a large species has been missed in the surveys of survey organizations. One probable reason could be that it was a rare species in the middle stretch of river Krishna, confining itself to deep pools. The formation of reservoirs on Tungabhadra (TB reservoir) and Krishna (Nagarjunasagar) appears to have created congenial conditions for proliferation of this species. With the result the populations of the fish have increased considerable in the reservoirs as well as in the river tailing the reservoirs, facilitating the detection of the fish. The species attains large size reaching 165 cm (60 kg). In stray cases, fishes weighing about 120 kg have also been reported in the downstream of Tungabhadra reservoir. It is fascinating to note that even peninsular rivers with their limited water discharge could hold large sized species as in river Ganga. The formation of reservoirs on peninsular rivers appears to have had a salutary effect for the rare and endangered fishes as the reservoirs often acted as sanctuaries for these fishes.

In Nagarjunasagar reservoir, the giant *Mystus* contributed to the commercial fishery to the extent of 1.0 to 3.0 t per annum during 1976-80 accounting for 1.0 to 1.7% of the total catch. It occurred in good numbers in lentic and lotic sectors with the larger specimens confining to the latter. In the commercial catches, it occurred in the size range between 18 and 150 cm, but 35-70 cm group contributed 80% of the catch. It is exploited by gillnets and long lines.

The fish breeds in the river above the reservoirs (Tungabhadra and Nagarjunasagar) as well as in the downstream. Spawn could be collected with the first floods in June and fry in the size range 15-50 mm during July-September. The length-weight relationship of the fish has been worked out to be $W = 0.0000004367 L^{3.4335}$.

Silonia childreni (Sykes)

The schilbeid catfish in endemic to Godavari, Krishna and Cauvery river systems. In the reservoir of Cauvery (Stanley) and Krishna systems (Nagarajunasagar and Tungabhadra) the fish contributed significantly to the commercial catches during the early years of their formation. It accounted for 21% in Stanley (1943-44) and 12% in Nagarjunasagar (1976-80). In Stanley reservoir it has been recorded as *Silonia silondia*. But the identification appears to be doubtful since *S. silondia* has been recorded in rivers of North India upto the river Mahanadi. It is not recorded in rivers Godavari and Krishna. Hence, its presence in Cauvery appears to be untenable. Most probably the Cauvery species could only be *S. childreni*. In Tungabhadra reservoir too it formed good fishery during earlier years but later declined to insignificant position. In the river Godavari between the anicuts of Dhawaleswaram and Dummagudem the fish has declined in recent years due to increased fishing intensity.

S. childreni is a gregarious fish, moves in shoals during monsoon. In Nagarjunasagar it is caught in large numbers from the lotic sector using drift gillnets. It breeds in the riverine zone above the reservoir. Peak breeding occurred during July to September. A minor peak has also been recorded in March in Godavari and Krishna rivers. Females occurred overwhelmingly in the populations. It is mainly a piscivore.

Proeutropiichthys taakree taakree (Sykes)

It is a medium sized schilbeid catfish (synonym-*Pseudeutropius taakree* (Day)), known for its consumer preference. Day (1878) has recorded its distribution in the rivers of Krishna, Godavari and Jamuna. It appears to be endemic to Krishna-Godavari river systems and its occurrence in Yamuna is doubtful. It forms a minor fishery in Nagarjunasagar and Tungabhadra reservoirs. In the fishery of Nagarjunasagar it occurred in the size range 9 to 42 cm. The smallest mature female measured 19 cm. Sex ratio was in favour of females (1:5). It breeds during June-September and the fry and fingerlings were available during August to September. The fish appears to be a surface and column feeder. The diet consisted predominantly of surface dwelling insects and also terrestrial ones washed into the reservoir.

In Nagarjunasagar it has been reported to attain a length of 13, 21, 27, 32 and 35 cm during 1 to 5 years respectively. The growth equation of von Bertallanffy's has been worked out as $L_t = 47.0[1-e^{-0.27(t+0.214)}]$. The length-weight relationship has been calculated as $W = 0.000008134 L^{2.9148}$.

Studies on Life History Traits of Inland Fishes of Kerala for Developing Conservation Programme

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Kerala is blessed with very rich water resource which includes 44 rivers, 32 estuaries, several fresh water lakes, innumerable ponds and more than 500 km2 of back waters. The west flowing rivers originating from the Western Ghats possess a rich fauna of stream fishes unique to this area. More than 72 species of fishes are considered endemic to the Western Ghats region of Kerala. Due to all these, the Western Ghats is now recognized as one of worlds 'hot spot' of fresh water fish biodiversity. However, many of the endemic species are threatened or endangered and several species are suspected to have become extinct. Under these circumstances, the need to chart out strategies for conserving these fishes is urgent.

The estuaries and backwaters of Kerala also support a rich diversity of fishes. Most of the fin fishes and shellfishes are commercially important and as such they are the targets of over exploitation. The breeding and feeding grounds of fish and shellfish have become damaged due to environmental degradation. In order to ensure sustainable biodiversity in aquatic ecosystem, it is highly imperative to protect the species, which are under threat as well as the environment from deterioration. It is in this context, a detailed investigation on the influence of the environmental factors on the present status of biodiversity in aquatic ecosystems is necessary.

For the effective conservation of the threatened and endangered species, it is necessary to have a sound knowledge of their biology and ecology, which will enable us to develop appropriate conservation methods. The Department of Aquatic Biology and Fisheries of under University of Kerala over the last several years has conducted detailed biological and ecological investigations of several inland fishes including *Etroplus suratensis*, *Channa marulius, Puntius sarana subnasutus, Gobius giuris, Gerres filamentosus, Mystus gulio, M. malabaricus, Wallago attu, Mugil* spp., *Lepidocephalus thermalis, Nemacheilus* spp. and *Rasbora* spp. and other species from Western Ghats. The life history traits including age and growth, feeding and reproduction of these fishes have been worked out. Such studies can from a baseline for developing conservation programmes.

Hypselobarbus dobsoni-A Cultivable Fish Endemic to Gadana River, South Tamil Nadu

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Hypselobarbus dobsoni

Common name: Krishna Carp. **Identification:** Moderately deep bodied; no bands or spots; 2 pairs of barbels, dorsal ray weak and articulate; lateral line complete with 26-32 scales, pre-dorsal scales 12. Maxillary barbel long as eye; rostral slightly shorter. Upper jaw longer. Lower labial fold interrupted. Dorsal fin inserted equidistant between tip of snout and base of caudal fin. Caudal fin deeply forked. D-iii/9-i/13V-i/8 A-ii/6. **Taxonomic status:** The species has been highly confused with *H. jerdoni* (Day) a species known from southern Karnataka (Menon, 1991) and Sirkuli in northern Karnataka (Arunachalam *et. al*., 1997). Day (1878) and Menon (1991) distinguished both based on body depth and scales between lateral line and pelvic fin base. The body is deeper 3 1/4-3 1/2 in total length (4 in *H. jerdoni*). Day (1878) described that the inter orbital space slightly concave (in *H. jerdoni* inter orbital space nearly flat). Menon (1991) described that the dorsal fin inserted nearer to the snout than to the base of caudal fin (in *H. jerdoni* dorsal inserted midway between tip of snout and the base of caudal fin). Based on our collections, we observed colour variations in both the species. In adult *H. dobsoni* the body is shiny yellowish and the fins are pale yellow; in juvenile the body is silvery white in colour (whereas in adult *H. jerdoni* the body is silvery; the fins are with reddish tint tipped with black). **Present distribution:** Known only from Deccan, in the Krishna river drainage. Its record from Nilgiris needs further confirmation (Menon, 1991). Current regional distribution is based on our ongoing studies. Viable populations exist in Pambar, Kallar and Iluppaiyar streams of Gadana River. Very few were found in Manimuthar River of south Tamil Nadu. **Habitat:** *H. dobsoni* prefers deep rocky pools in the upstream area and juveniles prefer pools and riffles. **Size range:** Day (1878) recorded the length of 187 mm in standard length. But in our collections we recorded the maximum size of 320 mm in standard length. **Reproduction:** Spawns throughout the year, however two peaks occur during the post monsoon seasons i.e. after southwest monsoon (July-August) and north-east monsoon (October-November). In mature males, horny tubercles are found in the snout region and during breeding seasons they are more prominent. Adult males have 40-78 tubercles which are present below the eye orbit to tip of snout region. **Threats:** Main threats are dynamite and destructive fishing, siltation in upstreams due to the removal of riparian vegetation and introduction of Indian Major Carp seed in reservoirs. **Conservation Action:** Due to various threats and declining population, this species needs monitoring. A through and detailed study on the ecology and genetic aspects along with induced breeding and ranching trials are underway. For this species, only in Gadana river a good viable population occurs and therefore upstreams of Gadana River may be declared as a fish sanctuary. **Current Potential:** As *H. dobsoni* migrates to the lowlands and wetlands in the irrigation system of Gadana river basin, it is very important for culture purposes in lowlands and wetlands.

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Puntius arulius tambraparniei - An Ornamental Stream Fish Endemic to Tamiraparani River Basin, South Tamil Nadu

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Puntius arulius tambraparniei

Common name: Tamiraparani barb, Silas barb. Conservation status: Critically Endangered (Anon, 1998). **Identification:** Dorsal and ventral profiles arched. Head short, snout obtusely rounded and plain; eyes large just visible from below ventral surface. Mouth sub terminal, its width less than inter nostril distance; barbels two in number. Weak non-osseous dorsal ray, the outer rays of the fins are dark strained; males have a few branches dorsal rays produced into a filament. Adult males have 42-68 tubercles, which are present below the eye orbit to tip of the snout. D-iii/8-9 P-i/13-14 V-i/8 A-ii/5. **Taxonomic status:** This species has been confused with *Puntius arulius* a species described from Cauvery river (Jayaram 1999). Silas (1953) first described *P. arulius tambraparniei* species from Kallidaikurichi in Tamiraparani River. Jayaram (1999) distinguished both the species on the basis of insertion of dorsal fin and extension of pectoral fin. In P. arilius tambraparniei dorsal fin is inserted nearer to tip of snout than caudal fin (in P. arulius dorsal fin inserted midway between tip of snout and caudal based) and pectoral fin do not extended to pelvic (in P. arulius pectoral fin extends to pelvic). **Distribution:** Rema Devi *et al.*, (1997) recorded this species from the tributaries of Tamiraparani river. However, in our ongoing research programmes, we recorded these species also in Gadana River (Arunachalam, 1998), Chittar (Arunachalam *et al.*, 1997) and Tamiraparani River (Arunachalam, 1997). **Present distribution:** Tamiraparani River, Gadana River, Manimuthar and Chittar rivers in Tirunelveli District, Tamil Nadu. **Habitat and ecology:** P. arulius tambiraparniei prefers pools and riffles where it feeds on animal matter, algae and detritus. Adults prefer zero flow region and juveniles prefer low flow region. **Size range:** Silas (1953) recorded a maximum size of 9.2 cm and in our ongoing research programmes, we have collected specimens ranging from 2.4 to 11.7 cm in standard length. **Reproduction:** Spawns throughout the year especially after the monsoon rains (south-west and north-east monsoon) when clear water conditions occur. Stability of the conditions in streams is important for spawning. Maturity is reached, in intermediate season in streams and during dry season in lowlands. In lowlands where water is available for 6-9 months, spawning occurs during intermediate seasons when water is released from the rivers for second cultivation of rice and banana as most of the streams/rivers are regulated. **Threats:** Dynamiting and other destructive fishing have contributed to population decline. Habitats are being lost due to expansion of agricultural area. Removal of riparian cover in upstream areas and in lowlands sewage entry is major threats. Also multiple impoundments in the river basin hinder the migration leading to population decline. Research and **Conservation Action:** Studies on food and feeding habits, interrelationship in the assemblage structure, colour variation and captive breeding are underway. Phenotypic variations in different stream reaches are being recorded. Further taxonomic and genetic studies are required. In some of the upstream areas, restriction on fishing may be imposed for conserving the stock. Colour pattern: Colour pattern in *P. arulius tambraparniei* varies with different stage of development. In small specimens 28-39 mm in length there are three vertical bands and 4 spots of blotches. The first bands is from the dorsal fin origin and not reaching the pelvic fin extension; the second below the posterior extremity of dorsal fin and extends to the anal fin base; the third across the origin of caudal fin. A round spot is found in the pre-dorsal region, the second one present on the upper angle of gill opening. The third spot is above the post dorsal region and the fourth one is present on the midline of the body. A reddish tinge is found at the end of caudal and anal fins. In specimens of 51-62 mm in length, there are three vertical bands and two spots/blotches. The size of the spots is large; spot located in pre dorsal region is joined with upper angle of gill opening. Spots found on the post dorsal regions joined with the spot on midline of the body. A reddish tinge is found at the end of caudal; anal fin and scales in the post dorsal region have a pale reddish in colour.

In specimens of 68 mm in length and above, there are three vertical bands that are not prominent. In the pre-dorsal region, the spot is joined with the bands giving wide band from the upper angle of gill opening to the base of dorsal fin, second band joins with the spot in the posterior extremity of dorsal fin region. The third is across the origin of caudal region. In the caudal band there is no change in its length and size, except for the caudal region band, the other two are not reaching the base. A metallic bluish colour is found in the pre-dorsal region. Above the lateral line in between the bands, there is a pale reddish colour. Caudal and anal fins are red. The 3rd, 4th and 5th branched filaments in dorsal fin are extended in specimens collected from Gadana river and not extended in specimens collected from Manimuthar river. Below lateral line the body is pale white in colour. Pectoral and pelvic fins are pale black in colour.

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Biology of the Hill Stream Loach, *Nemacheilus triangularis* Day

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Nemacheilus triangularis Day is a hill stream fish, whose distribution is restricted only to the high ranges of Kerala State and Kanyakumari District of Tamil Nadu, India. The study area is located at latitude 8^0 20′ N and longitude 77^0 15′ E at an altitude of 400 m above msl. The surface water temperature ranged between 21 and 26^0 C. the pH between 7.0-7.5; the dissolved oxygen content was very high (7.2-8.2 mg/l). The most important benthic fauna inhabiting the hill streams are larvae/nymph of caddis fly, *Chironomous*, stonefly, mayfly, dragonfly and damselfly.

The maximum-recorded size of *N. triangularis* is 71 mm in total length. The field population is mainly constituted by three year-classes; the average total length attained at the end of first, second and third year are 34, 49 and 58 mm respectively. The fish reaches a weight of 0.36, 1.13 and 1.92 g with an annual weight increment of 0.36, 0.77 and 0.79 g on the completion of the first, second and third year of life respectively. The K factor {the von Bertallanffy's growth equation is $Lt= 71^{[1-e-0.493\,(t+0.18)]}$} is very high in this fish. The maximum value of relative condition factor (K) is related to gonadal maturation. The co-variance analysis on the length-weight relationship for the two sexes indicates that the F value is not significant at 5% level and it exhibits isometric growth. The steep fall is taken to mark the size at first maturity. The covariance analysis on the length–weight relationship for the two sexes indicate that the 'F' value is not significant at 5% level and exhibits isometric growth.

N. triangularis is an insect and detritus feeder. The fish is not a selective feeder and the spectrum of food items changes with season. There is no appreciable change in the nature of diet (food preference) between the juveniles and adults. The feeding diel cycle shows that this fish is mainly a daytime feeder. The gastro-somatic index is found to be low in summer and monsoon months and reaches the maximum in post-monsoon months. The very low values of relative length of gut ranging between 0.63 and 0.65, further confirms its carnivorous habit. The mean energy value of food consumed and faeces released by 1.5 g fish is 3.26 and 1.01 Kcal/g dry weight respectively. A 1.5 g fish takes 16.4 Kcal/year from the biosphere, of which 2.2 Kcal returns back to the biosphere annually in the form of faeces.

This fish shows sexual dimorphism and the secondary sexual characters develop when the male fish attains a length of 35 mm. The size at first maturity was at about 45 mm and 48 mm in the males and the females respectively and the species attained maturity in the second year of life. The fish spawns only once in a year and the breeding season extends from May to August with a peak at June. The spawning season coincides with the south-west monsoon season. The ovaries of 1.2-3.0 g fish constitute 25.1 to 28.9% of the body weight, whereas in the case of males the testes constituted 6.4 to 7.6% of the body weight. The fecundity factor decreases with increase in body weight. The ripe intra-ovarian eggs measure from 0.78 to 1.01 mm in diameter. The monthly fluctuation in Gonado-somatic ratio (GSR) and condition factor (K) are closely related to maturity cycle.

The rate of oxygen consumption, when compared with other fishes, is of high order in this fish. A fish weighing 4.04 g consumes 4.4 ml/hr of oxygen at 27^0 C. The rate of oxygen consumption is independent of the environmental oxygen pressure down to a critical oxygen concentration of about 150 mm Hg. The asphyxia level of oxygen in this fish is very high, when compared to fishes of still waters. A 4.4 g fish is asphyxiated at 1.89 ppm (38 mm Hg). The opercular beats/ min are inversely proportional to body weight at any particular partial pressure of oxygen. The breathing rate increases, as partial pressure of oxygen declines from 250 to 50 mm Hg. The average weight specific gill area is relatively very high (2220 mm^2 /g), when compared with air breathing and amphibious fishes.

Like all hill stream fishes, the population of this species has also drastically come down. The life history traits documented can be utilized in planning species recovery programme.

Biology of the Hill Stream Fish *Garra mullya* (Sykes)

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The biology of the hill stream fish *Garra mullya* (Sykes) inhabiting the Ulakkaruvi stream in Kanyakumari District, Tamil Nadu, India has been studied. Ulakkaruvi stream which originates from an altitude of 1255m above mean sea level, is a torrential stream with rapids. The stream water is saturated with oxygen and the maximum temperature recorded is 27^0 C and changing environmental conditions in this ecosystem is mainly brought about by rainfall.

Age and growth parameters of *G. mullya* showed that in its habitat, the fish population has a life span of four years. When reared in a nursery, it showed a lesser growth rate than the wild. Length-weight relationship of both males and females did not differ and were found to follow the cube law. Parameters of von Bertallanffy's growth equation worked out for *G. mullya* showed a high value for the parameter 'K', suggesting its high metabolic rate $\{Lt = 104\ [1\text{-}e^{-0.517\ (t-0.2163)}]\}$. Relative condition (Kn) of the fish is closely related to its spawning cycle and there is a general similarity of 'Kn' with condition factor 'K' in the pattern of fluctuations. Log-log relationship between body length and scale radius, showed a linear relationship.

Analysis of food and feeding habits of *G. mullya* revealed that the fish feeds mainly on algae and detritus. Through there is no precise diversity in the nature of food consumed by juveniles and adults, intrinsically the adults are found to consume more detritus that the juveniles. Gastro-somatic and feeding indices showed a positive correlation with the spawning periodicity of the fish. The fish showed high-energy absorption efficiency, although feeding partly on low energy detritus.

Breeding biology of *G. mullya* indicated that the fish attains sexual maturity at a minimum size of 55 mm length. Sex ratio is 1:1. Maturity studies exhibited a short spawning periodicity of the species between January and March at Ulakkaruvi.

Between males and females, a remarkable difference in growth rate of gonads was observed in different months and the fecundity varied between 825 and 1395 per females. Relative fecundity showed the younger fish as more fecund than the older ones. Fecundity was correlated with various variables such as body length, body weight, ovary length and ovary weight and ovary weight found to be the best estimator of fecundity. Gonado-somatic ratios of males and females were closely related to the spawning cycle.

Studies on the condition factor (K) of *G. mullya* showed that the condition of the fish is greatly influenced by the development of gonads. When 'K' in relation to different length ranges is considered, the younger individuals showed high 'K' values.

The fish was found to undertake a pre-spawnal and post-spawnal migration. Actual spawning involved group mating and no pairing was observed. Eggs are highly adhesive, demersal and heavily yolked, which can be adaptive measure in fast flowing water.

Experiments conducted to find out the reaction of the fish to changes in hydrostatic pressure and velocity shows that the higher length groups display distress state at 50 cm depth or at a hydrostatic pressure of 4.095×10^4 dynes/cm^2, while smaller forms reacted at 15 cm depth or at a hydrostatic pressure of 1.4715×10^4 dynes/cm^2. Climbing reactions of the fish show that within the velocities tested (0.5 to 2.5 m/sec) the larger individuals failed to climb at higher velocities of water flow where as the smaller fish overcome all the velocities.

In *G. mullya* weight specific metabolic rate is found to be of the highest order when compared to other fishes. The proportionate ability of the fish to utilize oxygen under all PO_2 is the same irrespective of size. However, beyond the 3g stage, the irrigation rate of gills sharply differed and large fishes did not survive at lower PO_2. Gill area of the fish is found to be closely related to their habitat.

Morphological studies of the sucker revealed the presence of large number of elliptical concavities, the rim of which was provided with a number of papillae. The tip of each papilla was found to have 2 to 4 claws. Histology of the labial folds showed the presence of mucous secreting cells in the epidermis and papillae and the shape of the cells differed in these two regions. Histochemical analysis of the mucoid substances revealed that they are sulphated acid mucopolysaccharide in nature.

Biology of an Endemic Blind Catfish, *Horaglanis krishnai* Menon

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Horaglanis krishnai Menon is a blind clariid inhabiting the dug-out wells at Kottayam (lat. 8°4′ N and 18°21′ N Long. 76° 13′ E and 77° 38′ E), Kerala, India. The fish migrate from one well to another through the subterranean channels. The nearest relative of this fish is the bagrid, *Uegitglanis zammaroni* discovered from Italian Somaliland, Africa. This shows that this fish has got considerable zoogeographical importance. This is the only blind catfish reported from India. It is apparently widely distributed in the Kottayam Municipal area. The wells at Kottayam have different depths as the terrain is undulating. As the fishes invariably rest at the bottom of the wells, their presence or absence in a well can be ascertained only by draining the well completely. The occurrence of these blindfishes in widely distant wells indicates that the fish must gain entry into them through some underground water channels. It mush also be pointed out that the wells at Kottayam are inhabited by a remarkable blind mysid crustacean *Spelaeamysus longpipes* (Pillai and Mariamma) which also apparently enters the wells through the underground channels. Along with *H. krishnai*, blind angulliform fish *Monopterus travancoricus* Eapen is also obtained from the wells though not in large numbers. Both are zoo-geographically very important species.

A detailed anatomy of the different systems of *H. krishnai* has been carried out by the author for her Ph. D research work. The research work included detailed morphological and anatomical studies of *H. krishnai* covering the alimentary, reproductive, excretory, skeletal, nervous systems and sense organs. Experiments were also carried out to study the chemo sensitivity of the fish under laboratory conditions and to determine the respiratory metabolism.

A detailed description of individual bones of the skull, upper and lower jaw, operculum, gill arches, and the vertebral column were made. It has been observed that many bones have pores and pits. This is considered as caused by dearth of calcium in the water. Some modifications in response to the habitat were observed in the skeletal system. The bones of the skull are firmly articulated making it strong and capable to with-stand occasional bumping of the head against hard objects in the dark subterranean channels. A detailed comparison of the skeletal system of *H. krishnai* with that of *U. zammaroni* indicates that the former forms a link connecting bagridae with clariidae. The brain is typically teleostean. The high development of the forebrain and the medulla oblongata indicates dominance of the olfactory and gustatory senses. The absence of eyes has brought about the degeneration of the optic lobes. The skin is devoid of scales. The abundant mucus secreted by the fish presumably provides sufficient protection. The alimentary canal though typically teleostean shows several adaptive modifications. The bulbous stomach helps in storing food, which is helpful in an environment. chronically deficient in food. The ileo-rectal sphincter helps to retain the digested food for a long duration to facilitate maximum absorption. The intestine is short and the liver is well developed. The air bladder is much reduced in size and is confined to the anterior part of the visceral cavity as usual in siluroids. The reduction has affected only the posterior chamber. The presence of a connection between the air bladder and the inner ear, through the Weberian ossicles indicates that it has an auditory function.

Twelve distinct stages in the growth of the ova within the ovary have been identified. Oocytes arise from the germinal epithelium. There is no evidence to show that the follicular cells of degenerating oocytes get transformed into new oocytes. A distinct yolk nucleus arises *de novo* and stimulates the formation of the yolk in the oocyte. Artesia of oocytes has not been observed in the ovary. This is significant since the number of ripe oocytes present at a time is small.

Locomotion, comfort behavior, feeding and light sensitivity of the fish were studied under laboratory conditions. Even though the fish is totally blind, it is a predator. Under laboratory conditions, it unerringly snapped up food organisms. This is obviously facilitated by the high degree of development of the tactile and olfactory sense organs. The effect of body weight, light and darkness on the rate of oxygen consumption was studied. The rate per unit weight was higher in smaller fish.

Horaglanis krishnai is a unique fish. Further studies on it micro distribution and abundance in the locality, population structure and other life history traits needs to be carried out. Urgent attention to declare certain wells as sanctuaries is essential as it is on the verge of extinction.

Distribution and Life History Traits of an Endangered Carp *Labeo dussumieri* (Val.)

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Labeo dussumieri (Val). locally known as 'thooli' in Malayalam is an important delicacy of central Travancore region of Kerala. It attains about 50 cm in total length and more than 2.0 Kg in weight Although 18 rivers and the Vembanad lake were surveyed for delineating its regional distribution the occurrence of this species was noticed only in Pampa, Meenachil, Manimala and Achankovil and in the upper reaches of the Vembanad lake. An alarming depletion of the stock of *Labeo dussumieri* in the four rivers of central Kerala *viz.* Pampa, Manimala, Meenachil and Achankovil could be noticed in recent years and therefore it deserves the status and protection of and endangered species. The fishery of *Labeo dussumieri* has been enumerated based on the sampling made from three important landing centers of Central Kerala *viz.* Parumalakadavu, Pavukkara and Punnamada. The annual landings computed from three centers works out to be varying from 5140 to 7085 Kg. The commercial size group was predominated by 250-335 while 200-249 mm group occupied the second position. 22,250 fingerlings of this species in the size range 61-79 mm TL were released into the Pampa in September 1989 with a view to studying perceptible impact, if any in the exploited stock of *Labeo dussumieri*. From catch effort data collected from three landing centres *viz.* Pavukkara, Paramalakadavu, Punnamada, a slight improvement in catch and catch per unit effort could be observed at former two centres on 1990 while no such changes were discernable in latter years. Further, predominance of 0 year group was also perceptible during 1990 at two centers unlike in 1987-1988 and 1988-1989 during when one year group was predominant in catches.

Populations of *L. dussumieri* inhabiting Pampa. Manimala, Achankovil and Meenachil were compared subjecting morphological characters to ANACOVA and ANOVA. The results of the present study reveled that the population inhabiting

Pampa, Manimala and Achankovil constitute morphologically homogeneous stock and are not distinguishable by most of the morphometric and meristic characters while that of Meenachil River is distinguishable as a separate stock.

The present communication on distribution and life history traits of this fish is based on the extensive work carried out on this fish (Kurup, 1991; 1993a,b,c; 1994a, b, c; 1995a, b, c; 1996; 1997; 1998; Kurup and Kuriakose, 1990, 1993, 1999; Kurup *et al*., 1993).

Analysis of the gut content of *L. dussumieri* (Val.) collected from the river Pampa showed that this species is a herbivore and illiophagic in its feeding habit. Feeding is mainly done by resorting to browsing at the pond bottom and shallow fingerlings of the river. It mainly subsists in mud, detritus matter, Bacillariophyceae, Chlorophyceae and submerged aquatic plants. There is no significant difference in the nature of diet composition of various size groups, however, some variations in the proportion of various food items has been observed. The percentage of gut length to total length was found increased with length increments up to 280 mm TL, therefore, a decreasing trend could be discernible. The intensity of feeding was very poor during June to September and this period has synchronized with the spawning season of *L. dussumieri* in river Pampa and also with those months during when the food availability become sparse due to obliteration of the feeding grounds as a results of major changes brought to riverine environment due to monsoon flooding.

Age and growth of *L. dussumieri* of the river Pampa were determined by resorting to scale studies and Peterson's length frequency analysis. Examination of margin of scales collected duping different months of year revealed that the period of annulus formation is during March to August, Peak being in May- June. The theoretical length at various ages calculated by growth equation showed a high degree of agreement with length at ages calculated by scale studies and length frequency analysis. Therefore, it is inferred that von Bertallanffy's growth equitation adequately described the actual growth of L dussumieri. The theoretical growth equitation derived for *L. dussumieri* is Male: 460.87 $[1\text{-}e^{-0.7354(t+0.0589)}]$. Female: 502.46 $[1\text{-}e^{-0.7273(t+0.1106)}]$. The males attain asymptotic length faster than females. In natural waters, the rate of growth of *L. dussumieri* during its first year is almost comparable with that of *L. calbasu, L. rohita and L. fimbriatus*. The length -weight relationship and relative condition factor of *L. dussumieri* inhabiting Pampa River was estimated. Results of ANACOVA revealed that no significant difference exits among b values of males, females and indeterminants. The regression coefficient of females (3.17830) differs significantly while males (3.5406) did not show any difference from the isometric value. The pattern of growth changes significantly at the length of 75.72 mm when stouter growing indeterminants transformed in to comparatively less stout adults. In males and females seasonal fluctuations in Kn values mainly indicate cyclic changes taking place in gonads and the length–relative condition factor curve showed major inflection at 200 and 220 mm respectively.

Maturation and spawning of *L. dussumieri* in the river Pampa was studied from January 1988 to December 1989. Spawning season extends from June to early August with intense spawning activity during June and July. Individual fish spawns only once in a season . The specific gonadal cycle and the presence of a distinctly separate mode of mature ova in the ripe ovary are indicative of a synchronous and short spawning in *L. dussumieri*. Onset and intensity of spawning is directly dependent on the south west monsoon. Relatively high gonadosomatic values were observed from April to July. Length at first maturity for female is around 278 mm TL and that of male are around 265 mm. The sex ratio was significantly different in 1989, the skewness was apparent due to the preponderance of female and the mean ratio between males and females was found to be 1: 1.2743 whereas in 1988 the sex ratio did not show any significant difference, with a mean ratio of 1:1.1074. The absolute fecundity of *L. dussumieri* varied from 66,420- 2,39,854 eggs in specimens ranging in length 294.5–437.0 mm TL. The relative fecundity varied from 91-254 ova while the number of ova per gram ovarian weight ranged from 806-1791. The coefficient of maturity was found to vary from 13.3–26.8 and the gonadosomatic index from 11.5 to 35.9. The fecundity of *L. dussumieri* in relation to fish length, fish weight, gonad length and weight were worked out using regression analysis. By comparing the values of relative fecundity and number of ova per gram ovarian weight of *L. dussumieri* with those of other species of Labeo spp. of India, it could be seen that the former produces less number of ova, when compared that of latter.

L. dussumieri has successfully been bred in captivity using CPE, HCG and LHRH. The optimum dosage of CPE required for the successful spawning is found as a priming does of 4 mg/Kg followed by a second injection @ 8 mg/Kg in females and single injection @4 mg/Kg body weight in males. Alone administration of either HCG or LHRH was found to be ineffective in inducing ovulation , however, administration of priming dose of CPE and Pimozide prior to HCG and LHRH treatments respectively were effective in successful spawning. The percentage of fertilization and hatching when compared to that of fishes treated with CPE.

The life history of *L. dussumieri* is described in brief. The hatching was performed in hatching hapa as well as in carp hatchery (CIFE D 81). In carp hatchery, the hatching percentage varied between 90.4 to 100 at stocking densities ranging from survival percentages ranging from 65.1 to 86 could be registered. In the nursery rearing experiments conducted in earthen ponds, the survival of spawns to fingerling varied from 33.7 to 50 in stocking densities ranging from 40,00,000 to 1,15,000 spawns/ha.

Growth performance and production potential of *L. dussumieri* was studied by culturing it alone and also in combination with Indian major carps. Experiments were conducted in earthen ponds having area ranging from 100- 200 m. The ponds were fertilized with both organic and inorganic manures in installments and fishes were also fed with a mixer rice bran and ground nut oil cake in the ratio 1:1 at 2% body weight on every day. In mono culture trails, *L. dussumieri* attained a weight of 392 and 356 gm at stocking densities of 3000 and 4000 / ha respectively with in a period of 10 months.

In mixed culture experiments *L. dussumieri* was reared along with Catla, Rohu and Mrigal in the ratio 1:1:1:0.5 and the average weight attained by Catla, Rohu, Mrigal and Thooli within a period of 10 months was 671.0, 602.0, 474.0 and 323.0 gm respectively under a stocking density of 6000'ha whereas at a higher stocking density of 8000/ha the average weight registered was in the order of 557, 506.4, 397.1, 283.0 gm. respectively. These would work out to a production 2696.6 and 3039.7 Kg/ha. at stocking densities of 6000 and 8000/ha. respectively. Physicochemical factors of the pond were monitored at fortnightly intervals. The domestication of this indigenous carp may help in improvement of the growth in captivity.

The results on the growth performance of *L. dussumieri* in captivity shows that it deserves only the status of a minor carp. However, considering the maximum size attained by this species and also realizing its very limited and restricted distribution pattern, conservation and management of the stocks *L. dussumieri* in the inland water bodies of Kerala is found inevitable.

Utilization of Age and Growth Data in Conservation and Genetic Upgradation Programmes

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In recent years wild stocks of cultivable and commercially important fishes from natural water bodies are declining due to over exploitation, introduction of exotic species and various other anthropogenic factors. To arrest this decline, species-specific recovery programme are required. For this one of the basic requirement is data on age and growth of candidate species. Data on age, length and weight of the fishes can be conveniently used to study the changing trend in a fishery in combination with data on to the longevity, age at maturity/spawning, mortality and survival rates, old age and population size. Through age determination the age composition of a fish population can be identified, and it can also be assessed to which degree the various age classes are being fished. The age composition data can be used to study the differential growth rate between male and females and among different geographical populations. The use of harvestable size on the basis of growth data could play a vital role in regulating the fishery and obtaining sustainable yield and help conservation wild stocks.

In fishes, the growth is indeterminate and has been shown to be influenced by many factors including temperature, food availability, nutrient availability, light, oxygen, salinity, pollutants, predator density and intra-specific social interactions. These factors in combination interact with the genetic base of the animal and results in variable growth rates of fishes of the same age.

Various hard parts of the body of fishes like scales, opercula, vertebrate, frontal bone, otolith and fin ray sections are used for age determination. In India, studies on the age and growth of fishes based on hard parts and their application in fisheries management is very limited and restricted to only freshwater IMCs and few other marine fishes. Among hard parts, scales have been found very convenient and authentic in predicting the age and growth of fishes. However, the age and growth data on the basis of scales has not been properly utilized in management and conservation of fish genetic resources.

The literature review on age and growth in fish indicates a strong linear relationship between total fish length and lateral scale radius. The use of growth equation formula of Bagenal and Tesch (1978) for back calculation based on scale reading has been found to be more authentic than commonly used von Bertallanffy growth equation.

$$l_n - a = S_n/S\ (1 - a)$$

where :
- l_n = length of fish when annulus 'n' was formed
- l = length of the fish at the time of capture.
- S_n = radius of annulus 'n'
- S = total scale radius
- a = correction factor (value calculated by plotting the graph between total fish length and scale radius)

In Indian major carps, use of scale data to determine age and growth rates have been validated (Rao, 1974; Johal and Tandon 1992). It is also observed that by appropriate interpretation of scale features such as the number of growth checks, circuli, counts and spacing between circuli, it has been possible to obtain quantitative estimates of pre-reproductive growth and age at first spawning. For hatchery stock of rohu in Karnataka, scale data has proved valuable data on growth (Eknath and Doyle 1985). This indicates that the above parameters could be used to guide selection programmes and to compare populations in different aquaculture regimes for commercially important/cultivable species.

The scanning of literature reveals that the data on age and growth of the commercially important/cultivable species in the Western Ghat region of India is very scanty. So there is an urgent need to develop age and growth data of fish for measuring the population dynamics, first spawning age, sustainable catch and conservation of the fish germplasm resources. These data can also be utilised for gene banking stocks from natural population showing higher growth rate.

Utility of Life History Parameters in Conservation and Genetic Upgradation Programmes

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Variation in reproduction, growth and other life history fitness traits are crucial for the long-term viability of species. They also form the base material for selection and other genetic upgradation programmes. Quantitative genetic studies have clearly established the genetic basis of these traits. However, the problem is compounded in fishes due to large environmental influences on the expression of these life history traits. Domestication of a species has proved to have a significant and selective impact on these traits. Life history parameters having a strong genetic base differ among geographically distinct populations and in between farm and wild populations (Unwin and Glova,1997). Therefore in restocking programmes, it is essential to use wild brood stocks similar in genetic make up to that of the original stock. Founder stocks selected for genetic upgradation programmes need to be carefully selected based on their life history traits. The traits which can vary between different geographical stocks and can be used for both commercial and conservation applications are discussed.

Age and size at first maturity: Age and size at first maturity can differ between different strains and wild stocks of fishes (Naslund and Henricson, 1996; Gopalakrishnan, 1991). The trait has been reported to be partly under genetic and environmental control. In a common laboratory environment, large differences in the timing of male sexual maturity in four different populations of endangered Gila top minnow – a fitness related trait has been recorded (Cardwell *et al.*,1998). However, relative significance of early and late maturing stock in selection programmes depends upon the end objective. If seed production is the desired gain, early maturing stock can be useful; but, for raising table fish with better growth rate and flesh quality, the late maturing one can be a better option.

Spawning time: Genetic control of time of spawning has been observed in rainbow trout. Different stocks have different spawning time in the year and crossbreeds exhibit spawning time intermediate characteristics between the parents. Spawning date has significant genetic correlations with spawning body weight, egg size and egg volume as well as with egg number (Su *et al.*, 1997). Based on the natural variability present in wild stocks of rainbow trout, strains that spawn at different periods of the year have been selected and are being used commercially. Availability of such strains enables the hatcheries to produce seed for longer periods by using different stocks round the year. However, since our aquaculture system is extensive or semi intensive, it will need to be examined if the seed produced by prolonged breeding period, can be utilised throughout the year.

Growth rate: Growth rate is the most important commercial trait and has always dominated the genetic improvement programmes in aquaculture. This is more important for breeders of table fish that for aquarium fish. There has been considerable work to improve the trait through selection especially in rainbow trout, tilapia and common carp. In GIFT tilapia, genetic gain per generation across five generations of selection was 12-17% and cost of production for this strain is 20-30% lower than the other strains (Eknath *et al.*, 1998). In India, selection programme has been carried out at CIFA, Bhubaneswar for *Labeo rohita*, with the resultant "Jayanthi" strain of rohu exhibiting 13% higher growth rate after one generation of selection. Environment greatly influences the growth rate, and this interaction is modulated by genetic mechanisms. Growth rate has been found to be variable between different strains and geographical stocks (Naslund and Henricson, 1996). Under farmed conditions, it is easy to determine the comparative growth rates of different stocks.

Fecundity: The fecundity or egg producing capacity differs among the populations of species in different geographical areas (Brzuska, 2000). This can be due to genetic differences between strains and environmental influences. It could also be due to genetic difference between stocks for mean body size to which fecundity is related. Stocks exhibiting higher egg producing capacity can be more useful for seed production, provided there is no negative co-relation between fecundity and growth rate.

Disease resistance and tolerance to stresses: Few selection programmes have been directed towards selection for specific disease resistance. The best example has been comparison between unselected strains of brown trout with furunculosis resistant strains, which performed better. The clear differences between different natural stocks, if it exists can be a useful trait for commercial aquaculture. In plants, genes offering resistance to particular disease have been located in natural stocks and latter incorporated into improved varieties. Such an approach is yet to be attempted in fishes. Capacity to tolerate stressful environment can be an important commercial trait.

Coloration and scale patterns: These traits have been reported to be different between genetic strains. The best examples for diverse colour pattern have been in gold fish and koi (ornamental common carp). Scale patterns in common carp, which differentiate the different strains have been known to be due to interaction of alleles of two genes designated as S and N. Known differences between strains for colour, scale pattern or any other trait of fancy nature has important commercial application especially for aquarium species.

Establishing brood stocks for conservation programmes: Under conservation programmes brood stocks from natural population are utilized for the following three purposes : i) for setting up a live gene bank of captive brood stock, ii) as brood stock for producing seed for repopulating depleted stocks iii) for cryopreservation of gametes in a gene bank facility.

Under all these three conditions, to prevent domestication the following precautions should be taken care of: i) there is no inadvertent selection for larger sized or early maturing or more colourful individuals ii) the individuals collected represent a random sample of population iii) during the process of maintaining live gene bank or producing seed for repopulation, care is taken that the original life history traits of natural stock is not altered.

The reasons outlined in brief above clearly indicate that for both genetic selection as well as conservation programmes, detailed information on life history traits is essential.

Reproductive Biology Estimators for Conservation and Culture of Fish

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For diversification and expansion of aquaculture, new fish species need to be added. Captive breeding is one of the essential prerequisite for successful domestication of a new species. It also plays a significant role in conservation of wild germplasm through maintaining live gene bank of captive brood stock and for repopulating depleted natural habitats. Also data on reproductive life history parameters can indicate the long term viability of endangered species. Different reproductive biology estimators are useful for predicting reproductive success as well as in developing manipulative techniques for both culture and conservation. The various estimators discussed below can be used individually and collectively depending upon the end objective.

Estimators of sexuality and breeding

Reproductive strategy: Lengthwise distribution male and female for different size classes can provide strong indication whether the fish is typically a gonochorist or hermaphrodite (protandric/ protogynous). This requires around the year sampling if fish is annual breeder. Management strategy for both conservation and culture will differ as per mode of reproduction of candidate species (Moore, 1979, Blaber *etal.,* 1996).

Sexual dimorphism: Existence of sexual dimorphism and the changes occurring in secondary sexual characters during different phases of maturity need to be recorded. If clear distinction is present especially during breeding period it can be used as a quick diagnostic tool to evaluate whether the wild or captive brood stocks have attained maturity and are ready for the final induction of spawning.

Sex ratio: This is arrived by calculating the ratio of female: male recorded around the year. The expected ratio will be 1: 1 in a normal gonochorist fish. In few cases it is skewed due to certain life history traits like migration. In a protandric or protogynous, the ratio can be in favour of more male or female respectively. Any deviation from the expected sex ratio can be the result of negative forces, manmade or natural acting on the population and indicate the need for further investigation to understand if it will have deleterious effect on the viability of the population (Lal, 1992).

Age and size at first maturity: This is arrived by calculating age and size at which fifty percent of the individuals enter the maturing (normally stage 3) process. Beverton and Holt (1957). This is one of the most important reproductive biology estimators. This stage is characterized by recruitment of oocytes into gonadotropin dependent phase in ovaries and presence of spermatocyst in testicular lobules. Prerequisite for this estimator is precise categorization of maturity stages. Frequency distribution of stage 3 individuals against length/age classes will give, age and size at first maturity. Data on age and size at first maturity is a good indicator of the type of wild brood stock that can be used for captive breeding. Age and size at first maturity can have implications for management for capture fishery, e.g. in *Lates calcarifer* which matures around 600 mm (3.5 to 4.0 kg), exploitation below this size will remove potential brood stock even before first maturity is attained. Besides in protandric hermaphrodite, the practice can eliminate the males selectively leading to sex ratio skewed in natural population (Lal, 1992). In the light of this, the information on size at first maturity can be used for fixing net mesh size.

Potential fecundity: This is calculated by number of vitellogenic oocytes/ sample weight x ovary weight. The stage 4 or 5 ovaries are samples from anterior, middle and posterior portions of ovary especially if synchrony of development is not certain. This can be a useful predictor of potential recruitment magnitude in natural populations and seed production in hatchery (Greeley *et al.,* 1987).

Estimators for classification of maturity process

The most reliable classification method is tracing the process through histological examination of samples around the year for distribution of different types of cells. Non-histological methods are given below and preferably they should be used in conjunction with histological studies when a species is being studied for the first time or any discrepancy is to be resolved.

Macroscopic features of gonads: Examination of changes in macroscopic features including colour, size, shape, texture and thickness of gonadal wall. The correlative changes with identified stages can help in tentative identification of maturity stage with experience.

Gonadosomatic index: Gonadosomatic index (GSI) is the easiest to record and accurate as long as basic assumptions are not violated. GSI should have linear relationship with body weight and slope should not differ for different stages of maturity. If this is not met, parameter like standard gonad weight (SGW) can be calculated (deVlaming *et al.,* 1982) which is independent of change in body size and uses standard length in place of body weight. GSI/SGW can be predictive for assigning maturity stage to an unknown specimen collected from nature or captive brood stock, once the range for different maturity stages is established. The two parameters are estimated as follows.

i) Gonadosomatic index: Gonad weight/Body weight x 100.
ii) Standard gonad weight: This is the regression parameter calculated between gonad weight and standard length for two sexes and stage wise. For the two sexes, average of standard length in the samples is calculated. Using the above regression equation, expected gonad weight (GES) is obtained for all the stages. Similarly expected gonad weight (GEO) is obtained for observed length. Standard gonad weight (GS) is calculated as GES x GO/GEO, here GO is the observed gonad weight.

Oocyte diameter: Oocyte size is a good indicator of maturation and gonadal cycle (Greeley *et al.,* 1987). A representative piece from freshly collected ovary is teased in a drop of 1% formalin in physiological saline (0.67% NaCl) on a glass slide. Oocyte diameter is measured along its horizontal axis using ocular micrometer, pre-calibrated with stage micrometer. Oocytes are measured at random till the count reaches hundred cells. The data is used to calculate largest oocyte diameter (average of ten largest oocyte in sample) and comprehensive oocyte size frequency profile.

(i) Largest oocyte Diameter (LOD) classifies the maturity stages by tracing the course of development in the leading clutch (Greeley *et al.,* 1987). Clutch is a group of uniformly and synchronously developing oocytes after recruitment into gonadotropin dependent phase (vitellogenic phase). LOD can also be used to define gonadal cycle by plotting monthly average against months around the year. Moreover, information on the maximum size, oocyte can attain on completion of vitellogenic growth can be useful in planning the selection of brooder ready for induced breeding treatment.
(ii) Comprehensive oocyte frequency profile is a sensitive method to trace the development of oocytes. Advantage of the method is that it detects separation of developing clutch including multiple ones and traces the shift of the peak from one oocyte diameter class to the next (Greeley *et al.,* 1987). Frequency of oocytes in different size classes is plotted for maturity stage.

Both LOD and comprehensive, oocyte frequency profile can be standardized through catheter sampling; hence it can be carried out without sacrificing valuable brood stock if needed. The simple catheter can be the infant feeding tube fitted with 5 ml, syringe. Care should be taken, not to localize suction at one place.

Estimators for seasonal cycle

The fishes have cyclic breeding habits and many times these are triggered by environmental cues like temperature, daylight and rainfall. The knowledge of such seasonal cycles not only makes captive breeding more predictable, but also gives scope for artificial manipulation of environmental conditions to achieve multiple and prolonging breeding in hatchery brood stocks. The following estimators can be used for this purpose. Month wise variation in average GSI/SGW indicates onset and completion of development as well as the spawning season. Besides it can reflect the synchronisation of development between two sexes. Month wise frequency distribution of different maturity stages including spent and those undergoing ovarian atresia also give similar indication as GSI and LOD. In addition, it can also give an estimate of what percent of total fish in the wild pass the breeding season without reproductive development (Lal, 1992). The proportion of gravid female undergoing ovarian atrisia vis a vis developing and spent fish need to be investigated carefully as it can indicate lack of breeding opportunity which could be due to imbalanced sex ratio (Trippel and Harvey 1990; Lal 1992) or any stress on the population.

Estimators for multiple spawning

Before a species is domesticated for culture, it is essential to determine if it is a single or batch spawner. The number of breeding periods is indicated by month wise variation in GSI, LOD and maturity stages. However, in breeding season whether a fish releases the egg at one time or in different batches, is indicated by comprehensive oocyte frequency profile. In addition stage wise profile of serum alkali labile phosphorous, calcium and electrophoretic detection of female specific protein also provide definite indications (Lal, 1992). These are indicators of vitellogenin in blood stream being transported from liver to ovary for oocyte development. In single spawners, the vitellogenin level declines when development in leading clutch is complete. But in multiple spawners, level is maintained to sustain the succeeding clutch also.

These estimators will require extensive study to be correlated with environmental parameters for a minimum period of one year with repeat confirmation in the successive year to get a thorough picture of sexuality and seasonal cycle vis-à-vis environment. The resulting data profile can provide strong background for planning long-term conservation and domestication for the species.

Among the Western Ghats endemic fishes, many potential cultivable species have been identified and organizations, are taking up programmes on domestication of the species. For endangered species like *Labeo dussumieri, Horabagrus brachysoma* and *Gonoproktopterus curmuca*. NBFGR has already initiated a programme of captive breeding in collaboration with a local organization in Kerala (Regional Agricultural Research Station, Kumarakom). In both these programmes, the reproductive estimators outlined would be useful.

Captive Breeding and Ranching for Conservation of Endangered Fish Species

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India is fortunate to possess vast and varied fish germplasm resources distributed widely in cold waters, warm waters of plain, brackish water and marine ecosystems. About 11% (2,200) of the total world (more than 20,000) finfish species have been recorded from Indian subcontinent. Though many indigenous species are common and wide spread, due to various anthropogenic stresses like rapid development, river-valley projects, population explosion and over-exploitation, some of the conventional fishing grounds have been showing dwindling trends while some fish species are even endangered (Dehadrai *et al.,*1994). NBFGR has tentatively identified 4 endangered, 21 vulnerable, 2 rare and 52 indeterminate (total 79) fin fishes from different Indian waters. Among the Peninsular fin fishes, *Tor mussullah* has been grouped as endangered, *Cirrhinus cirrhosa* and *Labeo dussumieri* as vulnerable, *Horaglanis krishnai as rare and Tor khudree, Crossocheilus latius, Labeo fimbriatus, Puntius carnaticus, Silonia childreni* and *Lepidopygopsis typus* as indeterminate species.

Fish sanctuaries: Fish sanctuaries or parks provide protection and permit natural reproduction of threatened species. Some water areas and temple tanks near Haridwar and Rishikesh are protected due to religious sentiments. In Madhya Pradesh, there are sanctuaries on the Narmada at Kapileswar, Mangalnath and Sahastradhara. In Karnataka, fish sanctuaries are located at Shrigeri (Bhadra river), Shrirangapatnam Ramanathapuram and Chipalgudda (Cauvery river) and Shimasha (Sharavathi river). In Maharashtra, stretches of river Indrayani at Atlandi and Dehu, and on river Bhima at Pandharpur are closed for fishing during breeding season. In Himachal Pradesh, where landing of prized mahseer is fast declining, the State Government has banned mahseer fishing during June to August in Sedhpur and Machila in Mandi, Renuka in Sirmaur and Baiznath in Kangra districts.

Captive breeding: Some of the threatened fishes are being maintained outside their natural habitats for perpetuating the sample population through artificial fecundation. Take Electric Company has standardized the technique of induced breeding and larval rearing of mahseer, *Tor tor, T. khudree* and *T. putitora* at Lonavala. It supplies advanced fingerlings to various agencies for their ranching in the natural depleted water bodies. Developed the methods of artificial propagation of golden mahseer through stripping of the spawners collected from Bhimtal Lake (Kumaon Region) and rearing the hatchlings in flow-through hatcheries. In Karnataka, the College of Fisheries has also successfully carried out induced breeding of pond-raised *Tor khudree.* NBFGR achieved success in induced spawning of captive endangered golden mahseer (*Tor putitora*) at Baint-Wali-Mandi, near Dehradun (Garhwal Region) and endangered carp of Kerala *Labeo dussumieri*. Tata Electric Company is also maintaining a stock of endangered *Barilius bola* for captive breeding and propagation.

Monitoring of the stock: Regular monitoring of the gonadal development (maturity) of the captive stock through catheter sampling and histological studies are essential for inducing successful spawning. Such studies on ovarian maturation are necessary in the case of mahseer with females exhibiting intermittent breeding season extending from June to September. Males however are generally mature during this period as they release viable milt even on slight pressure to their belly.

Ranching: National Research Centre on Coldwater Fisheries has been producing the fingerlings of *Tor putitora* since 1990 and is stocking the hatchery-produced fingerlings in different natural waters like Bhimtal, Sattal, Naukuchiatal and Jhingeri stream. Tata Electric Company has supplied the fingerlings of endangered Deccan mahseer, *Tor khudree*, to several State Fisheries Departments, various Government organization including Central Inland Capture Fisheries Research Institute and Central Institute of Freshwater Aquaculture and even foreign country like Laos. For *Tenualosa ilisha* in Ganga river system, Central Inland Capture Fisheries Research Institute, Barrackpore has also initiated a similar rehabilitation programme.

Conclusions: It is imperative to ascertain the conservation status of the threatened species of the Peninsular India as per IUCN criteria based on the actual field surveys and assessment of its past and present abundance. Studies on life-history traits are essential to understand the breeding biology of the fish. Standardization of captive breeding and larval rearing techniques are essential aids in conservation and rehabilitation of the endangered species.

Induced Breeding of Tropical Air Breathing Fishes with Natural and Synthetic Hormones

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Procurement of pure seed of cultivable fishes from a dependable source posed a problem in India until the technique of hypophysation was successfully applied in Indian major carps in 1957 at Central Inland Fisheries Research Institute (CIFRI), Cuttack. The technique was disseminated to all status and as a result carp seed supply centers are available in almost all the states. However, with regard to air-breathing fishes there is considerable difficulty in captive breeding and no seed supply center is specifically available in any state. Hence those involved in air-breathing fish culture have to depend on the seed collection from the wild, which is unpredictable due to monsoon failure. Over the last ten years, air breathing fishes have undergone a steady decline mainly due to over exploitation, loss of habitat, diseases, pollution, siltation, poisoning, dynamiting, other destructive fishing methods and introduction of alien species like the major carps and tilapia. With an ultimate objective of conserving the air breathing fishes (murrels: *Channa striatus* and *C. punctatus* and singhi : *Heteropneustes fossilis*) the Centre for Aquaculture Research and Extension (CARE), St. Xavier's College, Palayamkottai, Tamil Nadu is actively involving in mass seed production by induced breeding. The studies carried out for breeding of air breathing fishes at CARE are important since they can be utilized in captive breeding of other endangered air breathing and cat fishes.

During the past two decades induced spawning by carp pituitary extract has been attempted in obligatory air breathing fishes *viz., Heteropneustes fossilis* (Sundararaj and Vasala, 1976) *Channa striatus* and *C. marulius* (Parameswaran and Murugesan, 1976) and *C. punctatus* (Banerjee, 1974). The ever increasing cost of donor pituitary and the cumbersome process pose a secondary problem and necessitate a simple, reliable and cost effective method for induced breeding.

Hence alternative sources *viz.,* human chorionic gonadotrophin (HCG) (Mollah and Tan, 1983; Zairin *et al.,* 1992), lutenizing hormone releasing hormone (Fostier *et al.,* 1983) and Ovaprim (Alok *et al.,* 1993; Haniffa *et al.,* 1996) has been used in air breathing fishes.

The following summarises the breeding experiments carried out with three air breathing fishes at CARE. Brooders of *C. striatus* (1.0 ± 0.3kg), were injected with intramuscular injection of natural (pituitary 10-50mg; HCG 3000-5000 IU) (Haniffa *et al.,* 2000) and synthetic hormones (ovaprim 0.3 + .007 ml/kg; LHRH 40-60 μg) (Table 1). *C. striatus* brooders (one female and two males) were introduced into breeding pond (5x4x1m; Haniffa *et al.,* 1996). The brooders showed aggressiveness after 10 h of injection irrespective of type of hormone. Each female paired with only a single male and other male was rejected. Mating was preceded by an elaborate courtship. During spawning, the male bents its body close to the female and releases the milt as soon as the eggs are released. Fertilization of eggs as in majority of teleosts is external. Both parents particularly the male guarded the young ones. Spawning was partial in low dosage of pituitary injected individuals. Fertilization rate ranged between 60-70%. The highest percentage of fertilization (95-98%) was noticed in eggs laid by ovaprim-injected individuals. Latency period

Table 1: Effects of different hormones on induced spawning in Channa striatus. Values are x ± SD (n=3) Values with different superscripts in column are significantly different (P<0.05)*

Hormone	Female Weight (g)	Male Weight (g)	Dosage of hormone/kg 1st + 2nd	Latency period (h)	Spawning	Fertili-sa-tion (%)	Incubation period (h)	Ova diameter (mm)
Pituitary Extract	710	590	10+50mg	24.3±0.3a	Partial	60.0±5.0a	43.3±0.3a	1.21±0.02a
	700	610	10+100mg	22.5±0.1b	Complete	70.3±3.0b	41.0±0.5b	1.23±0.01a
	700	570	10+150mg	23.0±0.2c	Complete	68.6±2.0b	39.0±0.3c	1.27±0.01b
HCG	625	550	3000IU	26.0±0.5a	Partial	65.3±7.0a	38.3±2.1a	1.22±0.01a
	620	590	4000IU	23.0±0.8b	Complete	79.5±3.0b	36.0±1.5a	1.28±0.03b
	750	620	5000IU	23.0±0.7b	Complete	79.0±5.0b	36.5±1.0a	1.30±0.02b
LHRHa + Pimozide							36.5±2.1a	
	680	590	40μg+5mg	20.0±1.0a	Complete	75.3±2.0a	34.0±1.0a	1.07±0.02a
	600	540	50μg+5mg	18.0±0.9b	Complete	84.0±2.0b	Death before hatching	1.09±0.03a
	645	520	60μg+5mg	19.3±0.8b	Complete	80.3±2.0b		1.09±0.01a
Ovaprim	640	540	0.3cm3	Nil	Nil	Nil	Nil	1.34±0.03a
	680	525	0.5cm3	24.0±0.9a	Complete	98.0±3.0a	21.0±1.4a	1.41±0.02b
	765	580	0.7cm3	23.0±0.9a	Complete	95.3±2.5a	23.0±2.0a	1.45±0.02b

	Latency period	Fertilisation	Incubation period	Ova diameter
	$\mu L \neq \mu P = \mu O = \mu H$	$\mu P = \mu H = \mu L \neq \mu O$	$\mu O \neq \mu L = \mu H = \mu P$	$\mu O \neq \mu L \neq \mu P = \mu H \neq \mu O$
Pituitary (P), HCG (H), LHRH-a (L) and Ovaprim (O)				

* Data were analysed by one way ANOVA followed by Tukey's multiple range test; ≠ P<0.05; = P>0.05

was relatively shorter (18-20h) in LHRH injected individuals. Ova diameter was the maximum (1.34-1.45mm) in Ovaprim followed by HCG (1.22-1.30mm), pituitary (1.21-1.27mm) and LHRH (1.07-1.09mm) injected *C. striatus*. Ovaprim showed better results in terms of spawning response, egg output, fertilization and percentage of hatching at medium dose of 0.3ml/kg (Table 1).

C. punctatus (60-58g) and H. fossilis (90-110g) brood stock were intramuscularly injected with HCG (1000-3000 IU) and Ovaprim (0.1-0.7 ml/kg) at various dosages to induce oocyte maturation and ovulation (Table 2). Both males and females were injected with equal dosage at the same time. Control fishes were injected with an equal volume of saline for each experiment. They were allowed to spawn and then the eggs were collected, counted and percentage of fertilization, hatching and survival rate of larvae were calculated. When injected with ovaprim the highest fecundity was recorded at 0.3ml/kg body weight (102 for *C. punctatus* and 6336 for *H. fossilis*) whereas maximum fecundity of 1253 for *C. punctatus* and 82,922 for *H. fossilis* were obtained at a dosage of 3000IU/kg (Table 2).

Table 2: Effect of different dosages of ovaprim and HCG on fecundity of C. punctatus and H. fossilis

Hormone used	Dosage of hormone/kg (b.w.)	Wt of fish (g)	Fecundity	Latent Period (h)
		C. punctatus		
Ovaprim	0.1 ml	65±5	30±8	18
	0.3 ml	70±5	3276±75	18
	0.5 ml	63±5	198±10	18
HCG	100 IU	62±5	102±20	18
	2000 IU	73±6	699±78	18
	3000 IU	70±5	1253±126	18
		H. fossilis		
Ovaprim	0.3 ml	100±10	258±85	18
	0.5 ml	105±10	1052±220	18
	0.7 ml	103±10	6692±790	18
HCG	1000 IU	106±10	6336±800	18
	2000 IU	100±10	18376±1020	18
	3000 IU	102±10	82922±5432	18

The dosage of ovaprim selected for induced spawning in carps and murrels was between 0.3-0.6ml/kg body weight (Nandeesha *et al.,* 1990; Haniffa *et al.,* 1996). In the present experiment, best results for ovaprim were obtained at 0.3ml/kg for *C. punctatus*. Further increase in ovaprim dosage beyond the optimum dosage of 0.3ml/kg resulted in decrease in egg out put. Whereas in *H. fossilis*, the number of eggs spawned increased with increase in dosage of ovaprim upto 0.7 ml/kg. HCG administered fishes spawned successfully in all the experimental dosages except in 1000 IU/kg in *C. punctatus*. The minimal required dosage to induce ovulation in *C. macrocephalus* was 2000 IU/kg while 1000 IU/kg was only partially effective (Mollah and Tan, 1983). The dosage varies in different species depending on how closely the endogenous gonadotrophin is related to HCG (Manickam and Joy, 1989). Irrespective of dosage, the time taken for spawning (latent period) was the same for both hormones, indicating that administration of higher dosage did not accelerate the rate of final maturation of oocytes. The latency period was the same irrespective of the hormone. When compared with *H. fossilis, C. punctatus* took a longer duration to spawn (Table 3).

Table 3 : Spawning characteristics of female *C. punctatus* and *H. fossilis* treated with Ovaprim and HCG.

	Sl. No.	Treat-ment	No. of fish	Body wt (g)	Dose/kg (b.w.)	Latency period (h)	Fish spawned (%)	Fertilisa-tion rate*	Hatching rate*	Survival rate of larva
C. punctatus	1.	Ovaprim	6	65-80	0.1 ml	-	-	-	-	-
	2.	Ovaprim	6	65-80	0.3 ml	28-34	100	Normal	Normal	30%
	3.	Ovaprim	6	75-85	0.5 ml	28-34	100	Normal	Normal	10%
	4.	HCG	4	60-70	1000 IU	-	-	-	-	-
	5.	HCG	4	70-80	2000 IU	28-34	100	Normal	Normal	50%
	6.	HCG	4	65-85	3000 IU	28-34	100	Normal	Normal	65%
	7.	Saline	2	60-80	-	-	-	-	-	-
H. fossilis	1.	Ovaprim	4	100-105	0.3 ml	18-24	100	Normal	Normal	10%
	2.	Ovaprim	4	90-105	0.5 ml	18-24	100	Normal	Normal	30%
	3.	Ovaprim	4	90-105	0.7 ml	18-24	100	Normal	Normal	15%
	4.	HCG	4	80-105	1000 IU	18-24	100	Normal	Normal	60%
	5.	HCG	4	90-100	2000 IU	18-24	100	Normal	Normal	50%
	6.	HCG	4	110-115	3000 IU	18-24	100	Normal	Normal	55%
	7.	Saline	2	95-105	-	-	-	-	-	-

* Fertilization rate of 70% and hatching rate of 50% are considered normal.

The survival rate of the larvae of HCG induced parent was 50-60% when compared to 10-30% in ovaprim induced larvae. However high survival rate of larvae has been reported by Haniffa *et al*. (1996) in Ovaprim induced fishes. Undetermined environmental factors such as one that affected that ovulatory response of carps to LHRH (Fostier *et al.,* 1984) could be regarded as a reason. The present study suggests that Ovaprim and HCG are better alternatives to the conventional hypophysation technique (Chondar, 1970) for the induced breeding of *H. fossilis, C. striatus* and *C. punctatus*. Based on the technique standardized for these fishes captive breeding technique can be developed for other endangered air-breathing/cat fishes.

Weaning Diets for Post Larvae, Fry and Fingerlings – Pre-Requisite for Commercial Murrel Culture

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In Peninsular India, murrels support a lucrative freshwater capture fishery. Characteristics of this fish that make it also a desirable cultivable fish includes its high market value (100-120/kg), rapid growth, tolerance to high stocking rate and utilization of atmospheric oxygen for respiration in oxygen depleted water (Josemon *et. al.,* 1994). One of the reasons for murrel culture being not practiced widely it that there is no seed supply/sales centre all over India and hence fish farmers have to depend on wild collections, which is unpredictable. When seed is available these are stocked in village ponds, irrigation wells and shallow water ponds. The culture of these species has also not picked up. Fish farmers are not aware of the breeding and culture techniques of murrels especially of its early life stages.

Relative ease of egg production from captive brood stock as well as simple and high effective larval rearing methods are important factors in the successful culture of the fish. Fish larvae usually accept formulated feed during the "eleutero-embryonic period" or the "mixed feeding period" (Kamler, 1992). Weaning diets improve the larval survival and growth significantly, although the problem of availability and cost of the ingredients prohibits its use on a commercial scale (Fonds *et. al.,* 1989). For most of the important commercially cultivated species, the initial exogenous feeding of larvae is usually ensured by the supply of live feed organisms like plankton upto "weaning period" at which stage larvae can switch from live food to a accepted formulated dry diet, without significant effect on growth and/or survival. The weaning period coincides with the stomach becoming functional. However, for most species problems are faced during the transfer from natural to artificial diet, which is consistently associated with high mortality and poor growth. Hence rearing of post larvae, fry and fingerlings always pose considerable difficulty, more so in the case of murrels. Recently attempts have been made on larval nutrition of *Channa striatus* by Qin *et al.,* (1997), Haniffa and Arockiaraj (1999).

The following summarizes the feeding trials carried out with early life stages of *C. striatus* at CARE. Feeding trials were conducted in 200 1 cement tanks at CARE at a water temperature of 28±1°C and photoperiod of 13 L and 11 D. In each tank, 200 *C. striatus* of each stage were stocked and assigned to one of the feeding regimes of formulated diet (Fd) and combined diet (Cd). The formulated diet was prepared using chicken intestine (63%), ground nut oil cake (15%), rice bran (10%), tapioca (10%) and vitamin mineral premix (2%). The ingredients were mixed with addition of water. The dough was extruded through pelletizer. The Cd contained the formulated diet and chopped *Chironomous* larvae. The control diet for early post larvae (EPL) and late post larvae (LPL) was the plankton whereas for the fry (FR) and fingerlings (FL), it was boiled egg white (particle size less than 0.4 mm). EPL and LPL were fed with diets Fd and Cd upto satiation level (2 mg/larvae/day), whereas FR and FL were fed at the rate of 15% of their body weight. Feed was given to all the four groups three times a day at 8h, 13h and 18h. Those fed on Cd were given finely chopped *Chironomous* larvae twice a day at 8h and 18h and Fd at 13h. At the end of the experiment, cannibalism for each size group was estimated based on the methodology of Qin et al. (1997). The data were analyzed employing Tukey's multiple range test (Tukey, 1953).

Early and late post larvae showed 100% mortality in all the treatment (Table 1). It is known that the larvae of *C. striatus* subsist only on zooplankton (Parameswaran and Murugesan, 1975). Fry and fingerlings fed Fd showed significantly better survival ($P < 0.05$) when compared to those fed Cd. But in terms of length the weight, fish fed on Cd performed better among the different treatments. Hoff and Snell (1989) reported that snakehead larvae could be successfully reared using plankton, which can actively swim for 5 hours in freshwater, there by extending their availability for larval consumption.

Mortality was significantly higher ($p < 0.05$), than cannibalism in FR in all the treatments, whereas fingerlings fed on Fd showed no significant difference ($p < 0.05$) between cannibalism and mortality. Ng and Lim (1990) reported cannibalism is the most common problem leading to low survival in snakehead culture because snakehead can easily consume a small fish of more than half its length. They also suggested that coefficient of variation of length of fish could be an indicator for size dependent cannibalism in fish. These findings suggest that snakehead can be successfully weaned by feeding the larvae with live plankton from hatchling to larval stage and with combined diet (live Chironomous larvae and formulated diet) during

Table 1: Weight gain, specific growth rate and mortality of early post larvae (EPL), late post larvae (LPL), fry (FR) and fingerlings (FL) of C. striatus fed formulated died (FD), combined diet (Cd) and control diets (C).

Stage	Diet	Initial weight (gm)	Mortality (%)		Coeffi-cient of variation (CV)	Specific growth rate (%/day)	Final weight (gm)
			Cannibal-ism	Death			
EPL	Fd	0.12±0.01	-	100	-	-	-
Cd	0.12±0.01	-	100	-	-	-	
LPL	Fd	0.3±0.01	-	100	-	-	-
Cd	0.3±0.01	-	100	-	-	-	
FR	Fd	1.3±0.06	20	7	3.7	1.0	3.2±0.07
Cd	1.3±0.06	30	10	3.5	1.49	5.0±0.04	
FL	Fd	2.0±0.05	12	28	5.12	1.54	8.0±0.04
Cd	2.0±0.05	15	41	4.54	1.8	10.3±0.03	
			Control diet				
EPL	C	0.12±0.01	3	12	1.66	0.998	2.7±0.02
LPL	C	0.3±0.01	5	10	1.4	1.05	3.0±0.06
FR	C	1.3±0.06	9	10	1.85	1.60	5.5±0.05
FL	C	2.0±0.05	10	8	0.0	1.70	9.3±0.8

the fry stage. At the fingerling stage, better survival and growth could be possible when fed on formulated diet.

Many of the potential cultivable fishes like Ompok malabaricus identified from Western Ghats (Gopalakrishnan and Ponniah, 2000) are catfishes. The weaning diets successfully tested by CARE can be utilized in developing larval rearing techniques for these fishes.

Induced Spawning and Establishment of Captive Population of an Endangered Fish *Ompok malabaricus* in India

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Haniffa, M.A., and Jesu Arockia Raj, A. and Arul Mozhi Varma, T., 2000. Induced spawning and establishment of captive population of an endangered fish *Ompok malabaricus* in India. pp. 302-304 In : Ponniah, A.G. and Gopalakrishnan, A. (Eds.). Endemic Fish Diversity of Western Ghats. NBFGR – NATP Publication – 1, 347 p. National Bureau of Fish Genetic Resources, Lucknow, U.P., India.

At the species level freshwater fishes are the most threatened of all vulnerable species, widely exploited by human (Bruton, 1995). Due to various anthropogenic stresses, some of the conventional fishing grounds have been showing dwindling catches, while some fish species are even endangered requiring conservation. Conservation Assessment and Management Plan Workshop (Anon, 1998) tentatively identified 98 threatened endemic freshwater species from Western Ghats and *Ompok malabaricus* popularly known as "butter fish" is one among them. Among the four *Ompok* species (*O. bimaculatus, O. malabaricus, O. pabo, O. pabda*), *O. malabaricus* has a restricted distribution confined to Goa and Kerala (Jayaram, 1999). It is a piscivorus fish inhabiting the lakes, ponds and rivers from an elevation of 100-2500 m. During the past ten years, *Ompok* spp. have undergone a steady decline due to various reasons *viz.,* over exploitation, loss of habitat, disease, pollution, siltation, poisoning, use of explosives and other destructive fishing (Nandeesha *et al.,* 1993; Sridhar *et al.,* 1998). With the ultimate objective of reestablishing natural populations of *Ompok* spp., a preliminary attempt on induced breeding was made by Sridhar *et al.,* (1998) at Centre for Aquaculture Research and Extension (CARE), St. Xavier's College, Palayamkottai. The attempt was successful. The present communication is an extension of this earlier study.

Individuals of *O. malabaricus* were collected from wet lands associated with the rivers Tambaraparani at Tirunelveli (8.15°N; 77.45°E) and Bhavani at Erode (9.55°N; 77.8°E). *O. malabaricus* also inhabits the lakes, ponds and rivers of Tamil Nadu. There is some confusion regarding identification of *O. malabaricus* and *O. bimaculatus*. In the case of *O. malabaricus*, the caudal fins are united whereas the same are distinct in *O. bimaculatus* (Talwar and Jhingran, 1991); the anal fin ray counts in *O. bimaculatus* ranges between 60 and 75 (Jayaram, 1999). After 24 hrs. starvation, they were introduced into plastic containers (capacity 15 l; 7 individuals/container) and transported to CARE by a van. They were introduced into the breeding pond (7.5x5x1.5m) at CARE aqua farm. After a couple of days, they were fed with finely chopped chicken intestine (5-10% body weight (Haniffa and Josemon, 1994). After 10 days acclimatization at CARE aqua farm, they were collected and assessed for maturity. *O. malabaricus* exhibits sexual dimorphism and the females could be easily identified by the vent during the breeding season. The fecundity was estimated by gravimetric method (Lagler, 1982). The egg diameter was measured under the microscope using a micrometer.

Brood fish selected for induced breeding experiments ranged between 90 and 115 g for females and 80 and 90 g for males. The breeding set consisted of a single male and a female. Both male and female brooders were administered a single intramuscular injection of Ovaprim at a dosage of 0.5 ml/kg body weight and the brooders were introduced into cement tanks (3 x 1 x 1m). Aquatic macrophytes like *Hydrilla verticillatta* and *Eichhornia crassipes* were introduced into the tank for hiding purposes.

The results of induced breeding experiments are summarized in Table 1. The fecundity ranged between 3700-4000. The egg diameter was 1.22 ± 0.03 mm and the fertilization rate was 75%. Hatching occurred 24-25 hour after spawning. The survival at hatching varied from 55-60%. The post larvae were 2.4-2.6 mm in total length (TL). Three days after hatching, the mouth was completely formed and the larvae began to ingest exogenous feed consisting of boiled egg yolk from day 4 post hatching besides their endogenous yolk. The post larvae were fed on chopped *Chironomous* larvae after 8 days post hatching. The post larval stage continued till 15 days post hatching and after that they underwent a transformation to resemble the adult. At this stage, they were termed as juveniles and fed with finely chopped beef liver. Fingerlings of *O. malabaricus* (length 3.2 ± 0.2 mm; weight 1.75 ± 0.25 gm) were released into the earthen pond (8 x 12 x 1.5m) and fed with finely chopped chicken intestine (Haniffa and Josemon, 1994). From the results, it is clear that Ovaprim is effective in inducing ovulation in *O. malabaricus*. The time taken for

Table 1 : Induced breeding in *Ompok malabaricus* using Ovaprim.

Sl. No.	Weight of female (g)	Weight of male (g)	Hormone dosage (ml/kg b.w.)	Time taken for response (hrs.)	Fecundity (no.)	Fertiliza-tion (%)	Survival at hatching (%)
1.	90	80 82	0.5	5	3700	75	55
2.	115	85 90	0.5	6	4000	75	60

response (5-6) is the lowest recorded among catfish species. For instance the latency period reported for *Heteropneustes fossilis* (Alok *et al.,* 1998), *Clarias gariepinus* (Salami *et al.,* 1994), *Tor khudree* (Nandeesha *et al.,* 1993), *Sparus aurata* (Zohar *et al.,* 1989), *Heterobrachus longifilis* (Nwadukwe *et al.,* 1993) were 12, 13, 6-7, 10 and 7-8 hours respectively.

The fertilization rate estimated in the present experiment (75%) is comparable to earlier reports of *Heteropneustes fossilis* (50% and above) using GnRH (Alok *et al.,* 1998), *Clarias gariepinus* (46-90%) using HCG (Salami *et al.,* 1994), *Tor khudree* (60-96%) using Ovaprim (Nandeesha *et al.,* 1993), *Sparus aurata* (53-66%) using LHRH (Zohar *et al.,* 1989), *Mystus punctatus* (85%) using dried carp pituitary extract and *Channa striatus* (60-68%) using pituitary extract, HCG, LHRH-a and Ovaprim (Haniffa *et al.,* 2000). The present dosage of 0.5 ml/kg body weight of Ovaprim may be used as a standard in future for breeding trials of *O. malabaricus*

Workshop Recommendations

Working Group I - Taxonomic Ambiguities

Focal theme: -

- To resolve taxonomic ambiguity of few freshwater species from Western Ghat area and to assign proper generic and species names in NBFGR's fish germplasm list for Western Ghats.

In this group, nine representatives from ICAR institutes, Zoological Survey of India and Universities participated with Dr. K.C. Jayaram, Ex-Joint Director, ZSI as the chairman. The group made following recommendations: -

The generic name to be used for yellow catfish endemic to Kerala is *Horabagrus* as it differed in several morphological and meristic characters from Japanese and Chinese Genus *Pseudobagrus*. The group also concluded that *Tor khudree* and *T. mussullah* are two distinct species, based on morphometric counts and the latter exhibiting a patchy distribution. Similarly, validity of *Channa micropeltes, C. leucopunctatus, Labeo nigrescens* and *Macropodus cupanus* dayi were agreed upon. The group also reported that *Puntius dobsoni* is a synonym of *P. jerdoni* and *P. pulchellus* is a valid species; and *Osteochilithys* and *Kantaka* as separate genera. For checking the validity of genus/ species it was suggested that the works of Jayaram (1999) and Nelson (1994) to be consulted.

Working Group II - Prioritisation of endemic species for aquaculture

Focal theme

- Prioritisation of potentially cultivable endemic species for development of aquaculture.
- Constraints experienced so far in utilization of potentially cultivable species.
- Action to be taken for popularizing potential cultivable species.

In this group 11 representatives from ICAR institutes, Fisheries colleges, State Agricultural Universities and conventional Universities participated. The group was chaired by Dr. P. Keshavanath, College of Fisheries, Mangalore. Three focal theses were discussed and based on interaction among group and discussions on extended abstracts, recommendations were adopted.

Prioritisation of potentially cultivable species

Due to extensive culture activities of Indian major carps and exotic varieties many indigenous species of the region with superior acceptability, better demand and higher price have gradually declined from the natural water bodies and disappeared from the local markets. In this connection, following 16 potential species were recommended both for conservation and developing their culture technology in a phased manner. These include *Gonoproktopterus curmuca, Labeo dussumieri, Horabagrus brachysoma, Labeo fimbriatus, Tor khudree, Gonoproktopterus kolus, G. dobsoni, G. dubius, Ompok malabaricus, Cirrhina cirrohsa, Puntius pulchellus, Barbodes carnaticus, Etroplus suratensis, Clarias dussumieri, Channa micropeltes* and *C. leucopunctatus*.. The working group also identified the organisations where aquaculture experiments of the species can be taken up. These include College of Fisheries, Mangalore, CIFA-Peninsular Aquaculture Station, Bangalore, Regional Agricultural Research Station (RARS), Kumarakom and St. Xavier's, College, Palayamkottai.

Constraints

The major constraints identified are lack of standardized seed production technique, dearth of information on the biology, especially the reproductive biology of the prioritized species and scarcity of spawners and seed. The other requirements for development of aquaculture practices of the species include formulation and evolution of artificial feed and attempts to polyculture these species along with other compatible farmed fish.

Action to be taken for popularizing cultivable endemic species

To overcome technology gap in promoting the culture of potential cultivable fishes in the region, it was strongly recommended that ICAR institutes especially CIFA, NBFGR, local SAU's and conventional Universities should develop technologies for seed production for these species. Efforts should also be taken to study the reproductive biology of the above listed species, which will ultimately be helpful in perfecting their captive breeding technology. It is also recommended that state fisheries departments should popularize these species by publishing pamphlets in local language for the fish farmers.

Working Group - III Prioritisation of potential ornamental speices endemic to Western Ghats

Focal Theme

- Prioritisation of potential ornamental species from NBFGR base list.
- Constraints experienced and action to be taken to popularize potential ornamental species .

In this group 15 representatives drawn from ICAR institutes, MPEDA, Cochin, conventional and State Agricultural Universities, Kerala Forest Research Institute (KFRI), Peechi, Ornamental fish hobbyists and traders participated. It was a composite group with representatives of all stakeholders in the sector. The group was chaired by Dr. R.J. Ranjit Daniels, Professor, M.S. Swaminathan Research Foundation, Chennai.

Thirty ornamental species were prioritised from NBFGR base list to be considered for culture purpose, which included *Puntius denisonii, P. fasciatus, P. arulius, P. narayani, P. sahyadriensis, P. filamentosus, P. punctatus, P. setnai, P. fraseri, Horabagrus brachysoma, all species of Barilius, Danio malabaricus, Danio neilgiriensis, Chela dadyburjori, Botia striata, B. macrolineata, Nangra ichthea, Tetraodon travancoricus, Pristolepis marginata, Scatophagus argus, Horaichthys setnai,* all species of *Nemacheil*us and *Etroplus canarensis*. The committee felt breeding of *Botia, Nemacheilus* species *Puntius denisonii* and *Tetraodon travancoricus* is urgent as over-exploitation of wild stock of these highly-priced fishes can lead to their diminution. The working group also added that the primary constraint with some of the endemic ornamental species was loss of the natural bright colour under captivity. By improving the quality of feed or by adopting selective breeding technique, colouration enhancement may be attempted, Dr. Ranjith Daniels added.

Working Group - IV Repopulating of endemic food/sport species

Focal theme

- To prioritize species from NBFGR list for repopulating rivers to improve fishery.
- Constraints experienced and steps to be taken.

In this group altogether 13 members were present and the group was chaired by Dr. K.G. Padmakumar, Associate Professor (Aquaculture), Regional Agricultural Research Station (RARS), of Kerala Agricultural University, Kumarakom. The group made following recommendations on the basis of focal theme.

Species prioritized

Altogether 21 peninsular endemic species were selected from NBFGR base-list for ranching to improve the commercial fishery. These include *Tor khudree, Gonoproktopterus curmuca, Labeo dussumieri, Horabagrus brachysoma, H. nigricollaris, Ompok malabaricus, Cirrhina cirrhosa, Labeo fimbriatus, Tor mussallah, Barbodes bovanicus, Barbodes carnaticus, Gonoproktopterus kolus, G. dubius,Channa micropeltes, C. leucopunctatus, Mystus krishnensis, G.micropogon periyarensis, Puntius pulchellus, P. jerdoni (P.dobsoni)* and *Silurus wynaadensis* . Of these, technology for breeding and mass rearing of larvae exists only for 6 species *viz., Labeo dussumieri, L. fimbriatus, Tor khudree, Puntius pulchellus, Ompok malabaricus* and *Silurus wynaadensis*.

Constraints

The major constraint identified by the group was difficulty in raising funds to promote fish culture in peninsular region. The working group felt the need to have centrally sponsored schemes for establishment of hatcheries for seed production of indigenous fish species for ranching. The group also suggested the requirement to preserve riverine/ reservoir habitat where the endemic species are to be ranched.

Replying to a query, Dr. Ponniah said, river ranching would be an ideal solution helping rehabilitation in cases where the organised fishery of a species had already collapsed. Citing case studies of salmon in European waters, he added, the genetic composition of the depleted stock and seed produced for ranching should be identical, preferably both belonging to the same stock.

Working Group - V River Ranching of endangered, endemic species for conservation

Focal theme

- To prioritize endangered species from NBFGR base list for conservation through river ranching
- Constraints identified and action to be taken.

In this group, 15 participants drawn from ICAR institutes, State Fisheries Departments, ZSI, conventional and State Agricultural Universities participated. Prof. M.A. Haniffa, Director, Centre for Aquaculture Research and Education (CARE), St. Xavier's College, Palayamkottai, T.N. was the chairman. The focal themes were discussed and following are the recommendations of the group.

Species Prioritized

The endangered, endemic species needing immediate steps for conservation, identified by the working group included *Gonoproktopterus curmuca, G. kolus, G. dubius, G. dobsoni, G. micropogon periyarensis, G. lithopidos, G. thomassi, Lepidopygopsis typus, Clarias dussumieri, Channa leucopunctatus, Etroplus canarensis, P. bovanicus, Horabagrus brachysoma, Tor mussullah, Neolissocheilus wynaadensis* and *Cirrhinus fulungee*. The group also recommended protection of specialized habitat (wells connected with underwater channels in Kottayam, Kerala) of endemic blind catfish, *Horaglanis krishnai* and streams where *Lepidopygopsis typus* and *Puntius ophicephalu*s are available. The group also felt, special efforts need to be made to collect the adult specimens of the endemic mahseer of Kerala, *Neolissochilus wynaadensis*.

Constraints

Major constraints identified include lack of information on breeding biology of all the species listed above and non-availability of technology to breed these species under captivity. The group felt the urgent need to establish brood stock of these endangered species for captive breeding programmes.

Working Group VI - Data base

Focal theme

- To build database of fish fauna of Western Ghats
- Sources and Type of information required

The working group contained 8 members with Dr. D. Kapoor, Senior Scientist, NBFGR as the chair person .The chairman summarized the suggestions of the working group on database. He explained, the collection source of data of already listed species was from scientific journals, database (ICLARM Database, NBFGR, CIFRI and CIFA), fisheries and forest departments, NGOs and universities. The format to be adopted to record data were also explained, including endemicity, scientific and local names, spatial and temporal distribution and abundance, introduction of exotics, life history parameters, present status, catch statistics, causes of depletion, IUCN categorisation if any, conservation efforts if any, landing figures, marketing and utilisation, culture potential, effect of other species and their interrelationships.

Working Group VII - Biology/ Life history traits of the species - Parameters & Methodology

Focal theme

- To identify parameters & methodology to determine life history traits of the species.
- To list out the species on which biological information is available.

The group consisting of 22 members from conventional and State Agricultural Universities and ICAR institutes was chaired by Dr. V.S.R. Murthy, Head, Demersal Fisheries Division, CMFRI, Cochin.

Parameters

The group identified fecundity, batch fecundity, annual fecundity, size at first maturity, gonadosomatic index, age and growth, length-weight relationship, oocyte-size frequency profile, relative condition factor, food and feeding etc. are crucial areas to be examined for any stock. The chairman of the group, Dr. V.S.R. Murthy reported, members of his group would be able to bring out detailed biological and ecological aspects of *Ompok bimaculatus, Heteropneustes microps (St. Xavier's college) Labeo fimbriatus, Labeo kontius, Puntius pulchellus* (CIFA, Bangalore), *Mystus* sp. (Dr. S.V. Sharma), *Etroplus suratensis* (CIFRI, Alleppey Centre) and *Labeo dussumieri* (Cochin University of Science and Technology, Cochin). Dr. Ponniah suggested the study may be brought out in a general format similar to that of FAO synopsis and said NBFGR would be happy to publish them. He also said, the priority may be given to species endemic to Western Ghats and Peninsular India. He also suggested examining the biological parameters of the different populations of same species from different geographic areas, which would help us know whether there are indications of differentiation of stock. Dr. Murthy suggested NBFGR to arrange a brain storming session of experts in the field of fishery biology to assess validity of growth rings on fish scales as a tool to estimate fish growth.

Working Group VIII - Habitat Inventory & Survey - Parameters & Methodology

Focal theme

- To identify parameters for habitat survey and inventory in streams and rivers originating from Western Ghats.

The working group to determine the parameters for habitat survey and inventory consisted of nine members and Dr. M. Arunachalam, M.S. University, Tirunelveli was the chairman of the group. The parameters to be recorded for habitat survey included stream order, name of stream/river, name of observer, reach length, climate, turbidity and flow rate, maximum/mean depth and length of channel, type of substrate, instream cover, bank stability and erosion, cause of erosion, riparian zone details, slope of habitat and gradient of stream.

For old reservoirs, the group felt the same methodology applied for lakes can be followed and survey of marshy-forested areas, the wetland evaluation technique (WET) developed by Paul Adams & Daniel Smith (1998) can be adopted.

Chemical parameters of water to be analysed for unpolluted upland part of stream/river include dissolved oxygen, electrical conductivity, total hardness, alkalinity and pH. For middle and lower part of stream the parameters for chemical analysis must be based on localized pollution problems, the group recommended.

Working Group IX - Local knowledge, access, benefits

Focal theme

- To understand the type of local knowledge
- To gain access to local knowledge
- Benefits of local knowledge
- Role of NGO's in gaining local knowledge

The working group headed by Dr. Robert B. Grubh, Director of a non-governmental organisation (COSMOS), Nagercoil, Tamil Nadu consisted of seven members from ICAR institutes, Universities and NGOs.

Types of Local knowledge

Local knowledge would be useful in determining the past and present abundance of a particular fish species in a locality when landing figures are not available. It would also be beneficial to understand the medicinal property cultural and religious values if any of a particular species. For example, the golden-yellow coloured mucus of yellow catfish (*Horabagrus* brachysoma) is believed to have antiseptic/wound healing properties and the local fisher-folk in Kerala do not hesitate to apply it on small cuts and bruises for speedy healing.

Access to local knowledge

For collecting such information from local people, the group felt, a carefully prepared detailed questionnaire with the help of social scientists would be beneficial. Such a questionnaire may contain photographs and diagrams of the target species.

Benefits

Local knowledge will be beneficial to science in several ways especially in effective implementation of conservation programmes as well as sustainable utilization of natural resources. The local people would also be benefited if engaged in habitat surveys on payment basis make them feel the essence of participation and involvement.

Role of NGOs

Many NGOs work in close association with local people in interior villages of the country for educational and social upliftment of the poor. They can be engaged in to gather local knowledge from their area of activity.

Working Group X - Region-wise species prioritisation - Kerala

Focal theme

- To prioritise

1) Endemic species for fishery and culture
2) Endangered species for conservation through river ranching, and
3) Endemic ornamental species for aquariculture

- To identify constraints, if any

This group had 20 members from state fisheries department, ICAR institutes, universities, NGOs and local colleges. Prof. B. Madhusoodana Kurup, School of Industrial Fisheries, Cochin University of Science and Technology, Cochin was the chairman. The methodology followed to prioritize species is explained in Appendix I, under the heading " Formation of working groups…".

Prioritisation of species for culture & fishery

The working group prioritized *Labeo dussumieri, Gonoproktopterus curmuca, Horabagrus brachysoma, Tor khudree, Clarias dussumieri, Channa micropeltes, C. leucopunctatus, Labeo ariza, Puntius (Barbodes) carnaticus* and *P. pulchellus* for aquaculture and *Gonoproktopterus kolus, G. periyarensis, Silurus wynaadensis* and *Ompok malabaricus* for culture based fishery.

Conservation of endangered species through river ranching

The species identified under this category included *Tor mussullah, Neolissochilus wynaadensis, Lepidopygopsis typus, Gonoproktopterus thomassi, G. lithopidos*, and *Horabagrus* nigricollaris.

Endemic ornamental species

The ornamental species identified for captive breeding and aquariculture were *Puntius denisonii, P. fasciatus (melanampyx), P. melanostigma, P. filamentosus, P. arulius, Tetraodon travancoricus, Danio malabaricus, Chela dadyburjori, Horabagrus brachysoma, H. nigricollaris, Pristolepis marginata* and all species of *Garra* and *Nemacheilus*.

Constraints

The biggest constraint to standardize breeding technique and popularize the above species is the lack of information on the biology especially on reproduction except of *L. dussumieri*. Hence attempts to study the breeding biology of the above species are to be given top priority. The group also felt the taxonomic ambiguity of *Tor khudree* and *T. khudree malabaricus* from Kerala waters to be settled by taking up detailed investigation using genetic markers. Drastic decline of *Clarias dussumieri* throughout the state and confinement of *Labeo dussumieri* to few rivers in Central Travancore which once enjoyed a wide distribution and occurrence of exotic African catfish *Clarias gariepinus* and transplanted Indian major carps in natural waters of Kerala are alarming, and needing immediate attention, the group felt.

Working Group XI - Region-wise species prioritisation - Karnataka, Maharashtra & Goa

Focal theme

- To prioritise
    1) Endemic species for fishery & culture
    2) Endangered species for conservation through river ranching, and

3) Endemic species for ornamental fish culture

- To identify constraints, if any

In this group 9 representatives from various central and state government agencies and universities held discussions under the chairmanship of Dr. P. Kumaraiah, Peninsular Aquaculutre Division of Central Institute of Freshwater Aquaculture (CIFA), Bangalore. The methodology followed to prioritize species is explained in Appendix I, under the heading " Formation of working groups…".

Prioritisation of species for culture and fishery

The working group identified *Labeo fimbriatus, Puntius pulchellus, P. carnaticus, Tor khudree, Cirrhinus fulungee, C. macrops, Gonoproktopterus micropogon, G. dobsoni, Thynnichthys sandkhol* and *Silonia childreni* for aquaculture and *Gonoproktopterus kolus*, *Tor mussullah, Labeo kawus* and *L. porcellus* for culture-based fishery.

Conservation of endangered species through river ranching

The species prioritised under this category included *Gonoproktopterus thomassi, G. dubius, Labeo potail* and *Etroplus canarensis.*

Endemic ornamental species

Puntius narayani, P. sahyadriensis, P. setnai, Barilius canarensis, B. evezardi, Rasbora cauverii, Botia striata, Pangio goaensis, Nangra itchteea, Labeo potail and all species of *Nemacheilus* were identified as potential ornamental species from the area.

Constraints

As in Kerala, lack of information on reproduction biology of most of these species is the bottleneck to take up captive breeding programmes.

Working Group XII - Region-wise species prioritisation - Tamil Nadu & Andhra Pradesh

Focal theme

- To prioritise
  1) Endemic species for fishery & culture
  2) Endangered species for conservation through river ranching, and
  3) Endemic species for ornamental fish culture
- To identify constraints, if any

Under the chairmanship of Prof. S. V. Sharma, Nagarjuna University, Guntur, this working group had 9 members from various organizations. The methodology followed to prioritize species is explained in Appendix I, under the heading " Formation of working groups…".

Prioritisation of endemic species for culture and fishery

The group prioritized *Cirrhinus cirrhosa, Labeo kontius, Puntius (Barbodes) bovanicus, P. carnaticus, Cirrhinus macrops, Mystus krishnensis, Ompok malabaricus, Gonoproktopterus dubius* and *G. kolus* for culture and culture based fishery.

Endangered species for river ranching

Due to various reasons, all the nine species listed above had declined drastically in natural water bodies and reservoirs of the region, hence they all are treated as endangered and needing conservation efforts.

Potential ornamental species

The aquarium species prioritized from the region include *Puntius fasciatus, P. arulius tambraparniei, P. bimaculatus, Barilius gatensis, Esomus barbatus, Danio neilgiriensis, Mesonoemacheilus triangularis, M. pulchellus, Schistura nilgiriensis, Garra hughi, G. kalakkadensis,* and *Aplocheilus rubrostigma*.

Constraints

Captive breeding technique for almost all the above listed species has to be developed. Biological information is not available for most of the species. Hence efforts are to be made in these lines to propagate them.

Working Group XIII - Sanctuaries

Focal theme

- To finalize criteria to select a water body as a sanctuary
- To list out few water bodies in Western Ghats as potential sanctuaries based on the above criteria

In this group, there were 17 representatives from different organisation and Dr. Robert B. Grubh, Director, COSMOS, Nagercoil, Tamil Nadu was the chairman.

Criteria to select a water body as sanctuary

The first criterion is water bodies harbouring endangered/endemic/rare species and large enough to support viable populations are to be considered as potential sanctuaries. Rivers, streams and large wetlands which are perennial and less disturbed can be the next criterion. The occurrence of endangered/endemic species can be determined from i) already published scientific reports; ii) a re-inventory of area, if needed and; iii) results of afresh survey in an area of high species diversity.

Nomination of sanctuaries

The group identified following areas in Western Ghats as potential fish sanctuaries.

Some of them occur in already established wild life sanctuaries (WLS) and hence offer better protection to fish species.

Potential fish Sanctuaries within already established Wildlife Sanctuaries

1) Moyar River from Pykara to Kalampalayam, T.N.
2) Karimpuzha and Kunthipuzha of Chaliyar River, Kerala
3) Upstream areas of Chalakkudy River, Kerala
4) Aghanashini River in Uttara Kannada, Karnataka
5) Upstreams of Periyar River, Kerala

Proposed Water bodies outside Wildlife Sanctuaries

1) Selected stretches of Vembanad Lake, Kerala
2) Kabani River down to Panamaran, Karnataka.

The group recommended following protection measures in proposed sanctuaries outside WLS to conserve species diversity. These include banning of i) dynamiting, poisoning and electrofishing; ii) fishing using velon screens and mechanized vessels; iii) commercial fishery; and iv) preventing pollutants contaminating these water bodies.

During discussion, Dr. B. Madhusoodana Kurup, CUSAT suggested to identify spawning grounds of endemic / endangered species in each river and protect those areas. Dr. Anna Mercy from Fisheries College, Cochin expressed her view to make provision to declare wells situated above interconnecting sub-terranean channels in Kottayam (harbouring a curious endemic blind catfish, *Horaglanis krishnai*) as sanctuaries. Dr. Ponniah suggested her to make an action plan explaining how to proceed with the concept as the wells are situated in private lands.

Working Group XIV - Prioritisation of Water bodies

Focal theme

- To collect nature and source of information available on water bodies of the area with a view to prepare a database.
- To evaluate present status of habitat fishery of different water bodies (rivers, streams, lakes, reservoirs, water bodies within wild life sanctuaries and others)
- To prepare action plan for integrating studies on habitat and fish germplasm conservation along with culture/captive fishery

The working group headed by Dr. V.S.R. Murthy, Central Marine Fisheries Research Institute, Cochin had 17 participants. However due to time constraint, only the first objective alone was completed during the workshop. It was decided to hold a separate meeting to discuss the other two focal points.

Nature & Source of Information on Water bodies

The discussion began with the need to come to a consensus on the classification of lotic and lentic water system. The group concluded that the former included the river systems consisting of big rivers down to small streams, while the latter consisted of all the flood plain wetlands, lakes, and reservoirs including mini-barrages, ponds and water-logged paddy fields.

With regards to water bodies for identifying their exact geographic range and to classify them into sub-types, it is felt that there is acute lack of authentic and up-to-date information regarding the present water spread area, catchments area and the extent of loss in the water spread area. Taking into consideration the above, the group felt the need for preparation of maps backed by re-surveying the water bodies with the help of remote sensing and supported by ground truth date. Once the up-to-date map of water bodies is available, it will be easy to document the present status.

The working group also felt information on ichtyofaunal composition needs to be compiled for prioritization. This can be obtained by carrying out actual field surveys and also collecting already available information from different sources. The nature and source of information available with following agencies are as follows.

- Anna University, Chennai - On water shed area of Tamil Nadu
- Centre for Water Resources Development & Management (CWRDM), Calicut, Kerala - On all water bodies and river basins of Kerala.
- Kerala State Irrigation Dept. - On all canals and rivers of Kerala.
- Kerala State Land Use Planning Board - Satellite imagery of the entire state.
- Zoological Survey of India (ZSI), Calcutta - state wise list of fishes and survey reports.
- Central Inland Fisheries Research Institute (CIFRI), Barrackpore - Hydrography, flora and fauna of selected reservoirs
- Kerala Forest Research Institute (KFRI), Peechi, Kerala - Riverine fish wealth of Kerala.
- Riverine Section, Ministry of Environ. & Forests, Govt. India - Project reports of riverine habitats.
- PWD of different states. - Dam and reservoir details.
- Ph.D. Theses and Grey literature on Western Ghats from different Universities.
- Persons to be contacted on Western Ghats water bodies:–Drs. E.G. Silas (Cochin), K.C. Jayaram (ZSI, Chennai), A.G.K. Menon (ZSI, Chennai), M. Arunachalam (M. S. University), A. Sreenivasan (Chennai), Prof. Madhyastha (Mangalore University), P.S. Easa & C.P. Shaji (KFRI, Peechi), and V.S.R. Murthy (CMFRI, Cochin).

Directory on Western Ghats

In view of the recommendations from the various working groups, it was decided to bring out a directory on Western Ghats. It will encompass information such as profile of institutes and individuals involved in research on fish fauna and aquatic habitats of Western Ghats; details of on-going and completed projects, doctoral / post-graduate dissertations (completed and on-going) on Western Ghats; and a bibliography. Such a directory is expected to quantify the work on ichthyology carried out in the world famous zone of aquatic hotspot and mega-biodiversity.

Appendix I : Summary of the Workshop Programme

A two-day workshop on *"Germplasm Inventory and Gene banking of Freshwater Fishes of Western Ghats"* was organised by National Bureau of Fish Genetics Resources, Lucknow at Central Marine Fisheries Research Institute, Cochin during 12th and 13th October, 1998, to finalize the priority areas of research on fish germplasm resources and conservation benefiting rich, diverse and endemic fish wealth of Western Ghats.

The main objectives were:

1) Facilitating conservation and sustainable commercial utilisation of endemic freshwater fishes of Western Ghats (covering states of Kerala, Tamil Nadu, Karnataka, Goa and Maharashtra) and developing an overall plan for building bio-diversity database.
2) Identifying strategies and necessary linkages for undertaking conservation programmes in Western Ghats under NATP.

The workshop was attended by 104 participants including Professors, Senior level Scientists, Planners, Officials from State Fisheries Departments, NGOs, exporters of aquarium fishes and research scholars.

Inaugural Session

The workshop was inaugurated by **Dr. E.G. SILAS**, Ex- Vice Chancellor, Kerala Agricultural University and Ex- Director, CMFRI. Welcoming the **Chief Guest, Dr. E. G. Silas**, the **President, Dr. T. J. Pandian**, National Professor, Madurai- Kamaraj University, **Dr. K.C. Jayaram**, the veteran in fish taxonomy, Directors of CMFRI and CIFT and all the participants, **Dr. A. G. Ponniah**, **Director, NBFGR**, said, the scientific and sustainable utilisation of our rich bio-diversity only can improve the living conditions of the common man of India. Expressing his utmost happiness over the overwhelming response to the workshop from different corners, Dr. Ponniah pointed out that the streams and rivers of peninsular India including those originating from Western Ghats, harbour a very rich, varied and endemic aquatic resources, including many cultivable, ornamental and sport fishes. However, the resources are neither properly utilised, nor the potential is fully harnessed, he added. There is also paucity of information in several aspects of the biology of many of these fishes, their present distribution and abundance.

He said, the workshop is oriented towards critical evaluation of present inventory of fish species and building up a database relevant for the sustainable utilization and conservation of freshwater aquatic resources of peninsular India with special reference to Western Ghats. The present workshop is a participatory planning one, where all the participants will have to sit together, interact and contribute towards the goals of workshop, he added. He hoped deliberations of the workshop would also help to update / modify the base list of economically important and ornamental peninsular species (prepared by NBFGR and circulated to participants) and in formulating an action plan for sustainable utilisation and conservation of the listed species. Dr. Ponniah expressed his heartfelt thanks to the Director and staff of CMFRI, Cochin for permitting NBFGR to hold the workshop in their premises.

Inaugurating the workshop, the **Chief Guest, Dr. E.G. Silas, Ex-Vice Chancellor, Kerala Agricultural University and Ex-Director, CMFRI, Cochin** said the country's aquatic ecosystems are facing threats on several fronts. There is an urgent need to revisit the type localities for fish species to document eco-habitat conditions, evaluate the status of species, its population density, area utilisation and its associated communities, he suggested. He also called for updating the database on endangered, vulnerable, endemic, commercially important and ornamental species for initiating conservation activities as well as for developing management plans for aquatic systems on a watershed or basin-wide basis. Dr. Silas, who is also associated with the recently launched National Agricultural Technology Project (NATP) said, the research achievements under NATP would lead to a people /oriented programme with voluntary participation of local people and NGOs networking with research institutes to achieve the goals of sustainable utilisation and conservation of aquatic resources. He congratulated Dr. Ponniah for his initiative to organize a workshop of its kind with the participation of like-minded experts and hoped the deliberations of the workshop will be most fruitful for the ultimate development of NATP sub-project.

In his presidential address, **Dr. T.J. Pandian, National Professor, Madurai Kamaraj University**, said greater emphasis would have to be placed on veterinary and fisheries science in an effort to evolve an effective strategy to meet our future food requirements from diverse sources. Fish Genetics should be given greater importance in the syllabus of courses in the institutions of higher learning, he added. Dr. Pandian pointed out, India and China have a greater responsibility in conservation of aquatic resources because the per capita water availability is less in these countries compared to other parts of the world. The research activities on genetics, sustainable utilization and conservation of aquatic resources are very vital and he urged the research organisations, universities, colleges and NGOs to join and give a helping hand to NBFGR to make the NATP programmes a great success.

Dr. D. Kapoor, Senior Scientist, NBFGR proposed the vote of thanks. On behalf of NBFGR, he lucidly expressed his thankfulness to the Chief Guest- Dr. E .G. Silas, President Dr. T. J. Pandian, dignitaries like Dr. K.C. Jayaram; Dr. Ravindran, Director, CIFT; Dr. Peer-Mohamed, Director-in-charge, CMFRI; Scientists of CMFRI, CIBA, CIFT, CIFRI, CIFA, MPEDA, Professors from Fisheries Colleges, University and College Teachers, Research Scholars of CMFRI, members from NGOs and all delegates for their kind presence and the press and mass-media for their coverage.

Technical Sessions

Theme of the workshop

Dr. A.G. Ponniah, Director, NBFGR in his speech explained the concepts behind the workshop and its expected outputs. He said, the participants will be divided into various thematic and technical groups depending on their expertise and interest in identified topics and chairman of each group will make the final presentation. He pointed out that the workshop would ultimately contribute an action plan, based on which NATP sub-projects will be prepared. In addition to the NATP sub-project, the delegates can prioritise their own external funded research projects based on this action plan, he added. A local area network involving local colleges, communities, NGOs and regional research centers can be expected out come of the workshop would eliminate the chances of duplication of research programmes. Giving the brief overview of NBFGR's mandate, Dr. Ponniah threw light on the concept of Ecological and Evolutionary Significant Units (EESUs) which is to identify distinct genetic units within a species which also differ in their life history traits.. He pointed out the need to build up database at microgeographic level for each EESU along with information on its biology, genetic-profile, habitat, spatial and temporal distribution. Citing selected case studies, he added that such an information on EESU will be of utmost importance for the planning process as well as for genetic management and upgradation programmes. The NATP sub-projects are expected to generate data on EESUs of selected prioritised species and the whole information will be utilized to build-up a database similar to the ICLARM's "Fish base", along with the well-knit local area network.

Formation of working groups and methodology for prioritisation of species and water bodies

The delegates were split into small working groups according to their own expertise, interest and choice. Altogether 14 working groups were formed and each group had a chairman/facilitator, a rapporteur and 8 to 10 members. The groups were:

1) Taxonomic group.
2) Prioritisation of endemic species for aquaculture/culture based fishery

3) Prioritisation of potential ornamental fishes endemic to Western Ghats
4) Repopulating endemic species for food / sport
5) Prioritisation of endangered species endemic to the region for river ranching
6) Data base
7) Parameters and methodology–Biology/ life history traits of species
8) Parameters and methodology–Habitat inventory and survey
9) Local knowledge, access, benefits.
10) Region-wise species prioritisation–Kerala
11) Region-wise species prioritisation – Karnataka, Maharashtra and Goa
12) Region-wise species prioritisation–Tamil Nadu and Andhra Pradesh
13) Sanctuaries
14) Water bodies

For species and region wise prioritisation, the list of species (food and ornamental) prepared by NBFGR (Gopalakrishnan and Ponniah) served as the base material. The members of respective groups were asked to critically examine the list initially, modify, add or delete species, prior to starting the exercise. In order to have a rapid appraisal system of prioritisation and finally to select few species and water bodies for NATP sub-projects, a set of criteria developed by NBFGR was followed. This had several segments; each one fixing an arbitrary value to a species / water body, state–wise. The cumulative figure obtained for each species / water body (streams, rivers, reservoirs, lakes etc) were listed and those which topped the list were considered as candidate ones for NATP sub-projects. Price structure of local species in comparison to Indian Major Carps (IMC) and consumer preference were two major criteria employed in prioritising endemic food fishes. The average price of Indian Major Carps ranged from Rs.40-50/kg, while most of the local species fetched Rs.80-120/kg and the latter had a better acceptance by consumers. The only advantage IMCs have is their fast growth rate in comparison to their Western Ghat relatives and standardized aquaculture techniques. The other criteria for species prioritisation included segments like maximum size, seed production technique, difficulty in larval rearing; shape / colour / beauty (for ornamental species); conservation status and endemicity (for endangered varieties).

The working group for biological parameters decided life-history traits to be studied for the selected species. Similarly, hydrological parameters for habitat and survey were selected by the respective working group. Taxonomic ambiguities if any concerned with the species in NBFGR-base list were resolved by the taxonomic group headed by eminent taxonomist Dr. K.C. Jayaram. Information on medicinal / cultural / tribal/ religious values aiding in prioritisation of species were accounted by the local knowledge working group.

The working groups followed a rigourous exercise, carefully prioritising species;

identifying technical and hydrological parameters to be considered for habitat / biological studies and arriving at consensus regarding the taxonomic disputes of selected species. In order to assess the progress, clarify the doubts and to reach an agreement of opinion within each working group, periodic meetings of plenary were also held. The process continued till 9.00 pm on 12th October and concluded in the late evening of 13th October. Prior to finalisation, the list of selected species, water bodies, hydrological and biological parameters and scientific and technical requirements were presented by the facilitator of respective working group to all the participants and detailed discussions were held.

Valedictory function

The valedictory function was chaired by **Dr. E.G. Silas**, Ex-Vice Chancellor, Kerala Agricultural University. In his address, he hoped, recommendations of the workshop would facilitate saving many peninsular endemic fish fauna from becoming endangered and even extinct, if timely action is taken by NBFGR and other organizations. The NATP sub-projects based on the workshop recommendations would help to develop and propagate culture practices of endemic food fishes like *Gonoproktopterus curmuca, Labeo dussumieri, Clarias dussumieri, Horabagrus brachysoma* and several ornamental species, he contemplated. **Dr. A.G. Ponniah** stressed the fact, that the list of prioritized species, water bodies and scientific requirements were the out come of the group process of participants of NBFGR-NATP workshop. He pointed out that joint programmes will be taken up between NBFGR and selected institutions, based on the recommendations of the workshop. On behalf of NBFGR, he profusely thanked all the delegates; Director, staff and scholars of CMFRI, Cochin for making the workshop, highly productive and successful.

Appendix II : Working Group Members

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1) Dr. K.C. Jayaram (Chairman)
2) Dr. M.B. Raghunathan
3) Dr. K.C. Gopi
4) Dr. M.M. Shirdhankar
5) Dr. A. Gopalakrishnan
6) Dr. Prathibha Rohit
7) Ms. Anuradha Bhat
8) Dr. P. Laxmilatha
9) Mr. A. Sankaranarayanan

Working Group II – Prioritization of endemic species for aquaculture

1) Dr. P. Keshavanath (Chairman)
2) Dr. N. Basavaraja
3) Dr. P. Kumaraiah
4) Dr. N.M. Chakraborty
5) Dr. K. Raman
6) Dr. M. Peter Marian
7) Dr. S. Godwin Wesley
8) Dr. S. Mercy
9) Dr. Prathibha Rohit
10) Dr. P. Laxmilatha
11) Dr. A. Gopalakrishnan

Working Group III – Prioritization of potential Ornamental species endemic to Western Ghats

1) Dr. R.J. Ranjit Daniels (Chairman)
2) Dr. S.R. Sane
3) Dr. Elizabeth Joseph
4) Dr. C.P.Shaji
5) Dr. T.V. Anna Mercy
6) Dr. V.K. Dey
7) Mr. Eapen Zachariah
8) Mr. K.R. Pushpangadan
9) Dr. P. Subramanian
10) Dr. S.N. Satyanarayanappa
11) Mr. R. Soranam
12) Mr. Archis R. Grubh
13) Dr. R.A Mote
14) Mr. V.S. Basheer
15) Dr. A. Gopalakrishnan

Working Group IV – Repopulating of endemic food/ sport species

1) Dr. K.G. Padmakumar (Chairman)
2) Dr. N. Basavaraja
3) Mr. K. Thankappan
4) Mr. T.D. Velayudhan
5) Mr. K. Prasadachandran Pillai
6) Dr. D.M. Abdul Hameed
7) Dr. M. Peer Mohammed
8) Dr. B. Madhusoodana Kurup
9) Dr. Anuradha Krishnan
10) Dr. V. K. Unnithan
11) Dr. C.M. Aravindan
12) Dr. U.K. Sarkar
13) Dr. C.P. Shaji

Working Group V – River Ranching of endangered, endemic species for conservation

1) Prof. M.A. Haniffa(Chairman)
2) Dr. K.C. Jayaram
3) Prof. S.V. Sharma
4) Dr. N. Basavaraja
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9) Dr. J. Anthony Johnson
10) Dr. T.V. Anna Mercy
11) Mr. A. Sankaranarayanan
12) Mr. A. Manimekalan
13) Dr. P.C. Thomas
14) Ms. P.N. Shanti
15) Mr. G. Venkatasamy

Working Group VI – Data base

1) Dr. D. Kapoor (Chairman)
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3) Dr. P. Keshavanath
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Working Group VII – Biology/ Life history traits of the species

1) Dr. V.S.R. Murthy (Chairman)
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15) Dr. P. Laxmilatha
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19) Mr. S. Sridhar
20) Mr. C. Vijayakumar
21) Dr. C. Balasundaram
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Working Group VIII – Habitat Inventory and Survey

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4) Dr. R.S. Lal Mohan
5) Mr. Shaju Thomas
6) Ms. Sasikala K. Joseph
7) Ms. Mini Santhosh Lal
8) Mr. A Manimekalan
9) Dr. B.E. Yadav

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3) Mr. Archis R. Grubh
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4) Dr. V.S. Basheer, Scientist, NBFGR, Lucknow, U.P., India
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Appendix V : National Agricultural Technology Project (NATP)

Western Ghats and North East of India are identified as Bio-diversity hotspots. To identify the fish germplasm of the area and conserve the same, this project is formulated. The details of the on going **NATP** project are given below:

1.	Title of the Project	:	**Germplam Inventory, Evaluation and Gene Banking of Freshwater Fishes.**
2.	Objectives	:	I) **Germplam and habitat inventory** Survey of bio-diversity rich regions of Western Ghats and North East India with a view to document the distribution and present status of aquatic bio-diversity with special reference to economically important, endangered and endemic species.
			II) **Biological characterization and captive breeding of prioritized species** To carry out biological characterization of prioritized species and captive breeding of endemic, endangered and potential ornamental species
			III) **Genetic characterization of prioritized species** To genetically characterize different populations of prioritized species
			IV) **Gene banking of prioritized species** To collect and maintain germplasm in gene bank from natural population of prioritised species.
3.	Date of the start of the project	:	Sanction letter dated, 23rd Dec. 1999 (Letter no. F. No. 27 (28)/98/NATP/MM-III-18)
4.	Name of the Mission Leader		**Dr. A.G. Ponniah**
5.	Name of Principal Investigator	:	**Dr. S.P. Singh**
6.	Project duration	:	**Four years**
7.	Budget allocation	:	**Rs. 487.6966 lakhs**
8.	Name of lead centre	:	**National Bureau of Fish Genetic Resources (NBFGR), Lucknow – 226 002, U.P.**

9.	**Name of Investigators from NBFGR**		
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	2. Dr. Vindhya Mohindra Sr. Scientist	:	Genetic Characterization
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Appendix – VI : References (for Parts II, III and IV)

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