

# **DATABASE ON COASTAL INFORMATION OF TAMILNADU**

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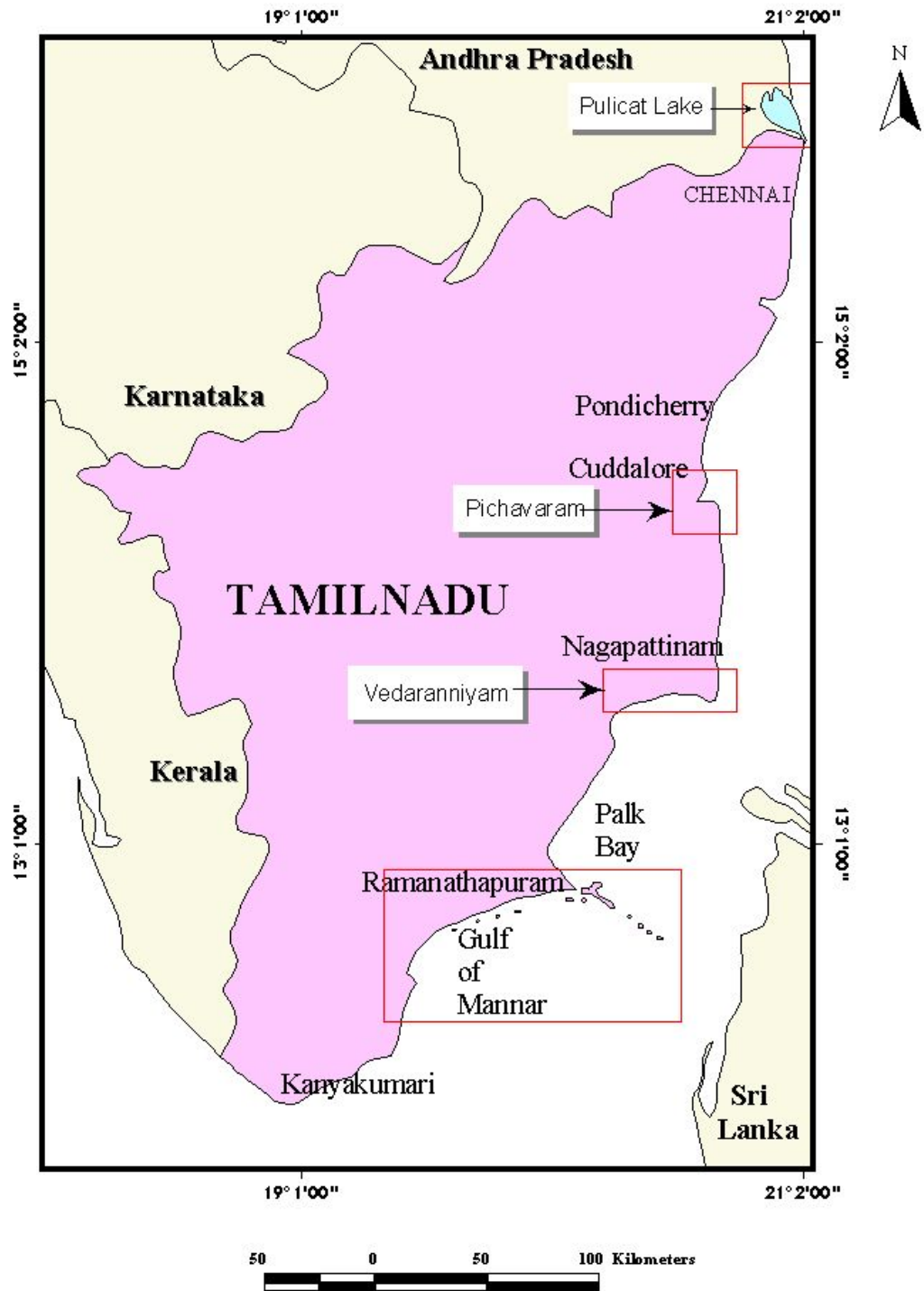
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# **1. Ecological Important Coastal Areas of Tamilnadu**

**Fig 1.1 Ecologically Important Areas in Tamilnadu**



## **Introduction:**

Coastal zone is a dynamic area with many cyclic processes owing to a variety of resources and habitats. Coastal plains and seas include the most taxonomically rich and productive ecosystems on the earth. Mangroves forests are over 20 times more productive than the average open ocean. Estuaries, salt marshes and coral reefs are 5 to 15 times higher and shelf seas and upwelling zones 2 to 5 times higher. These enhanced rates of primary production result in an abundance of other life forms including species of commercial importance. Although occupying only 8% of the total surface, ecologically important areas account for 20-25% of global plant growth.

Tamilnadu is the southern most state in India, flanked by Andhra Pradesh, Karnataka on the north / north west; Indian Ocean on the south; Kerala on the west and Bay of Bengal on the east. The coastline of Tamilnadu has a length of about 1076kms (Table 1.1), constitutes about a 15% of the total coastal length of India and stretches along Bay of Bengal, Arabian Sea and Indian Ocean.

**Table 1.1. Coastal length of Tamilnadu**

No.	Coastal district	Coastal length (Km)
1.	Chennai	19.0
2.	Thiruvallur	27.9
3.	Villupuram	40.7
4.	Pudukottai	42.8
5.	Thanjavur	45.1
6.	Thiruvarur	47.2
7.	Tirunelveli	48.9
8.	Cuddalore	57.5
9.	Kanyakumari	71.5
10.	Kanchipuram	87.2
11.	Tuticorin	163.5
12.	Nagapattinam	187.9
13.	Ramanthapuram	236.8
	Total	1076.0

Ports, fishing harbours and a variety of coastal industries like nuclear thermal power plants, refineries, fertilizer, marine chemicals are situated on the coast. Chennai is the

capital of Tamilnadu, an important coastal and mega metropolitan city of India having a major port and many coastal industries.

**Importance of Coastal Regulation Zone (CRZ):**

The coastal region is a place of hectic human activity owing to urbanization and industrialization resulting in human interference of rapid development. In recent years, the coastal ecosystems are highly disturbed and very much threatened, encountering problems like pollution, siltation, erosion, flooding, salt water intrusion, storm surges etc. Realizing the importance of the coastal ecosystems, Coastal Regulation Zone notification was issued in 1991 and the coastal areas have been classified into four categories (CRZ I, II, III and IV). The ecologically sensitive areas are included under CRZ-I, where no activity is allowed.

Efforts were taken to collect all the details pertaining to the ecologically sensitive areas (EIA) along the Tamilnadu coast (Table 1.2. and Fig 1.1.)

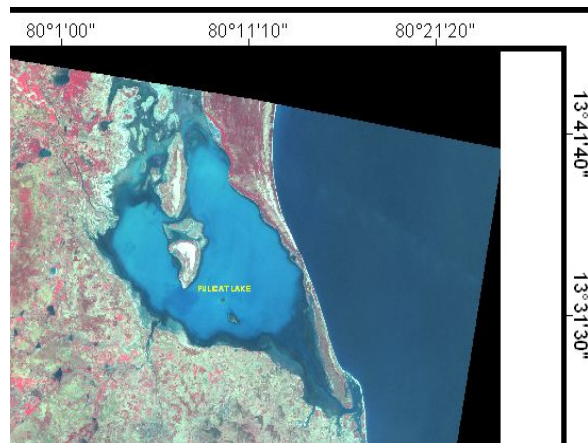
**Table 1.2 Ecologically important coastal areas along Tamilnadu coast**

Identified area	Districts			
	Thiruvallur	Cuddalore	Nagapattinam	Ramnad
	Pulicat lake	Pichavaram	Vedaranyam Muthupettai	Gulf of Mannar (21 islands)
Ecologically sensitive for	Lagoon	Mangroves	Mangroves	Coral reefs
Location	13°26'–13°43'N 80°03'–80°18'E	11°24'–11°27'N 79°46'–79°48'E	10°15'–10°35'N 79°20'–79°55'E	78°5'–79°3'E 8°45'–9°25'N
Area (km <sup>2</sup> )	252.04	10.61	24.53	63.22

**1.1. Ecologically Sensitive Area – Pulicat Lake:**

Pulicat lake is the second largest brackishwater lake in India and is located between 13°26' and 13°43'N latitude and 80°03' and 80°18'E longitudes. The dried parts of the lagoon extend up to 13° 60' N latitude. It opens into the Bay of Bengal through the south-eastern margin near the Pulicat town which is located 40 km north of Chennai city. Pulicat lake is lying almost parallel to the Bay of Bengal. The Pulicat lake is extending over the Ponneri and Gummidipundi taluk of Thiruvallur district in

Tamilnadu and Sulurpet and Tada Mandals of Nellore district in Andhra Pradesh and covers an area of about 461 km<sup>2</sup>. The lake extends to about 59km from north to south direction with a maximum width of 19 km in east - west direction in the northern sector of the lake. The narrowest region of the lake is near Pazhaverkadu (Pulicat) village measuring about 250m with a narrow channel part. The average depth of the lake is about 1.5m and the minimum and maximum depth varies between 0.5 to 6.0m respectively. The location of the Pulicat lagoon has been shown in Fig.1.2.



**Fig. 1.2. Aerial view of Pulicat Lake**

The hydrodynamic characteristics of the lake are restricted to lagoon-ocean water exchange and seasonal positional switching of the entrance channel. Within the lagoon sediment may be transported by wind-induced waves and currents directed predominantly towards the northeast and west direction. The evaporation rate exceeds precipitation and runoff.

Comparing with the past data, the total water spread area of the Pulicat Lake in 1700 AD is around 481km<sup>2</sup>, but the present area is only 281km<sup>2</sup>. It shows that the lake area is shrinking by 200km<sup>2</sup> in 300 years. Tidal fluctuation within the lake is 0.6m. The comparative analysis of depth data also shows the depth reduction by 2.5m in 300 years. The shrinking of area is mostly in the north.

**Tidal dynamics of Pulicat Lake:**

Sediments have been carried into the lagoons by tidal currents, river discharges and by winds. Deposits in lagoons also include materials of organic origin such as shells, guano and peat and in arid regions chemically precipitated salt, calcite and dolomite. The coastal geomorphology and the man made structures like breakwater intercepting the coastal processes (long shore currents) largely influence the mouth of the Pulicat lake tidal inlet. The observations reveal that the entire zone is prone to accretion. At the southern side of the mouth, it is around 40m during 1999 to 2001.

Tidal inlet of Pulicat Lake was closed from April 2001 due to failure of monsoon during preceding years, accretion at mouth by the long shore sediment transport, reduced fresh water flow in the Pulicat Lake system, weak tidal currents, not strong enough to keep the sand out of the inlet. After November, the mouth opened due to increased runoff and it is migrating at a fast rate towards north. Long term changes in the inlet dynamics were monitored using remote sensing, GPS and GIS techniques. Three Inlets were present during 2000 survey while during 2001 inlet channel was completely closed causing inconvenience to the fishermen community. During April, 2002 only one inlet was present which was opened during November 2001. The above observations clearly indicate the dynamics of tidal inlet and its impacts.

### **Ecologically Sensitive Ecosystems**

Pulicat lake is a rich natural but at the same time is very fragile ecosystem. This lagoon provides nursery and breeding grounds for many species of marine fauna and supports commercial fishing with major fish landing centers at Pulicat and Arambakkam.

The flora and fauna of the lake ecosystem are changing both quantitatively and qualitatively, mainly due to the natural process, especially reduction in depth and in water spread area. The anthropogenic influences like over exploitation of resources, land use changes and alteration of the habitats are also influencing the ecosystem to a minor extent. Major biological resources and their spatial and temporal distribution in the lake have been described in Table 1.3.



**Table 1.3 Major biological resources of Pulicat lake ecosystem**

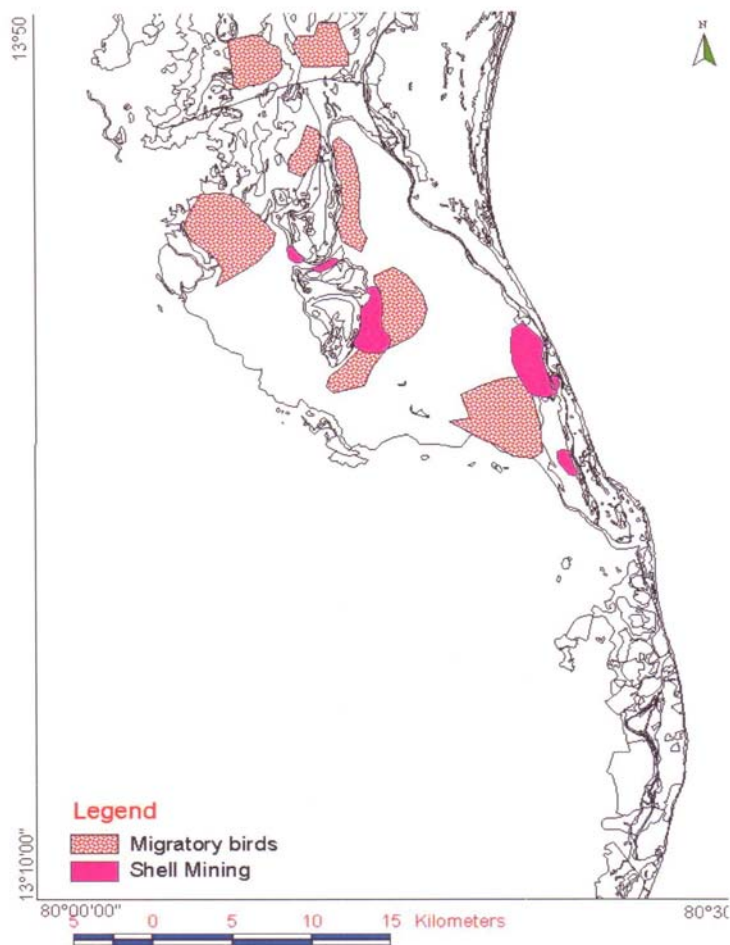
Resource	1960 (species No.)	1980 (species No.)	2000 (species No.)
Phytoplankton	43	30	49
Macro algae	16	8	12
Zooplankton	31	44	31
Benthos	--	--	57
Macrofauna	43	28	26
Fishes	50	13	39
Birds	--	--	115

### **Waterfowl Population**

Birds are the important components in the Pulicat Lake ecosystem and this lagoon area has been announced as a RAMSAR site. Around 1,10,000 migratory birds and local birds are depending on the lake ecosystem. The important migratory waterfowls are pelicans, herons, egrets, storks, flamingos, ducks, shorebirds, gulls and terns. Pulicat is the third most important wetland for migratory bird population along the eastern seaboard of India and is especially important during the spring and autumn migratory seasons. Around 120 species of birds have been recorded so far from this area at various seasons and periods.

Bird population is higher at the center of the lagoon where the benthic animal composition and algal biomass is higher. The north western side of the lake has comparatively less number of birds due to the siltation at the lake bottom and reduced benthic biomass. Bird population is generally higher at the southern side of the lake, which possess the dense, and diverse algal mat, which is the feeding and sheltering ground for the nurseries.

Important locations of migratory birds are shown in Fig.1.3. Local people and forest officers of the sanctuary have informed that the migratory bird population arrival to this sanctuary has been increasing for the past 10 years. It might be due to increasing wetland area and the laws and legislations implemented by the sanctuary authority in recent years. The Government of Andhra Pradesh has declared it as a Bird Sanctuary and banned the shell mining activity in and around the lake.



**Fig 1.3. Location of site for (a) Migratory birds and (b) Shell mining activities in Pulicat Lake**

### **Fishery of Pulicat lake ecosystem**

The Pulicat town is a major fish landing centre. Fishing and boat making are the main occupation of the traditional fishing community living around this lake. There are

around 20 villages near the bar mouth region on the landwards side. Major villages are Pulicat, Kottaikuppam, Jameelabath, Annamalaichery and Avirivakkam.

People own their own catamaran and mechanized boats for their fishing activity. The data on fishery show the reduction of annual catch from the lake from 2562 tons in 1951 to 1120 tons 1999. About 39 species of fishes were recorded so far from this area (IOM,2000). Of this, 30 species are common species. The main reason for the changes is depth reduction, selective fishing and reduction in fresh water flow and changes in water quality.

Of the fin-fishes captured, mullets are the dominant species. Other important fishes includes *Sardinella sp.*, *Hilisa keele.*, *Chanos chanos*, *Plotosus canius*, *Liza parsia*, *Mugil cephalus*, *Hemiramphus far*, *Platycephalus indicus*, *Lates calcarifer.*, *Epinephelus tauvina*, *Sillago sihama*, *Caranx sem*, *Leiognathus daura*, *Lutjanus sp*, *Gerres sp.*, *Siganus javus* and *Tricanthus sp*. The larvae and young ones of these fishes are dense in the lake or canal connecting the lake.

### **Crab fishery**

It is another important commercial resource exploited from the Pulicat lake. Around 150 tons/year of crabs have been harvested from this lake. Eight species of crab have been recorded in this lake. Of this, mud crab *Scylla serrata* is the most dominant species in crab fishery, which have high demand in international market. *Portunus pelagicus* has been recorded around the mouth region of the lake. The crab capture is higher at the central part of the lagoon compared with the other regions of the lake. Algal mat is the suitable feeding and nursery ground for crabs. Suspended sediment concentration plays a major role in distribution and diversity of the crabs through affecting its physiology and larval dispersal.

### **Shrimp fishery**

Shrimps are the most important economic resource for the fishermen community living around this lake. It is estimated that around 1232 kg of shrimps (>10gm in weight) has been captured every day from the Pulicat lake. Six species of shrimps are recorded in this area. The dominant composition is *Penaeus monodon*, *P.indicus*, and

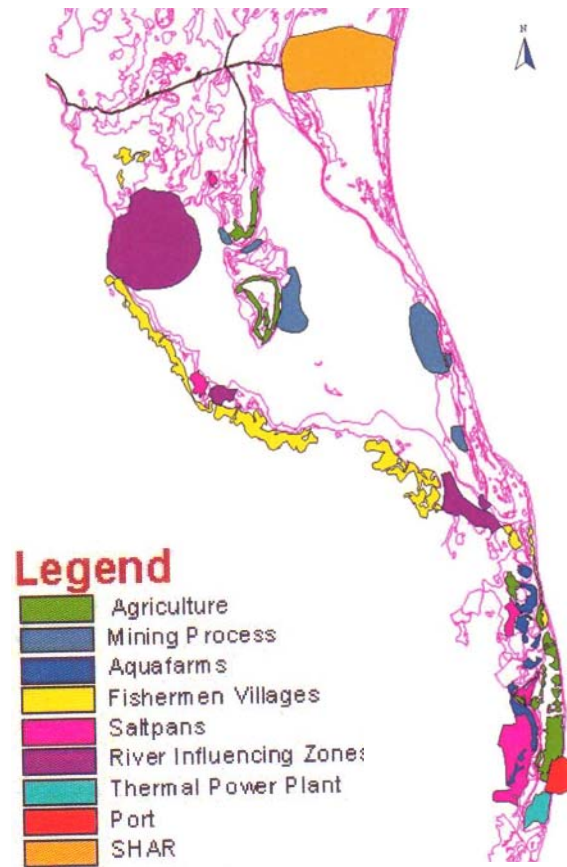
*P.semisulcatus*. Shrimps are more in numbers at the central side of the lake due to the organic rich mud, regular tidal flushing and the algal bed.

### **Padu system**

Fishermen practice 'Padu system' of fishing in the lake region. In this system, the individual villages are fixed for a particular area of operation inside the lake and duration of their activity is also restricted. This gives all the villagers equal amount of share on the resources available from the lake.

### **Aquaculture**

Aqua farms are active after 1990 after changing the agricultural practices in the channel part present in the southern side of the Pulicat lake. Both semi-intensive and intensive type of farming has taken place in this area. The nutrient concentrations in the waters near the farms are not changed due to aquaculture activity. If this activity continues in the present rate and more farms are added in this zone, then the water quality will be affected by the excessive nutrient load and eutrophication along the channel. The various activities in the lake are shown in the Figure 1.4.



**Fig 1.4. Activities zones of Pulicat Lake**

**1.2. Ecologically Sensitive Area – Pichavaram:**

The Pichavaram mangrove (11°24'-11°27'N and 79°46'-79°48') is situated about 240km south of Chennai and about 45km south of Cuddalore. It is located between the Vellar river in the north, the Coleroon in the south and the Uppanar in the west. It consists of number of small and large islets surrounded by numerous creeks, canals and channels. The various wetlands of Pichavaram are given in the Table 1.4. and Fig 1.5.

**Table.1.4. Ecologically sensitive areas - Pichavaram**

Wetlands	Areal extent (km <sup>2</sup> )
Mangroves	8.79
Mangroves with scrub	1.82
Tidal flats	1.44

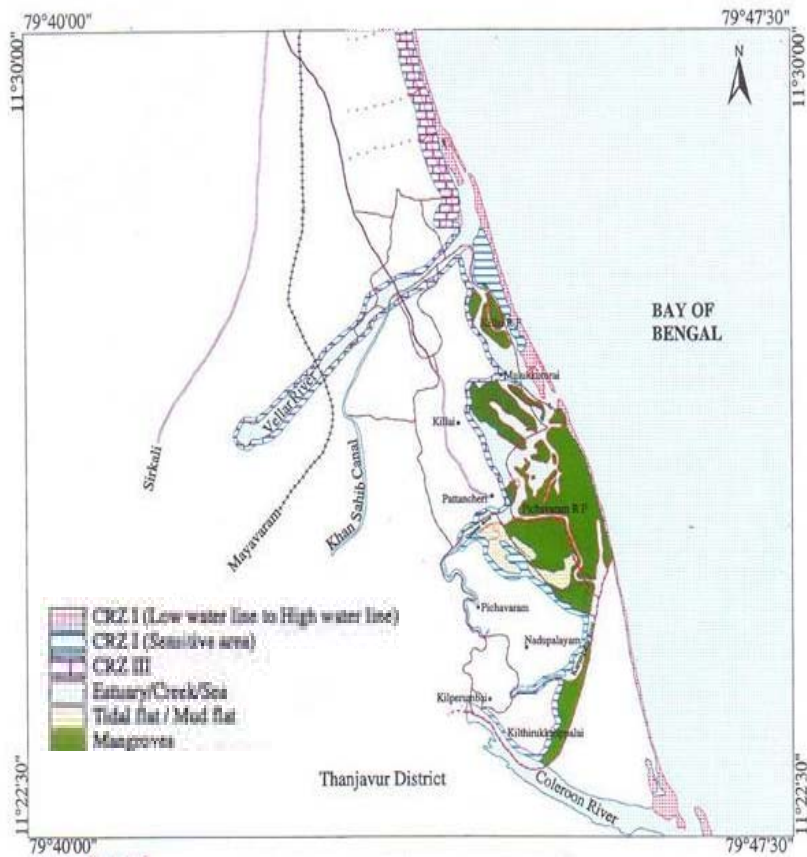
### **Mangrove ecosystem:**

Mangroves of Pichavaram can be classified under six zones.

Zone I: *Avicennia marina* is dominant and shrubby where soil is sandy mud. Besides, *Halophytes*, *Salicornia brachiata*, *Suaeda maritime*, *Sesuvium portulacastrum*, *Arthrocnemum indicum* and *Excoecaria agallocha* are also found. *Boerhavia diffusa*, *Clerodendron inerme*, *Croton sp.*, *Eragrostis sp.*, *Geniosporum tenuiflorum*, *Ipomea pascaprae*, *Molluga pentaphylla*, *Oldenlandia umbellata*, *Opuntia sp.*, *Phylla nodiflora*, *Spinifex littoreus*, *Thespesia populnea* and *Vernonia cinerea* are seen in heaped soils. All the plants represented in this zone do not exceed 0.5m in height.

Zone II: This zone includes the banks of three creeks lying parallel to the sea shore. These banks show gradation of floristic components from shoreline inwards.

The eastern bank of the first creek show three belts. The fringe of the shoreward belt is almost barren, the middle belt is dominated by *Salicornia brachiata* and the inner belt is occupied by *Avicennia marina*.



**Fig.1.5. Ecological important areas in Pichavaram**

The eastern bank of the second creek also presents three belts. The shoreward belt is colonized by *Salicornia brachiata* and *Avicennia marina*. The middle one is occupied by *Salicornia brachiata* and the inner belt shows both *Salicornia brachiata* and *Avicennia marina*.

The western bank of the third creek presents barren sand and has terrestrial vegetation. *Arthrocnemum indicum* occurs in patches in this zone.

Zone III: Luxuriant mangrove vegetation exists in this zone with maximum number of species of mangroves. The channels are bordered by *Rhizophora apiculata* and *Rhizophora stylosa*. Immediately behind the *Rhizophora* communities, *Bruguiera cylindrica* and *Ceriops decandra* are common in shrubby habit. *Excoercia agallocha* also occurs.

Zone IV: This fresh water zone is generally dominated by *Acanthus ilicifolius*. The vegetation on the two banks of Thiruvasadai freshwater channel varies considerably. The northern bank is dominated by *Acanthus ilicifolius* along with a few representatives of *Dalbergia spinosa* and *Deris heterophila*. On the southern bank, there is sporadic occurrence of high *Avicennia officinalis* trees with mixed communities of *Arthrocnemum indicum*, *Excoecaria agallocha*, *Lumnitzera racemosa*, *Suaeda brachiata* and *Suaeda maritima*.

Zone V: The western bank of the channel is rich with *Suaeda maritima* which occupies 3km<sup>2</sup> giving a salt-marsh appearance along with *Salicornia brachiata*. This area is elevated with a vast intertidal area and with lesser number of gullies. The soil texture is silty mud. On the eastern side of the channel towards the sea shore *Casuarina equisetifolia* is under large cultivation.

Zone VI: This zone exists nearly to the Coleroon estuary. The channel on the landward side is occupied by *Salicornia brachiata* and on the seaward side by *Avicennia marina*. Sand heaps are also noticed with *Pandanus* sp.

#### **Endangered and vulnerable status of species**

Two mangroves i.e. *Kandelia candel* and *Bruguiera gymnorrhiza* recorded in this area, have become extinct in 19<sup>th</sup> century and *Xylocarpus granatum* is facing extinction. One rare species i.e. *Rhizophora lamarckii* is reported to be nearing extinction. Among the 14 species recorded, IUCN has categorized 10 species as ‘Endangered’ and 3 as ‘Vulnerable’ and 1 as ‘Lower risk near threatened’ (Table 1.5.).

**Table 1.5. Endangered and vulnerable mangroves of Pichavaram**

No.	Name	IUCN status
1.	<i>Aegiceros corniculatum</i>	Endangered
2.	<i>Acanthus ilicifolius</i>	Endangered
3.	<i>Avicennia marina</i>	Endangered
4.	<i>Avicennia officinalis</i>	Endangered
5.	<i>Bruguiera cylindrical</i>	Endangered



No.	Name	IUCN status
6.	<i>Ceriops decandra</i>	Endangered
7.	<i>Lumnitzera racemosa</i>	Endangered
8.	<i>Rhizophora apiculata</i>	Endangered
9.	<i>Suaeda maritime</i>	Endangered
10.	<i>Suaeda monica</i>	Endangered

11.	<i>Anthrocnemum indicum</i>	Vulnerable
12.	<i>Excoecaria agallocha</i>	Vulnerable
13.	<i>Rhizophora mucronata</i>	Vulnerable
14.	<i>Salicornia brachiata</i>	Lower risk nearly threatened

The mudskipper fish, *Boleophthalmus boddarti* belonging to the family *Gobiidae* is reported as vulnerable species.

### **Biodiversity**

Pichavaram has a great wealth of biological diversity in mangrove ecosystem. The aquatic floral community such as sea weeds (*Enteromorpha*, *Cladophora*, *Chaetomorpha*, *Padina*, *Gracilaria* and *Hypnea*) and seagrasses (*Halophila*) occur in this ecosystem. The mangroves are distributed in varying degrees of abundance in which *Avicennia* is the most common species followed by *Rhizophora apiculata*, *Rhizophora mucronata*, *Bruguiera cylindrica* and *Aegiceros corniculatum*.

The mangroves support oysters like *Crassostrea madrasensis*, *Crassostrea gyrophoides*, *Crassostrea discoidea* and *Saccostrea cucullata*. Commercially important crustaceans like *Macrobrachium malcomsonii*, *Penaeus indicus*, *P.monodon* and *Scylla serrata* are commonly available species. The marine turtle – Olive Ridley – *Lepidochelys olivacea* has also been reported here.

Pichavaram is an important habitat for a variety of resident and migratory waterfowls and other birds. About 200 species of birds have been recorded. Among those *Egretta*

*garzetta*, *Egretta intermedia*, *Nycticorax nycticorax*, *himantopus himantopus*, *Anatomus oscitans* etc are notable.

The common mammals seen in this area include the Otter – *Lutra lutra* and Jackal – *Canis aureus*.

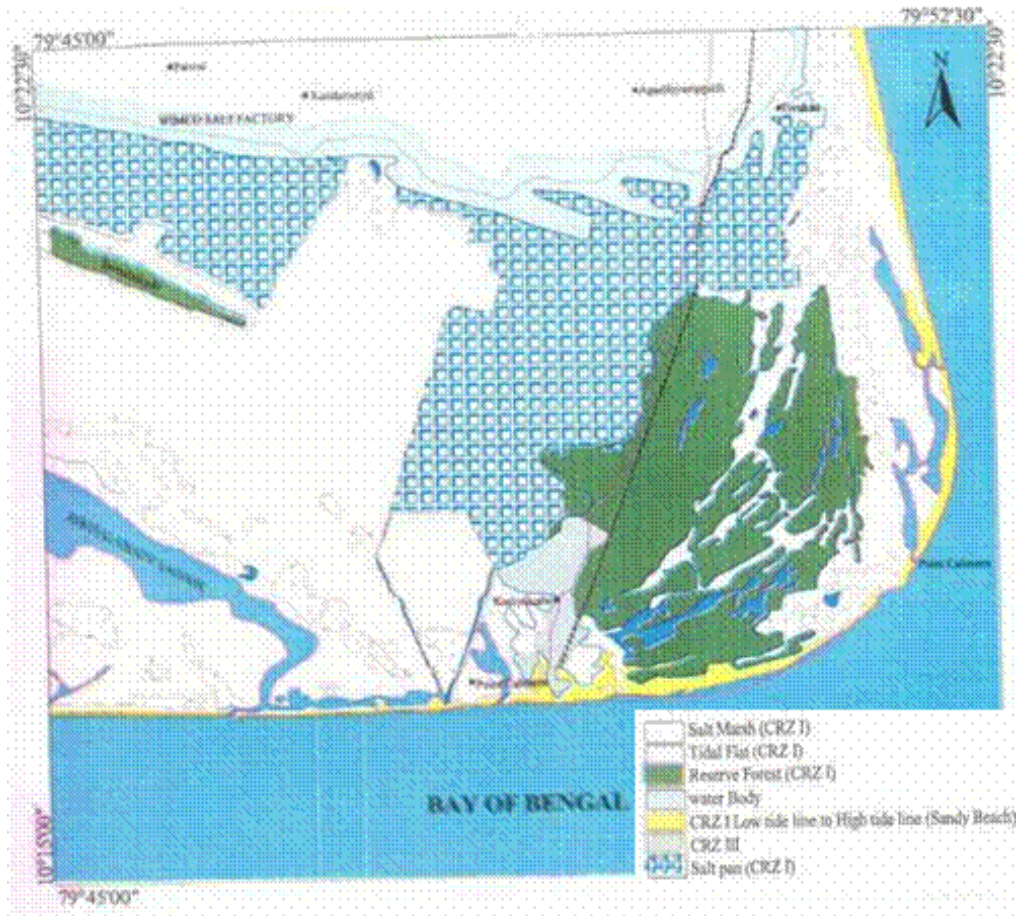
The Pichavaram mangroves show the great potential for fishery source. Shrimps constitute bulk (81.1%) of total fisheries. Of these *Metapenaeus monoceros* (29.5%), *Penaeus indicus* (17.6%) and *Metapenaeus dobsoni* (17.4%) are worth mentioning. The crab fishery is dominated by *Scylla serrata* and *Portunus pelagicus* contributing 4.1% of the total catch. Fishes contribute 7.1% of the total annual landings mainly by Mulletts (*Mugil cephalus*, *Liza dussumieri*, *Liza macrolepis*, *Liza tade* and *Osteomugil speigleri*).

### 1.3. Ecological sensitive areas – Vedaranyam

It is one of the coastal blocks in Thanjavur district. It falls within the co-ordinates of 10°15'-10°22'N and 79°45'–79°52'E (Fig 1.6.). Vedaranyam is one of the six major Wildlife Sanctuaries and also an important coastal wetland in Tamilnadu. Different wetland categories in Vedaranyam and their areal extent are shown in the Table.1.6. It has a tropical climate and the average temperature is 27°C. The total annual rainfall varies from 1000 to 1500mm with a dry period of 5-6 months.

**Table 1.6 Ecological sensitive areas of Vedaranyam**

Wetlands	Areal extent (km <sup>2</sup> )
Tidal flats	97.95
Salt pans	34.70
Mangroves	24.53
Salt marshes	24.53
Reserves forests	19.58



**Fig.1.6 Ecological sensitive areas – Vedaranyam**

**Bird sanctuary:**

Vedaranyam is one of the major wintering grounds for migratory birds from North India, Europe, Asia and Africa. The number of reservoirs formed here for making salt, serve as feeding grounds for the migratory birds and to the resident bird population. These swamps host around 240 species of birds out of which 48% is aquatic and the rest is terrestrial. November to January is the peak migratory period.

Every year, thousands of migratory waterfowls visit this area. The migrants include Garganey, Teals, Shovellers, Whistling teals, Caspian terns, Godwits, Golden Plovers, Reef Heron, Whimbrels and red necked Phalaropes. During spring, the trees and

shrubs attract frugivorous birds like Koels, Mynas and Barbets. As winter sets in, many insectivorous birds are attracted by the abundance of insects. During the season of migration, the long legged and small wanderers, flamingoes, grey herons, purple herons, reef herons, egrets, spoon bills and painted storks are seen in the reservoirs. Long distant migrants include *Calidris minuta*, *Calidris restacea* and *Charadris mongolus*.

In addition, Cormorants, Darter black Kite, Booted hawk-eagle, short toed eagle and ringed Plovers are also seen in this sanctuary. Various types of gulls like Herring gull, Brown headed gull, Black backed gull are common here. This sanctuary includes reptiles like monitor lizard, chameleon, tortoises, cobras, saw scaled vipers, green vipers, olive ridley turtles.

The mammals found in Vedaranyam are Black buck, Spotted deer, Wild boar, Ponies, black napped Hare, Bonnet Macaque, Civet cat, Jungle cat, Mongoose etc.

**Threats:**

Only a small part of the sanctuary is protected and most of the important wetlands are unprotected. Hence this area has been proposed as to include “wetland of international importance” under RAMSAR convention. This area is one of the most vulnerable sites affected by cyclonic storms which cause great damage to the ecosystem due to flooding and siltation.

The other problem is deforestation due to felling of trees for firewood requirement of the local people. The deforestation leads to soil erosion and degradation. According to a survey (IOM, 2001) more than 40% of the mangrove forests have been removed between 1976 and 1989. This also reflected in the decreased fish catch as it increased coastal erosion and decreased the supply of nutrients to the sea thus affecting the fish catch in this area. About 66% of the dense marsh vegetation has been degraded. Around 32% of salt pan area has been increased at the expense of mangrove forests. The salt affected area has also increased to about 4.5 times due to drying up of mud flats and expansion of salt pans.

#### 1.4. Ecological Sensitive area – Muthupet

Muthupet mangrove swamp is in close association with the coastal wetlands of Vedaranyam spreading an area of approximately 6,800ha. out of which 77.20 ha. is occupied by well grown mangrove and the remaining area is covered by poorly grown mangroves (Fig.1.7). Mangrove zone of the forest is restricted to the edges of the brackishwater lagoon where the true mangrove species are distributed in varying degree of abundance. *Avicennia marina* is the most common and abundant species followed by *Exoceria agallocha*, *Aegicerus corniculatum*, *Acanthus ilicifolius*, *Suaeda maritima* and *Suaeda monica*. According to a survey (IOM, 2001), about 87km<sup>2</sup> of total mangrove forest have been degraded in Muthupet between 1989 and 1996.

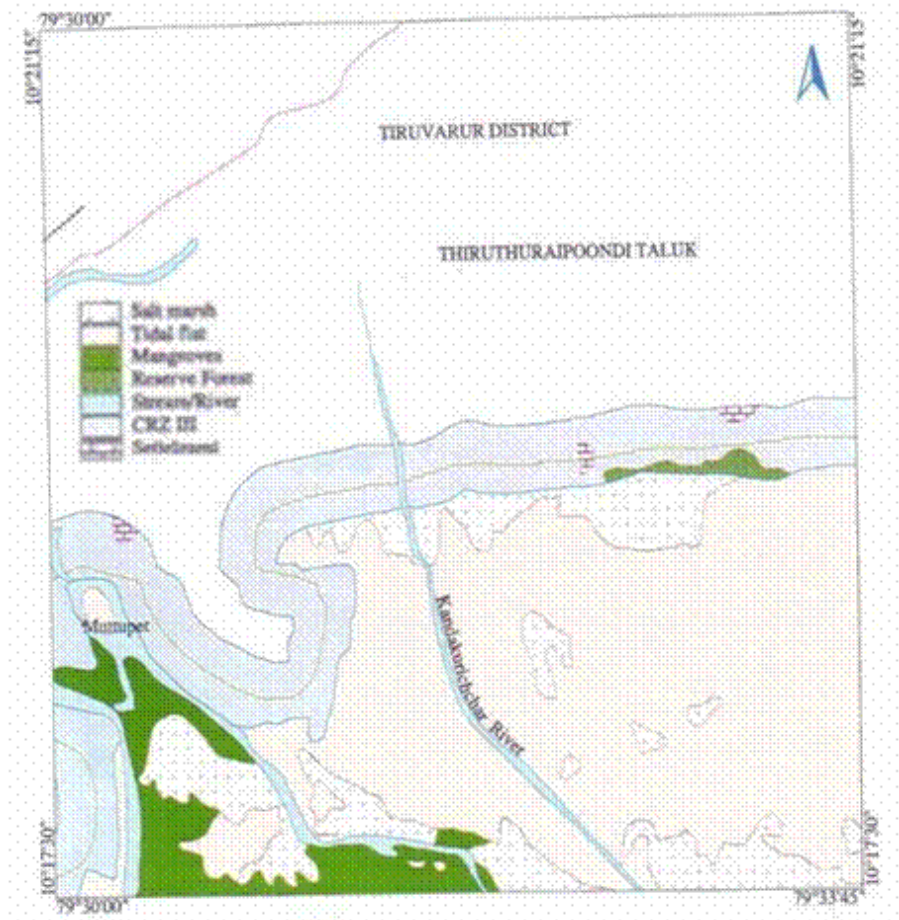


Fig.1.7 Ecological Sensitive areas – Muthupet

As Muthupet is dry for the most of the year, human activities like cutting of wood for fuel, grazing by cattles etc. have caused the degradation of mangroves.

Seaweeds like *Chaetomorpha*, *Enteromorpha*, *Gracilaria* and *Hypnea* are found in Muthupet. The aquatic fauna comprise of finfishes, shrimps, molluscs, crabs and benthic invertebrates. The finfishes constitute the bulk of the total fishery in Muthupet mangroves. *Mugil cephalus*, *Liza* sp., *Chanos* sp., *Siganus* sp. and *Etroplus* sp. are common. The shrimp fishery is dominated by *Penaeus indicus*, *Penaeus monodon*, *Metapenaeus dobsoni*, *Metapenaeus monoceros* and *Macrobrachium* sp. The commercially important crabs *Scylla serrata*, *Portunus pelagicus*; oysters (*Crassostrea madrasensis*); clams (*Meretrix meretrix*) are recorded in this area. Birds like Herons, Egrets, Kingfishers, Myna, Plovers and Sand Piper are also seen.

#### **1.5. Ecological Sensitive Area – Gulf of Mannar (GOM):**

GOM is the southeast coast of India extends from Rameswaram island in the north to Kanyakumari in the south. The GOM Biosphere Reserve was set up on 18.2.89 jointly by the Government of India and Government of Tamilnadu. The Govt. of Tamilnadu in G.O.M.S.No. 962 dated 10.9.86 notified under the intention to declare the 21 islands as Marine National Park for the purpose of protecting marine wildlife and its environment including depths of 3.5 fathoms on the bay side to 5 fathoms on the seaward side under the section 35(1) of the Wildlife (Protection) Act 1972.

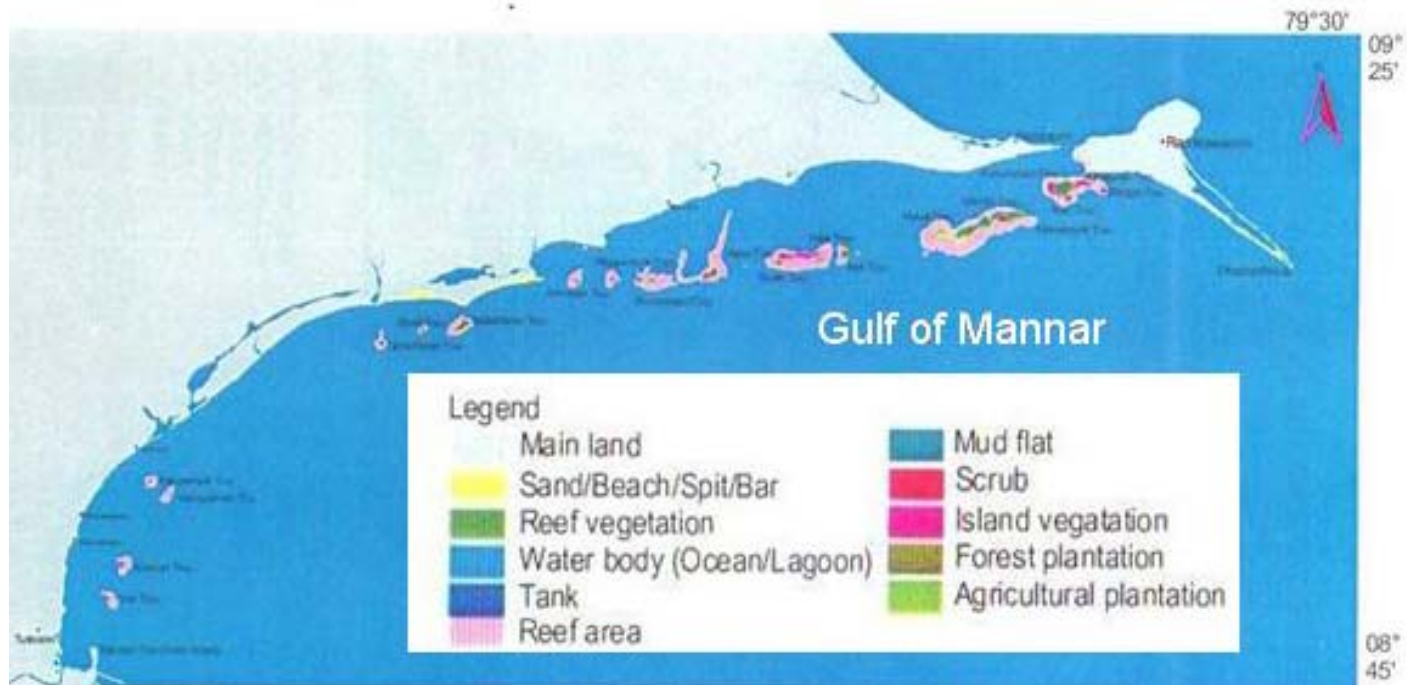
This biosphere reserve extends from Rameswaram to Tuticorin, lies between 78°5'E - 79°30'E longitudes and 8°45'N - 9°25'N and extends to a distance of 140km. There are almost 21 islands running almost parallel to the coastline of Gulf of Mannar. The detailed location of these islands is shown in the Table 1.7.

The Gulf of Mannar Marine National Park has the core area of about 560Km<sup>2</sup> from Rameswaram to Tuticorin lying within the Gulf of Mannar Biosphere Reserve covering an area of 10,500Km<sup>2</sup> on the south-east coast of India. It is one of the world's richest regions from marine biodiversity perspective and the first marine Biosphere Reserve in Southeast Asia. The Biosphere Reserve comprises 21 islands with estuaries, mudflats, beaches, forests of the near shore environment, including

marine components like algal communities, sea grasses, coral reefs, salt marshes and mangroves (Fig.1.8). The 21 islands vary from 0.25 ha to 130 ha. Total area of the islands is 6.23 km<sup>2</sup>.

**Table 1.7. Location of islands in Gulf of Mannar**

No.	Group	Island	Location		Area (ha)
			Latitude	Longitude	
1.	Mandapam	Shingle island	9° 15'	79° 14'	12.69
2.		Krusadai island	9° 15'	79° 12'	65.80
3.		Pullivasal island	9° 14'	79° 11'	29.95
4.		Poomarichan tivu	9° 14'	79° 11'	16.58
5.		Manoliputti tivu	9° 13'	79° 07'	2.34
6.		Manoli tivu	9° 13'	79° 07'	25.90
7.		Musal tivu	9° 12'	79° 05'	124.0
8.	Kilakarai	Mulli tivu	9° 11'	78° 56'	10.20
9.		Valai tivu	9° 11'	78° 56'	10.10
10.		Thalaiyari tivu	9° 11'	78° 56'	75.15
11.		Appa tivu	9° 09'	78° 54'	28.63
12.		Poovarasampatti tivu	9° 09'	78° 49'	0.50
13.		Vallimunai tivu	9° 09'	78° 35'	6.72
14.		Anaipar tivu	9° 09'	78° 45'	11.00
15.	Vembar	Nallathanni tivu	9° 06'	78° 35'	101.00
16.		Puluvunnichalli tivu	9° 06'	78° 35'	6.12
17.		Upputanni tivu	9° 05'	78° 30'	22.94
18.	Tuticorin	Vilanguchalli tivu	8° 56'	78° 15'	0.95
19.		Karaichalli tivu	8° 57'	78° 14'	16.46
20.		Kasuwar island	8° 52'	78° 13'	19.50
21.		Van tivu	8° 50'	78° 13'	16.00



**Fig.1.8 Ecological Sensitive areas – Gulf of Mannar**



**Climate:**

The Gulf of Mannar experiences a tropical climate. The southwest monsoon contributes only very little towards the annual rainfall. Rainfall is moderate to heavy during October and December under the spell of northeast monsoon. The mean annual rainfall varies from 762mm to 1270mm. The period from January to May is marked by hot climate. The coldest climate is December having a minimum of 25°C. The ocean currents in Gulf of Mannar are swift. The sea is rough between April and August and calm during September. It will be stormy during June to August. The tidal amplitude is about half a meter.

The GOM is influenced by both southwest and northeast monsoons and hence the physical, chemical and biological characteristics are different from other areas. Light penetration also varies from season to season. Secchi-disc value of 7.5m is common in the inshore region. During summer, calm weather conditions exist and the euphotic zone is known to go even beyond 100m depth. During monsoon period (July-September), water becomes turbid and the secchi-disc values can become 2m or less. Temperature oscillation is unique in GOM, steadily increases from January to April reaching upto 32°C and declines till August.

The wind velocity is generally high and is north/northeasterly from June to December and westerly during the rest of the period. The wind speed is lowest (6.9km/hr) in November and highest (17.6km/hr) in August.

**Drainage system:**

The drainage system consists of Vaigai, Gundar, Vembar, Vaippar and their tributaries. The Vaigai and Vaippar are the biggest rivers and all the rivers are non-perennial which get waters only during rainy season.

**Biological resources of Gulf of Mannar:**

The Exclusive Economic Zone (EEZ) of GoM is about 15,000km<sup>2</sup> out of which the GoM biosphere reserve has an area of about 10,500km<sup>2</sup> and the commercial fishing is carried out in about 5,500 km<sup>2</sup> upto a depth of 50m. GoM is endowed with a rich

variety of marine organisms because its biosphere includes ecosystems of coral reefs, rocky shores, sandy beaches, mud flats, estuaries, mangrove forests, seaweed stretches and seagrass beds. A wide variety of cowries, cones, volutes, murices, whelks, strombids, tonnids, prawns, lobsters, pearl oysters, sea horses, seacucumbers etc., are available in this biosphere. The coral reefs support a variety of ornamental fishes and provide feeding and breeding grounds for a number of edible finfishes and shellfishes.

The diverse nature of ecosystems in the GoM supports significant species including 117 species of corals, 641 species of crustaceans, 731 species of molluscs, 441 species of finfishes and 147 species of seaweeds apart from marine mammals like whales, dolphins, porpoises and turtles. The mangrove habitats have 9 different species of vegetation supporting a variety of marine fauna including seabirds and seasnakes.

About 3,600 species of flora and fauna have been identified so far and the fauna is said to be one of the richest in the whole of Indo-west pacific region. Littoral, swamp forests, thorny scrubs and other vegetations in Gulf of Mannar area is not uniformly spread. *Thespesia populnea*, *Acacia planifrons*, *Tamarix*, *Vitex negundo* etc., are commonly seen. Mangroves and associated species are seen in Shingle, Krusadai, Poomarichan, Manoli and Manoliputti islands. *Avicennia*, *Rhizophora*, *Brugeira*, *Pumphis*, *Pandanus* occurs along the periphery of the islands. Palmyra, Casuarina, Coconut, Mango, Tamarind trees can be seen in Krusadai, Musal and Nallathanni islands.

Algal growth is very rich in Gulf of Mannar. Krusadai and Shingle islands have very rich algal beds of *Litho thamnion*, *Martensia claudia*, *Anadyomene* etc. There are different types of algal species formed on coral reef in lagoons. It is also rich in sea grasses. The algal species composition on the coral reefs is different from that found in the lagoons. The following species are noticed in the reefs: *Ulva reticulata*, *Halimeda opuntia*, *H.tuna*, *Caulerpa racemosa*, *V.clavifera*, *Pocockiella sp.*, *Chnospora implexa*. *Padina* was observed on the shores and lagoons. *Gracilaria lichenoides* was found more on the shore and lagoon than on reefs. *Sargassum* and *Turbinaria* are found on the shoreward part of the reefs. The predominant species on

the coral reefs is *Halimeda opuntia*. *Caulerpa*, *Sargassum*, *Amphiroa fragilissima*, *Gracilaria lichenoides* are the other dominant species.

### **The Seagrass Ecosystem**

The Gulf of Mannar is rich in seagrasses. The following species belonging to Hydrocharitaceae and Potamogetonaceae have been recorded. The seagrass beds provide food sources for the sea mammals, particularly *Dugong dugong* which feeds upon these pastures on the Gulf shoreline and surrounding islands like Krusadai. The Dugongs prefer pastures of *Halodule uninervis* for food. The species composition of seagrasses is as follows:

#### Hydrocharitaceae

*Thalassia hemprichii*

*Enhalus acoroides*

*Halophila ovalis*

*H.ovata*

*H.beccari*

*H.stipulacea*

#### Potamogetonaceae

*Cymadocea serrulata*

*C.rotundata*

*Halodule uninervis*

*Syringodium isoetifolium*

It is significant to observe that among marine angiosperms, only *Enhalus acoroides* shows aerial surface pollination. Most seagrasses are dioecious and cross fertilization is the rule. Not a single marine angiosperm is closely related to terrestrial plants. The marine share, however, in total angiospermic species is negligible. No marine dicot has been recorded so far.

The Gulf of Mannar is famous for its chank and pearl fisheries. The sacred Chank – *Xancus pyrum* occurs in Gulf of Mannar area, found on fine, soft sandy substrates under water. There are about ten pearl banks in the region. The major pearl bank is found off Tuticorin and in between Nallathanni tivu and Valinokkam point. The region between Tuticorin and Kanyakumari has extensive pearl banks.

**Associated industries: Finfish industry:**

The finfish fishery includes perches, carangids, barracudas, mackerels, milkfish, grey mullets, tunas, sardines, scombroids, silver bellies, pomfrets, lethrinids, groupers, sharks and rays.

**Shellfish industry:**

The shellfish fishery includes oysters, mussels, clams, shrimps, lobsters and crabs.

**Aquaculture industry:**

Much concentration has been given on pearl oysters, edible oysters, crabs, shrimps, milkfish etc.

**Mineral resources:**

The Gulf of Mannar has significant amounts of monazite, illmenite, rutile and garnet and a small amount of zircon and sillimanite. These minerals are found as placer deposits.

## **2. Pollution hot spots along the coast of Tamilnadu**

**Introduction:**

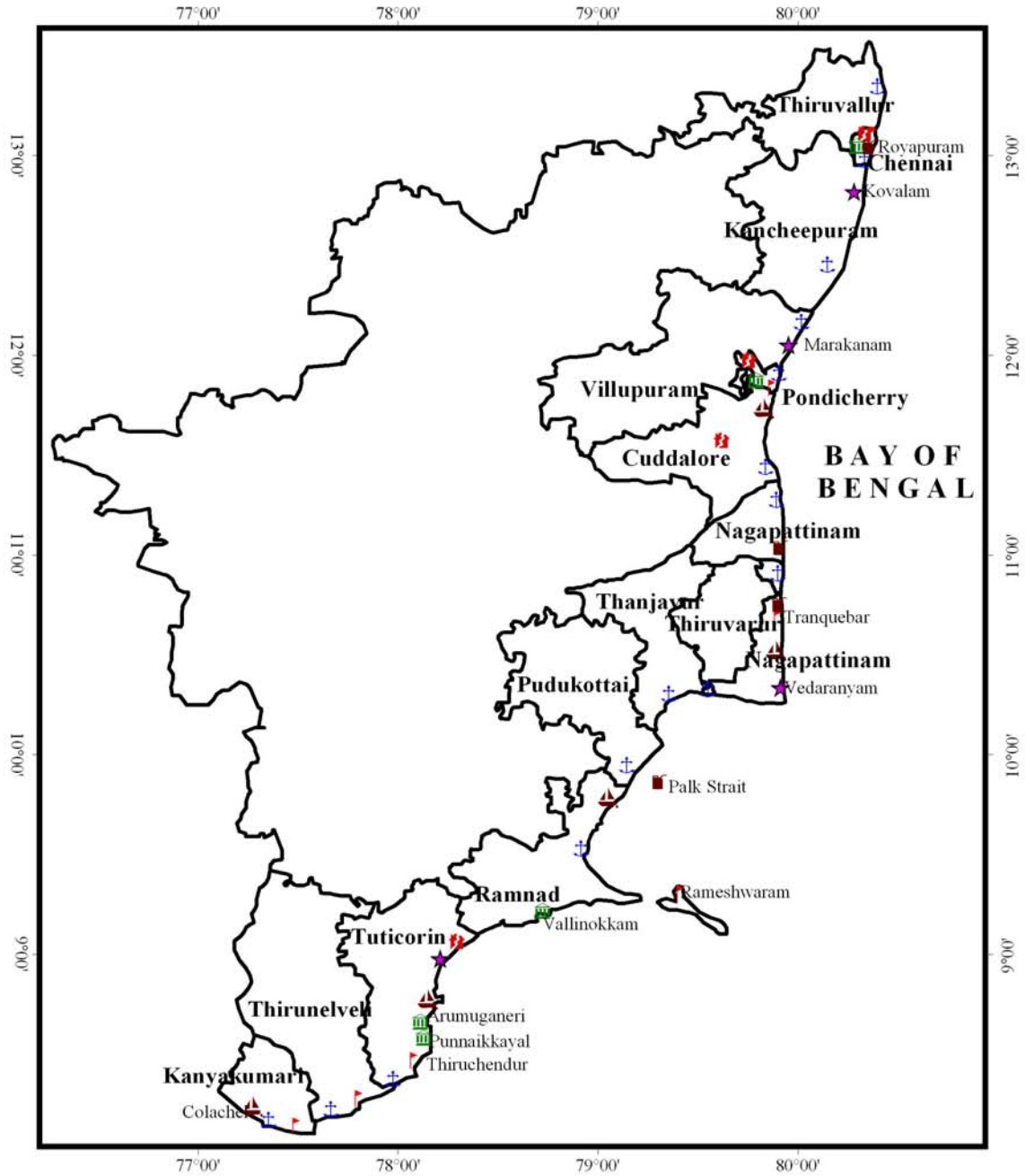
The coastal areas of Tamilnadu are assuming greater importance owing to increasing human population, urbanization and accelerated industrial activities. These anthropogenic activities have put tremendous pressure on the fragile coastal environments. In general, the near shore regions are of great concern now, due to the fact that they are not only most productive areas but also the sites of the most critical pollution hot spots (Table 2.1 and Fig.2.1).

**Table. 2.1. Pollution hot spots along the coast of Tamil nadu**





No.	District	Nature of Pollution
1	Thiruvallur	Thermal, domestic sewage, industrial, chemical
2	Chennai	Harbour, domestic sewage, industrial, chemical
3	Kancheepuram	Thermal, domestic sewage, industrial, chemical, textile, tannery and tourism
4	Villupuram	Domestic sewage, industrial, chemical, aquaculture waste
5	Cuddalore	Domestic sewage, industrial, chemical, Aquaculture waste, harbour
6	Nagapattinam	Domestic sewage, Aquaculture waste, tourism
7	Thiruvarur	Aquaculture waste, Muthupet swamps
8	Thanjavur	Domestic sewage, Sethubava chatram
9	Pudukottai	Domestic sewage, oil & fish, industrial, Aquaculture waste
10	Ramnad	Domestic sewage, Fishing harbour, Aquaculture waste
11	Tuticorin	Thermal, domestic sewage, industrial, chemical, salt, tourism, aquaculture waste
12	Thirunelveli	Domestic sewage, industrial, nuclear
13	Kanyakumari	Domestic sewage, fishing waste, tourism




Coastal pollution in Tamilnadu has seriously affected the exploitable living resources, recreational and commercial uses of coastal areas and the overall integrity of the marine and coastal ecosystems. Hence protection of the coastal and marine regions from continuing pollution becomes the most essential in coastal resources management. Effective planning for controlling and combating coastal pollution requires knowledge about the magnitude of the pollution, the entry, transport and the state of pollutants in the

**Fig 2.1 Major Coastal activities leading to Coastal / Marine pollution in Tamilnadu**



**Legend**

-  Discharge and Disposal of Sewage and Industrial Waste
-  Discharge and Disposal of Domestic Waste
-  Harbour Activities and Maritime Transport
-  Oil Exploration, Production and Refining

- 50 0 50 Kilometers
-  Recreation and Tourism
  -  Salt Production
  -  Fishing Activities

marine environment and their effects on marine ecosystems. There are about 12,000 industries in Tamilnadu out of these 5,500 industries are located in coastal districts and 2,500 are situated near the coasts. The major congregation of industries along Chennai coast where 1500 industries are located. The group wise distribution of industries along the Chennai coast are as follows: Electricity, Gas and water (35%); Rubber, Plastic, Petroleum and coal products (9.5%); Machine tools (9.3%); Paper and paper products (5.5%); metal products (5.1%) and others (26.3%) (GoTN, 1995).

### **Major coastal activities:**

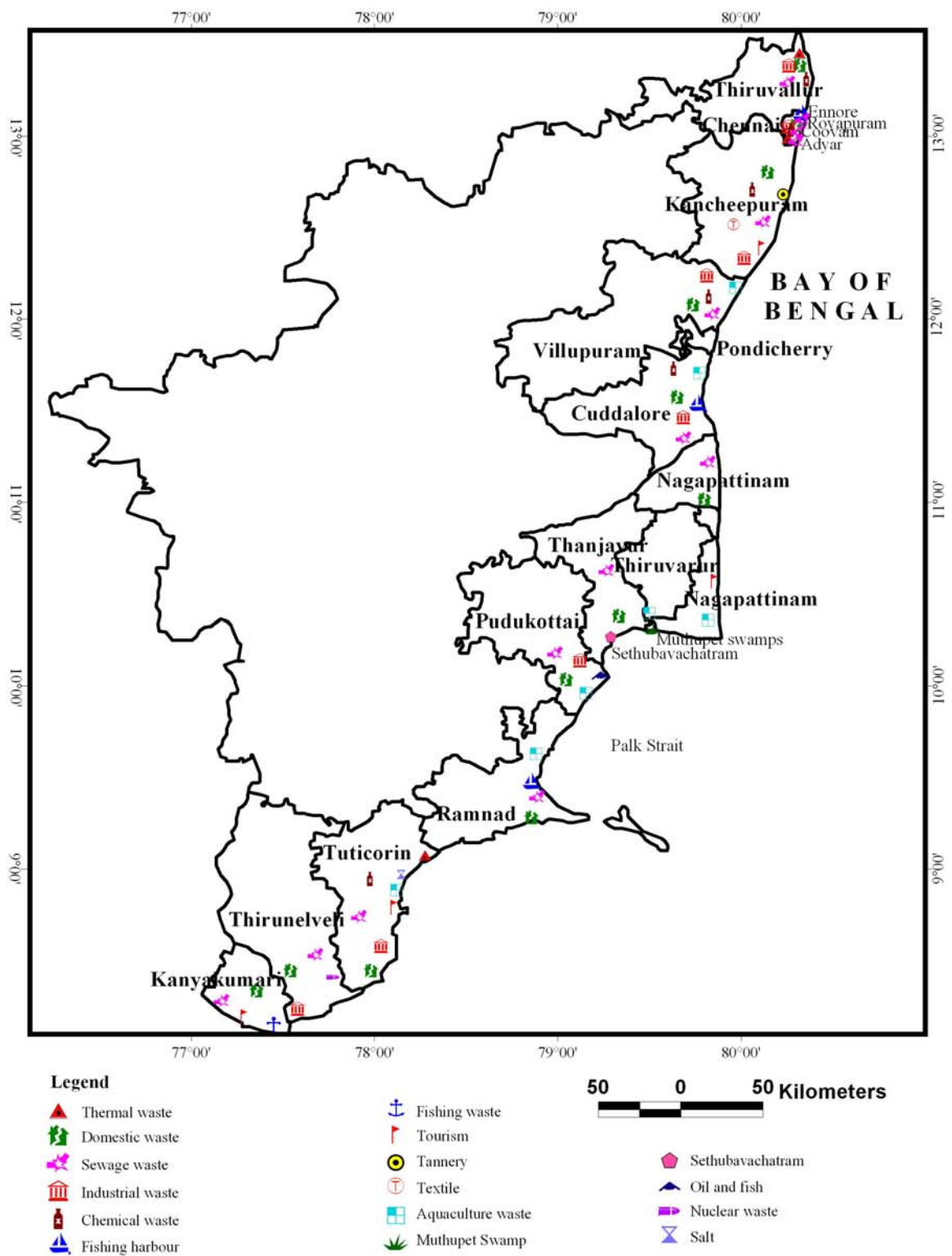
Major coastal activities responsible for coastal/ marine pollution in Tamilnadu are discharge and disposal of treated (1.8mld) / untreated sewage and industrial wastes; discharge on industrial coolant waters, harbour activities such as dredging, cargo handling, dumping of ship wastes, spilling of cargoes such as chemicals and metal ores, oil transport, fishing activities such as mechanized fishing vessels movements, draining of waste oil, painting of fishing vessels, scrapping of metal lining of fishing vessels, dumping of wastes and trash fishes, oil exploration and oil refining activities, recreation and tourism activities, salt production etc. The places where these activities are predominant are given in Table 2.2 and Fig.2.2.

**Table 2.2. Major coastal activities leading to coastal/ marine pollution in Tamil Nadu**

No.	Activities	Places
1.	Discharge and disposal of Domestic wastes	Chennai, Pondicherry, Cuddalore, Tuticorin
2.	Discharge and disposal of sewage and industrial wastes	Chennai, Pondicherry, Kayalpattinam, Tuticorin
3.	Harbour activities and maritime transport	Chennai, Cuddalore, Nagapattinam, Tuticorin, Colachel, Vallinokkam
4.	Fishing activities	Throughout the coast
5.	Oil exploration, production and refining	Chennai, Cauvery delta, Nagapattinam, Palk Strait
6.	Recreation and tourism	Chennai, Pondicherry, Tranquebar, Rameswaram, Thiruchendur and Kanyakumari
7.	Salt production	Kovalam, Marakkanam, Vedaranyam, Tuticorin



**Fig 2.2 Pollution Hot Spots along the coast of Tamilnadu**



wide variety of pollutants enter into coastal marine environment of Tamilnadu. These can be classified and categorized in different ways according to the nature, source, physical state etc. The most widely known, according to nature and source are sewage, heavy metals, pesticides and oil plays the dominant role.

### **Sewage pollution**

The domestic and municipal wastes from many coastal cities in Tamilnadu are discharged directly into the coastal waters. The major cities situated along the Tamilnadu coast are Chennai, Cuddalore, Nagapattinam, Pondicherry and Tuticorin. Apart from these, more than 500 fishing villages and small towns are also situated on the coast. The domestic waste discharged into the sea from most of the urban and rural areas are untreated. The estimated population of these coastal cities is around 20 million. In the city of Chennai alone, there are more than 10million people living along the coast, and as a result more than 75 million gallons /day of sewage get discharged into adjoining sea. The major part of the sewage is released into Cooum, Adyar rivers and Buckingham canal.

### **Industrial pollution**

The natural sources of heavy metals in coastal waters are through river runoff. The mechanical and chemical weathering of rocks serves as another major source. In addition, components washed into the atmosphere, through rainfall, wind blown dust, forest fires and volcanic particles also added to this. The natural concentrations of metals in sea water are very low and the possibility of contamination are high (Bryan, 1984). Virtually, all industrial processes involving water are potential sources of metallic contamination in estuaries and coastal waters. The various sources of metal pollutants and principal metals associated with these sources are presented in Table 2.3. The heavy metals commonly found along Tamilnadu coastal waters are Cadmium, Copper, Lead, Mercury, Nickel and Zinc and the coastal waters of Tamilnadu are polluted with all these metals.

The coastal waters of Chennai are very highly polluted compared to other places in the state, indicating the impact of too many industries, all crowded near Chennai and

the consequent increase in urban population in one large metropolitan area of the coast.

**Table 2.3 Major sources of metal pollutants**

No.	Pollutant sources	Major pollutants
1.	Chlor alkali factories	Mercury
2.	Industrial coolant water discharge and corrosion of pipe lines	Copper
3.	Dust and rain (atmospheric fall out petroleum burning)	Lead
4.	Plating and Galvanizing (Machine tools and metal products)	Zinc, Cadmium and Chromium
5.	Municipal waste waters	Cadmium, Copper
6.	Combustion of coal (power plants – fly ash)	Copper, Lead and Zinc
7.	Combustion of oil (power generators)	Nickel
8.	Dredging and dumping of sediments (harbours)	Zinc, Lead and Copper
9.	Anti fouling paints	Copper and Mercury

The red category, highly polluting industries include petroleum refineries, thermal power plants, tanneries, pulp and paper, industrial chemicals, non metallic mineral products and small scale industries like chemical manufacturing along the coast causing widespread air, water and land pollution. Studies indicate that an industrial sector's contribution to pollution is often disproportionately higher than its industrial output. About 27% of the industrial output contributes to 87% of all sulphur emissions and 70% of nitrogen emissions.

There are 14 major industries located in the Ennore-Manali areas. The industries at Manali and Ennore are mostly chemical based, manufacturing petro-chemicals, fertilizers, pharmaceuticals, paints etc. There are two power plants at Ennore, namely, Ennore Thermal Power Plant with a production capacity of 200 MW and North Chennai Thermal Power Plant with a production capacity of 600 MW. The fly ash continuously deposits in the sea. The industries at Ennore-Manali are using a wide

variety of raw materials and discharge waste products into the air, water or land as gaseous emissions, liquid effluents and sludge, respectively.

Manali in Chennai, Cuddalore and Tuticorin emerged as industrial hotspots for air pollution. Ennore creek is heavily polluted due to discharge of untreated sewage from Chennai. Coastal areas such as Chennai, Cuddalore, Nagapattinam and Tuticorin did not fare any better.

In Cuddalore the major problem confronted in the town is due to the development of Cuddalore chemical complex by the SIPCOT near the coast. There are 12 major industries very close to the seacoast. The treated effluent from the industrial unit is discharged on land.

Another industrial complex along the coast is found near Nagapattinam. This group consists of a TNEB, Thermal Power station at Nannilam, WIMCO Bromide extraction plant at Vedaranyam, Mettur chemical Plant manufacturing Liquid Bromide, the Indian Steel Rolling Mill at Thirunindravur of Tiruvar.

Refineries, bromide extraction plant and chemical industries are located along the coast in Thanjavur district. Manufacture of magnesium chloride solution plant is located in Ramanathapuram district.

Manufacture of aluminum fluoride, urea, ammonium chloride, caustic soda manufacturing factories is located in Tuticorin district. The seafood processing plant in Tuticorin discharges water with high concentration of  $H_2S (>2\text{mg/l})$ ,  $BOD_5 (>30\text{ mg/l})$ ,  $COD (> 100\text{ mg/l})$  and low pH (6.5). The effluents were mostly untreated or, at best, partially treated. Except some of the major industries, the effluents coming out of the industries are disposed off in the coastal area.

### **Tanning industry**

Oceanographic studies of the impact of tannery waste off the Tamil Nadu coast have been carried out by the National Institute of Oceanography, Goa. They showed pollution from tanneries all along the coastal stretch from Chennai to Vedaranyam.

Since the impacts of tannery wastes have increased alarmingly, the Government has requested the Central Leather Research Institute (CLRI), Chennai, to find remedies for the crises. It has designed, erected, put into operation and maintained a full-scale demonstration effluent treatment plant in Ranipettai since 1977 in a collaborative venture with the industry. Since then, it has designed several effluent treatment systems for various factories in Chennai, Ranipettai and Vaniyambadi.

### **Energy production**

The most important environmental effects caused by electrical power plants are due to thermal and residual chlorine effluents. Tropical aquatic organisms are more prone to thermal effects because they normally live in a temperature regime which is close to the upper tolerance limit. Temperature may exert synergistic effects with mechanical stresses as well as chlorine residuals and trace metals present in the effluent waters. Temperature elevation, due to effluent discharges from the power plants in Madras (Kalpakkam and Ennore), has been observed in an area of several square kilometres. The three condenser cooling system at Kalpakkam uses seawater which is then discharged at high temperatures. The rise at the outfall is found to range between 8 and 10°C. Ecological changes included a marginal decrease in dissolved oxygen, pH, and primary productivity. The movement of the thermal plume on the coast has not, led to fish kills, but significant changes in sedentary fauna and flora have been recorded in the condenser outfall area. The poor phytoplankton species diversity in the mangrove estuaries of Tuticorin is due to the influence of the impact of direct mixing of thermal effluents.

On the sandy shores, where the impact of the thermal plume is observed, *Emerita asiatica* seemed to be the first order impact organisms. There was also a marked reduction of biota upto a few kilometers on the adjacent shores. When the ambient temperature ranged between 37.0 and 37.6°C, almost all the macro-epifauna and epifocal perished, except for Periwinkles and Barnacles.

The nuclear power plants at Kalpakkam and Koodankulam in Tamilnadu poses a dreadful threatening to the people living around the radius of 170km. If any accident occurs, the lives would be doomed. The increase in usage of nuclear energy for the

production of power has increased the amount of radioactive wastes. During the power plant operations, tritium is routinely released into the environment from the reactors, through atmospheric and liquid discharge routes. Although tritium occurs in nature (formed by the action of cosmic rays on the earth's atmosphere), nuclear installations are, by far, the greatest source of tritium in the environment. The nuclear industry insists that such releases pose no risk to the public, but there is mounting evidence linking tritium emissions with birth defects and cancers.

### Oil pollution

In Tamilnadu, various activities responsible for oil pollution in the coastal and marine environment are exploration, refining, transport, spills and leakages from ships and fishing trawlers and from petro chemical industries. The places with such activities and their magnitude are presented in Table 2.4.

**Table 2.4. Activities related to coastal oil pollution in Tamilnadu**

No.	Activity	Area	Other details
1.	Oil exploration (drilling wastes, production wastes and sanitary wastes)	Cauvery delta, Palk bay	Offshore and near shore
2.	Oil production (same as above and free emulsion tank bottom sludge etc)	Koilkalapai, Narimanam, Bhuvanagiri	25000 to 30000 BBL/ d
3.	Oil transport (ship wastes, tank washings, spills etc)	Chennai and Tuticorin	$3 \times 10^6$ t/yr
4.	Oil refining (oil leaks, spills, effluents tank drawoff etc)	Chennai	$5 \times 10^6$ t/yr
5.	Petro chemical production (by product production and industrial wastes)	Chennai, Gulf of Mannar	75000 – 1 lakh t/yr

The dissolved Petroleum hydrocarbon in the Pichavaram mangrove waters (Parangipettai) ranged from 5 to 15ug/l and in Kodiakkarai (Point Calimere) from 8 to 20ug/l. In Chennai, values ranging from 4ug/l to 108ug/l in water and from 1.5 to 3.5ug/g dry weight of sediments were reported. The values recorded along the Tamil Nadu coast are slightly less than those recorded in other parts of the world. Thus, at

present levels, they do not pose any threat to marine life. However, intensification of oil exploration in the Palk Strait will cause concern. The Gulf of Mannar region forms a part of the one of the oil tanker routes. Continuous monitoring of Cauvery delta to establish a scientific data base and to assess the environmental impact and degradation are urgently needed.

### **Pesticide pollution**

Pesticides that are transported to the aquatic environments are primarily of agricultural origin. The agriculture return flow and drainage constitutes the main pathways of transport of pesticides from arable to the soil to the coastal marine environment. The fate of pesticide in the coastal environment may i) degrade into non-toxic by products by microbial actions and chemical reactions, ii) persist in solutions or get absorbed to particulate matter for extended period, iii) get deposited in sediments, iv) concentrated in certain organisms (bio-accumulation) and v) get propagated through trophic chain (bio-magnification).

The most commonly used pesticides are HCH, Lindane, Endosulfan, Heptachlor, Malathion, Parathion and Monocrotophos. In addition, DDT is still used in significant amounts for sanitation purposes. Pesticides recorded in Tamil Nadu coastal waters include DDT, Lindane (r-HCH), Endosulfan and Heptachlor. The Chennai waters had higher values than the Parangipettai waters. Higher values have been recorded in Parangipettai sediments, than in Chennai. Analysis of pesticide residues in marine fish revealed that the highest concentrations were found in Pomfret followed by Tuna and Mackerel. However, their concentration was well below the permissible level to be a potential hazard to human health. The available published data indicate that the coastal marine waters of Chennai are highly polluted than other areas of Tamilnadu. Overall, the coastal waters of Tamilnadu are less polluted compared to other coastal states.

### **Aquacultural pollution**

Aquaculture waste management has become a very serious issue. The majority of the farms use source water as a dumping ground for waste discharge. Raw effluents rich

in organic matter and waste feed are released directly into water sources without any treatment or settlement. There are no community joint agreements on coordinated arrangements for water intake and effluent discharge. This has led to problems connected with disease transmission and bad water quality, and little attention is being given to pond drying, disinfection and waste removal between crops.

Shrimp farming are done in coastal districts of Chengalpattu, Cuddalore, Thanjavur, Nagapattinam, Tiruvarur, Pudukottai, Ramanathapuram, Tuticorin and Kanyakumari. There are about 1200 such aquaculture farms in Tamilnadu. Sirkali taluk, in Nagapattinam Quaid-e-Millet district in Tamil Nadu, for example, has seen extensive conversion of 2000 ha. of prime agricultural land into 150 shrimp farms.

The effluents let out of these farms containing bio-degradable wastes are not properly treated in many cases and hence pollute groundwater in adjoining areas, even upto a distance of 6 km. affecting agriculture. Added to this, a majority of the shrimp farms have been flouting environmental guidelines by discharging untreated effluents into the neighbouring Poromboke lands.

The waste water produced during the post-harvest cleaning operations of shrimp farms can have a much greater impact on the ecology of the open waters, although it may be for a shorter period. Similarly, the impact can be significant where large numbers of shrimp farms are established in areas with poor flushing capacity.

The main environmental concerns in the shrimp farming sector are about the increased levels of nutrients including nitrogen and phosphorus and excess quantities of suspended solids and particulate organic matter in the waste water released from the farms. While there has been much discussion on the impact of aquaculture waste water on the environment, there is paucity of time-series data to scientifically correlate the adverse impact of shrimp farm wastes on the ecology of the open waters.



The nutrient levels and suspended solids in the waste water of shrimp farms practicing improved traditional and extensive methods are within the accepted norms and much less when compared with the waste water generated from the domestic sector and the fish processing units (Table 2.5).

**Table 2.5. Comparison of waste water generated from shrimp farm with domestic and industrial waste water**

Parameters	Shrimp farm waste water	Domestic waste water			Effluent from fish processing plant
		Untreated	Primary treatment	Biological treatment	
BOD (mg/l)	4.0 - 10.2	300	200	30	2000-4000
Total N (mg/l)	0.03 - 5.06	75	60	40	700-4530
Total P (mg/l)	0.05 - 2.02	20	15	12	120-298
Solids (mg/l)	119 - 225	500	--	151	880-7475

#### **Potential Hot Spots along the coast in Villupuram district**

The time has come now to identify and conserve wet lands of Kaluveli Swamp that has an important ecological value. Efforts must be taken to presume this swamp in order to revive different species of water birds. There have been one potential hot spots of Vanur in this district.

#### **Hot spot in Nagapattinam district**

Vedaranyam is the only potential hot spot along the east coast in this district. The coastal areas of district are of marine origin since they are in contact with sea, backwaters, lagoons, swamps, etc. The area around Vedaranyam is especially of very poor quality in nature. The highly saline and brackish water occurs at all levels partly by the influence of swamps and partly due to the deeper cretaceous formation. In the N-E portion of the district, heavy extraction of groundwater through filter points has resulted intrusion of salt water from the nearby marine deposits. These are noticed in the villages of Mangaimadam, Kollur and Tirunaganai of Sembanarkoil blocks.

M/s.ONGC has explored crude oil and natural gas in Nagapattinam district. The crude oil is made available for Madras refineries limited whereas natural gas is utilised as fuel in ten nos. of sodium silicate units. Also this gas is utilised as a fuel for one thermal power generation unit (2X5 MW) by TNEB in this area. One SIDCO Industrial Estate is located at Nagapattinam. The industrial units in these estates are non-polluting or less polluting in nature.

**Hot spot in Thanjavur district:**

There are 490 industrial units situated in the composite Thanjavur district, of which, 4 sugar units, 1 petroleum refinery, 1 distillery, 1 thermal power plant are coming under highly polluting industry.

**Hot spot in Pudukottai district**

The potential hot spot identified for this district is the seashore at Manalmelkudi. Industrial growth is not much in this district. One SIPCOT complex near Pudukottai is functioning in an extent of 412 acres and one SIDCO estate is functioning in Madur. Coastal waters do not face any serious problems from discharge of domestic or industrial waste at present.

**Hot spot in Thirunelveli district**

Madura coats and Sun paper mills are the major industries located in this district. Effluents from these mills are being led in to the Thamiraparani River. The public sector companies (TNSTC) located in Tirunelveli, Papanasam and Tenkasi discharged the effluents into the Thamiraparani and Chitaru.

The planning of monitoring hot spots is to understand the nature and extent of pollution load in the waterways. Pollution comes from non-point sources and also from point sources. Creation of a database will be helpful in taking precautionary measures and prevention of deterioration of water quality.

### **3. Coastal Biodiversity Statistics of Tamilnadu**

**Introduction:**

The marine biodiversity of Tamilnadu is rich and varied. The coastline encompasses almost all types of intertidal habitats from hypersaline and brackishwater lagoons, estuaries and coastal marsh and mud flats to sandy and rocky shores with varying degrees of exposure and widely varying profiles. Subtidal habitats are equally diverse. Each local habitat reflects prevailing environmental factors and is further characterized by its biota. Thus the marine fauna itself demonstrates gradients of change throughout the Tamilnadu coast. Among coastal wetlands, estuaries, mangroves and coastal lagoons are biodiversity rich areas, whereas the other brackishwater habitats have only a few specialized species. It is well known that the reduction in number of species is greater in estuaries when compared to adjacent seas and in-flowing river systems. It has been observed that as the distance increases from the sea, the number of species decreases. Salinity becomes the important regulating factor. However, much study is to be conducted in the estuaries, mangroves and coastal lagoons of Tamilnadu.

**Corals and coral reef associated organisms**

Coral reefs are one of the important ecosystems in India. They form the most productive, dynamic ecosystem providing shelter and nourishment to thousands of marine flora and fauna. They are the protectors of the coastlines of the maritime states. They are well developed in warm, clear, shallow coastal regions where light is abundant. Massive deposits of calcium carbonate that are secreted by the corals form the main girdle of the reef. Corals growth is greatly influenced by the presence of an algae called "Zooxanthellae" that provides a symbiotic relationship with the corals. The interaction of coral reefs with algae provides habitats for all the other reef associated organisms.

They protect shorelines from erosion and damage due to cyclone. The sand beaches around these coral reefs are also used as tourist spots which earns foreign exchange. These coral reefs are also called as marine biodiversity supporting many species of corals, fishes, crustaceans and many other animals and plants. Coral reefs are often

termed as fragile ecosystems. If the present day human population does not coexist well with the coral reef ecosystem, there will be a decline in the coral reef biodiversity.

India's coral reefs are of international interest in that all major types of reefs are present. Fringing reefs are found in Gulf of Mannar and Palk Bay. Platform reefs are seen along Gulf of Kutch. Patch reefs are found near Ratnagiri and Malvan coasts. Atoll reefs are found in Lakshadweep. Both fringing and barrier reefs are found in Andaman and Nicobar islands. The total area of coral reef in India is estimated to be 2,374.9km<sup>2</sup>. In Tamilnadu, the area estimate of coral reefs is represented in the Table 3.1 (DOD, 1997).

**Table 3.1. Estimates of Coral Reef in Tamilnadu**

Category	Tamilnadu (km <sup>2</sup> )
Reef flat	64.9
Sand over reef	12.0
Reef vegetation	13.3
Vegetation over sand	3.60
Algae	0.40
Lagoon	0.10
Total	94.30

In Tamilnadu, the coral reefs are distributed along the Gulf of Mannar, Palk Bay and at restricted places in Chennai, Pondicherry and Cuddalore. The reef formation of southeast coast of India along the Tamilnadu coast is scattered between 79° to 79°9'E to 8°45' to 9°11'N covering nearly 21 islands from Tuticorin to Rameswaram. Though the reefs are mostly of fringing types around the islands, it is discontinuous barrier, termed as 'Mannar Barrier'. The fringing reefs around the islands normally have a lagoon of 100-150m wide and 1-2m deep. The dominant genera include *Acropora*, *Montipora* and *Pocillopora* among the ramose forms. Massive forms are represented by *Porites*, *Favia*, *Favites*, *Goniastrea*, *Platygyra* and rarely *Symphyllia*.

*Cyphastrea* and *Leptastrea* are very common on all reef habitats of this area. The foliaceous forms are *Echinoptera*, *Lamellosa* and *Montipora foliosa* in Gulf of Mannar. In Palk Bay, the reef extends along the shore from Mandapam eastward along the shores of Rameswaram island interrupted only at Pamban pass. Corals are found on reef rocks and no consolidated reef flat is seen. Zonation is indistinct. The siltation especially during monsoon along the inshore region is reported to have marked impact on the distribution of corals on the reef.

### **Mangroves:**

Mangroves are of great ecological and economic significance and are among the most productive ecosystems. Because their high rate of production of organic matter, the mangrove are able to sustain a diverse community of organisms, ranging from bacteria to fishes, birds and mammals. Tamilnadu has two major mangrove forests. The Pichavaram mangrove is located 200km south of Chennai covering an area of 1,100 ha. The whole mangroves consist of 51 small and large islands and are bathed with seawater during high tide and freshwater from irrigation channels during low tide. The Muthupet mangrove forest which spreads over an area of approximately 6,800 ha. of which only 77.2 ha (4%) is occupied by well grown mangrove and the remaining 96% of the area is covered by poorly grown mangrove vegetation, is situated near Point Calimere on the southeast coast of the peninsular India (ENVIS, 2005).

The Pichavaram and Muthupet mangrove ecosystems embrace a heterogenous mixture of plants and animals. The aquatic fauna comprises of juveniles and adults of finfishes, shrimps, mollusks, crabs and benthic invertebrates. About 13 species of true mangrove species are present in Pichavaram (Table 3.2). The *Rhizophora annamalayana* has been described as a hybrid between *Rhizophora stylosa* and *Rhizophora apiculata*.

The distribution of various species of mangroves in Shingle, Krusadai, Poomarichan, Manoliputti, Manoli, Musal (Hare), Mulli, Poovarasampatti, Anaipar, Upputhanni, Kasuwar, Valai, Appa, Nallathanni, Karaichalli, Van Tivu, Thalaiyari, Vallimunai,

Puluvunnichalli and Vilanguchalli islands of Gulf of Mannar revealed dominant species of *Avicennia marina*, *Rhizophora mucronata*, *Bruguiera cylindrica*, *Ceriops decandrus*, *Lumnitzera racemosa*, *Excoecaria agallocha* and *Suaeda spp* (Nammalwar, 1998). The status of mangroves in Gulf of Mannar is given in Table 3.3.

**Table 3.2. True mangrove species in Pichavaram**

No.	Mangrove species	No.	Mangrove species
1.	<i>Acanthus ilicifolius</i>	8.	<i>Lumnitzera racemosa</i>
2.	<i>Aegiceras corniculatum</i>	9.	<i>Rhizophora apiculata</i>
3.	<i>Avicennia marina</i>	10.	<i>Rhizophora annamalayana</i>
4.	<i>Avicennia officinalis</i>	11.	<i>Rhizophora mucronata</i>
5.	<i>Bruguiera cylindrica</i>	12.	<i>Sonneratia apetala</i>
6.	<i>Ceriops decandra</i>	13.	<i>Xylocarpus granatum</i>
7.	<i>Excoecaria agallocha</i>		

**Table 3.3. Status of mangroves in Gulf of Mannar**

No.	Mangrove species	Status (based on IUCN)
1.	<i>Aegiceras corniculatum</i>	Critically endangered
2.	<i>Avicennia marina</i>	Vulnerable, stunted growth in all islands
3.	<i>Bruguiera cylindrica</i>	Endangered
4.	<i>Exocoecaria agallocha</i>	Critically endangered
5.	<i>Lumnitzera racemosa</i>	Endangered
6.	<i>Rhizophora apiculata</i>	Critically endangered
7.	<i>Rhizophora mucronata</i>	Endangered

The Pichavaram mangroves are an important breeding and nursery area for many fishes, crustaceans and the waterfowl population. The biodiversity of organisms living

in association with Pichavaram mangroves is shown in the Table 3.4 (Asir, *et.al*, 2001).

### Seagrass and seaweeds:

Seagrasses occur in the intertidal and midtidal zones of shallow and sheltered areas of sea, gulf, bays, backwaters and lagoons. They are submerged monocotyledonous plants and are adapted to the marine environment for the completion of their life cycle under water. They form a dense meadow on sandy and coral rubble bottom and sometimes in the crevices under water.

**Table 3.4. Living organisms in association with Pichavaram mangroves**

No.	Group	Domination species	Species (No.)
1.	Phytoplankton	<i>Biddulphia</i> sp., <i>Nitzchia</i> sp., <i>Ceratium</i> sp.	160
2.	Fishes	<i>Mugil</i> sp., <i>Leiognathus</i> sp.	147
3.	Zooplankton	Fish larvae, Shrimp larvae	129
4.	Birds	<i>Circus</i> sp., <i>Trunga</i> sp.	82
5.	Bivalves	<i>Meretrix</i> sp., <i>Arca</i> sp., <i>Crassostrea</i> sp.	21
6.	Gastropods	<i>Conus</i> sp.	18
7.	Meiofauna	Polychaetes, nematodes, amphipods, isopods	14
8.	Seaweeds	<i>Enteromorpha</i> , <i>Chaetomorpha</i>	12
9.	Prawn	<i>Metapenaeus</i> sp., <i>P.monodon</i> , <i>P.semisulcatus</i>	12
10.	Crabs	<i>Scylla serrata</i> , <i>Portunus</i> sp.	10
11.	Seagrass	<i>Halophila</i> , <i>Halodule</i>	5

Seagrasses are involved in cycling of nutrients. They provide food, shelter for diverse organisms and act as a nursery ground for many fishes of commercial importance and play a vital role in the fisheries production of the region. Among the 6 Indian genera of sea grasses, 11 species are recorded from Palk Bay of Tamilnadu. Of the 11 species, *Cymodocea serrulata*, *Halophila ovalis*, *Halodule pinifolia* and *Syringodium*



*isoetifolium* are predominantly distributed. *Halodule wrightii* occur only in Akkalmadam in Rameswaram.

13 species of seagrasses under 6 genera occur in the Gulf of Mannar region. *Enhalus acaroides*, *Halophila ovalis*, *Halophila ovata*, *Halophila beccari*, *Halophila stipulacea*, *Thalassia hemprichii*, *Cymodocea serrulata*, *Cymodocea rotundata*, *Halodule uninervis*, *Syringodium isoetifolium* are some of the seagrasses available in the Gulf. *Thalassia* and *Syringodium* are dominant in the areas of coral reefs and coral rubbles whereas others are distributed in muddy and sandy soils. The unique ecological importance of the sea grasses is the conservation of rare and endangered animals like marine turtles, dugongs and some echinoderms. Seagrass distributed areas around the coral islands of Gulf of Mannar are shown in the Table.3.5 (Asir, *et.al*, 2001).

**Table 3.5 Areal extent of seagrass in Gulf of Mannar**

Island	Area (km <sup>2</sup> )	Island	Area (km <sup>2</sup> )
Anaipar	14.0	Krusadai	3.0
Poovarasampatti and Valimunai	11.5	Karaichalli	3.0
Musal	9.5	Upputhanni	2.5
Valai and Thalaiyari	8.0	Mulli	2.0
Appa	8.0	Puluvinnichalli	1.5
Pullivasal and Poomarichan	5.0	Kasuwar	1.5
Manoli and Manoliputti	5.0	Vilanguchalli	1.0
Nallathanni	5.0	Shingle	0.21
Van	5.0		

Seaweeds are marine plants belonging to lower Cryptogams. They are one of the commercially important marine living renewable resources. They occur in the intertidal, shallow and deep waters of the sea upto 150m depth and also in estuaries

and backwaters. These are large and diversified groups with size ranging from single cell such as *Chlamydomonas* to several meters in length (*Macrocystis*). The four classes of seaweeds are Chlorophyta (green algae), Phaeophyta (brown algae), Rhodophyta (red algae) and Cyanophyta (blue-green algae). In India, so far 650 species of marine algae with a maximum of 320 species of Rhodophyta followed by 165 species of Chlorophyta and 150 species of Phaeophyta have been recorded. Out of these, Tamilnadu has the maximum (302 species). A total number of 147 species of algae comprising 42 species of green algae, 31 species of brown algae, 69 species of red algae and 5 species of blue green algae distributed in Gulf of Mannar islands. The agar yielding seaweeds are being harvested since 1966 from Gulf of Mannar islands, along the coastline from Rameswaram to Tuticorin and Sethubavachatram area in Palk Bay.

The following economically important species were recorded in Gulf of Mannar islands. *Gelidiella acerosa*, *Gracilaria edulis*, *G.follifera*, *Gracilaria sp.*, *Hypnea sp.*, *Acanthophora*, *Sargassum sp.*, *Turbinaria sp.*, *Cystoseira trinodis* and *Hormophysa triquetra*, *Ulva sp.*, *Enteromorpha*, *Caulerpa*, *Codium*, *Hydroclathrus*, *Halimeda*, *Padina*, *Chondrococcus* and *Laurencia* (edible seaweeds). The estimated standing crop of some economically important seaweeds growing on the islands is given in Table 3.6 (Kaliaperumal, 1998).

**Table. 3.6. Standing crop of some economically important seaweeds in Gulf of Mannar.**

Species	Biomass (tons)
<i>Sargassum sp.</i>	6736
<i>Carragenophytes</i>	965
<i>Gracilaria edulis</i>	225
<i>Turbinaria sp.</i>	224
<i>Gracilaria sp.</i>	213
<i>Gelidiella acerosa</i>	42
<i>Cystoseira trinodis</i>	40

**Gulf of Mannar Biosphere Reserve (GoMBR):**

The Govt. of Tamilnadu has declared the ecosystem off Rameswaram coast as a Marine National Park area under the Wildlife Act of 1972 (G.O.No. 962, Forest and Fisheries, dt.10.9.1986). The GoMBR consists of three important ecosystems i.e. mangrove, seaweed /seagrass and coral reef and associated fauna such as fishes, sponges, gorgonids, holothurians, pearl oyster, chank beds, endangered turtles and the endangered mammal, the *Dugong dugong*. All the three highly productive ecosystems harbor a rich biodiversity of flora and fauna making it biologically one of the richest coastal regions in India and also world's richest region from a marine biodiversity perspective.

Different types of reef formation have been observed in Gulf of Mannar i.e. fringing reef, patchy reef and coral pinnacles. The major coral genera include *Acropora*, *Pocillopora*, *Montipora*, *Turbinaria*, *Echinopora*, *Favia*, *Favites*, *Goniastrea*, *Leptastrea*, *Leptoria*, *Platygyra*, *Goniopora*, *Porites*, *Merulina*, *Symphyllia*, *Galaxea*, *pavona*, *Coscinaria*, *Psammacora* etc. Coral reef area and percentage of live corals and other biodiversity in different islands of Gulf of Mannar are shown in the Table 3.7 and Table 3.8.

**Table 3.7. Coral reef area and percentage of live corals in Gulf of Mannar**

No.	Group	Island	Corals	
			Reef area (Km <sup>2</sup> )	Live cover (%)
1.	Mandapam	Shingle island	2.0	46
2.		Krusadai island	1.5	33
3.		Pullivasal tivu	--	--
4.		Poomarichan tivu	4.0	14
5.		Manoliputti tivu	15.0	25
6.		Manoli tivu		
7.		Musal tivu	18.0	52
8.	Kilakarai	Mulli tivu	7.0	25
9.		Valai tivu	14.0	16
10.		Thalaiyari tivu		
11.		Appa tivu	5.0	2

12.		Poovarasampatti tivu	6.0	50
13.		Vallimunai tivu		
14.		Anaipar tivu	5.0	37
15.	Vembar	Nallathanni tivu	2.0	38
16.		Puluvinnichalli tivu	7.0	38
17.		Upputhanni tivu	3.0	6
18.	Tuticorin	Vilanguchalli tivu	1.0	8
19.		Karaichalli tivu	0.3	4
20.		Kasuar island	6.0	5
21.		Van tivu	2.5	7

Gulf of Mannar encompasses 21 islands. There are uninhabited islands, ranging in size 0.25 to 130ha, along the coast for 170km with the closes being 500m from shore and the farthest over 4km. The islands and their shallow water form the core of the reserve, which is in turn surrounded by a 10km wide buffer zone.

1. Shingle island: The area is 12.69 ha. and 4km from Pamban village. This island is full of shingle and coral rubbles, heaped all along the shore to a height of 0.75m, completely covered by bushes and trees. Fringing reefs are present on the eastern, northern and western side of the island. The corals are mostly of *Acropora sp.* Present 300m from the island shore. Patchy distribution of boulder corals is also found.
2. Krusadai island: The area is 65.80 ha. And is 3km from Pamban and the nearest land is Kundugal point 500m away. This island is completely covered with trees and bushes having many varieties of animal life. A continuous fringing reef is present on the southern side of the island at 500m distance. The lagoon in this area also contains live coral patches. The northern and eastern side also a few patches of *Acropora sp.*.
3. Pullivasal island: The area is 29.95 ha. and appears as thickly wooded jungle. There are fringing reefs on the southern side of at a distance of 200m. A

similar patchy reef distribution is also found in the muddy area on the northern side.

4. Poomarichan island: The area is 16.58 ha. and appears as a thickly wooded jungle. It is about 5km from Mandapam. This is almost horse shoe shaped island, with a scanty foreshore, surrounded by a marshy area and broken coral stones. Extensive corals are found on the western and eastern side of the island at a distance of 150m from island shore. On the southern side also, a continuous reef exists close to the shore.
5. Manoliputti island: The area is 2.34ha. and 6km from Mandapam. This is a very small island separated from the nearby Manoli island by extensive sand flat fully exposed during low tide. In this island, a patchy distribution of massive coral is present throughout the island at 500m distance from the shore.
6. Manoli island: The area is 25.90 ha. and is also 6km form Mandapam. The island is surrounded by sand flats and mud flats exposed during low tide and well covered by trees and shrubs. There are extensive reefs on southern and northern sides at 250m distance from the shore. Both *Acropora spp.* and *Porites spp.* are found in large numbers.
7. Hare island: The area is 10.20 ha. and is 9km from Kilakarai. This small island is covered by thick vegetation of *Acacia* trees, palmyrah, coconut plantations and other trees. Massive corals are found on the southern lagoon in several places as well as in northern side. Fringing reefs are also present at 1.5km distance on south side. The reef continues upto the northern tip of the island.
8. Mulli island: The area is 10.20 ha. and 9km form Kilakarai. This island is completely covered with tall shrubs and bushes with a swamp. The northern side of the island is studded with massive corals. Eastern side with low fringing reef continues up to 3m depth. The south reef is 1.25km from shore and it extends upto the western side.

9. Valai island: The area is 10.15 ha. and is 10kms from Kilakarai. It is small minor island lying parallel to mainland and is connected to Talaiyari island by a channel which is submerged during high tide. The western side of northern shore has good cover of massive coral as well as branching coral types. The southern reef is far away from the shore at 3m depth.
10. Thalaiyari island: The area is 75.15 ha. and is 10km from Kilakarai. It is an elongated island. The coral reef exists very close to the shore to the entire length of island on northern side except northwestern edge. Continuous fringing reefs are found at a distance of 0.75km all along the southern side.
11. Poovarasampatti island: This is a narrow sandy flat (100m x 25m) exposed during low tide and fully covered over by high tide water. Live coral reef surrounds this submerged island upto to a distance of 100m. Apart from a few massive corals occurring on the eastern side, the rest are branching type which lies at depth of 1-2m.
12. Appa island: The area is 28.63ha. and is 8km from Kilakarai. The southern portion of the island is highly elevated (6m). The entire southern side of the island is fringed with live coral reef. A good number of dead coral stones, boulders are found on the north west corner of the island from the shore which extends up to the distance of 1.5km.
13. Vallimunai island: The area is 6.72ha. and is a sandy island, completely covered with *Acacia* and *Zizyphus jujuba* bushes. Coral reefs are present at the southwestern corner at a distance of 200m from the shore.
14. Anaipar island: The area is 11 ha. and is 9km from Kilakarai. This island is completely covered with tall shrubs and *Acacia* trees. Live coral reefs are seen near western shore of the island upto a distance 200m from shore.
15. Nallathanni island: The area is 110ha. and is 2km from Mundal near Valinokkam. It is one of the largest islands containing 4000 coconut trees,

palmyrah and other woody trees. Coral reef and coral boulders are present all round the island at a distance of 500m on the southern side and northern shore.

16. Puluvinichalli island: The area is 6.12ha. and is 18km from Vembar. This island has a good sandy beach and thick vegetation, surrounded by coral reef except for a small stretch on eastern side.
17. Upputhanni island: The area is 29.94ha. and is 8km from Vembar. It is a big sandy island with plenty of coral rubbles all over. There are a few trees, tall bushes and grasses present in this island. Fringing reefs are found in the mid-eastern and running upto western side at a distance of 150-300m from the island.
18. Vilanguchalli island: The area is 0.95 ha. and is 15km from Tuticorin. This island is submerged now. There are isolated patches of thin reef of corals along southeastern side of the island.
19. Karaichalli island: The area is 12.70 ha. after erosion of some portion of island and is 15km from Tuticorin. It is a sandy island, thickly set with tall bushes in the center and western side. The whole island is covered with grasses and small plants at a distance of 500m – 1km from the shore.
20. Kasuwar island: The area is 15ha. after erosion and is 7km from Tuticorin. The whole island is covered with xerophytic vegetation. Coral reefs are found at the southwest corner of the island at a distance of 500m.
21. Van Tivu: The area is 16ha. and is 6km from Tuticorin. This island is covered with sparse vegetation of low bushes mostly grasses and xerophytic plants. Fringing reefs are present on the eastern side of the island at a distance of 500m.

The boring sponges cause considerable destruction to corals. 20 species of boring sponges have been recorded. *Spirastrella aurivilli* has been recorded for the first time,

for the Indian Ocean and *Aka minuta* as new to science. Two varieties of chank are fished at Rameswaram i) Tuttikudi – well known for ‘Palescent whiteness’, great hardness and evenness of texture and ii) Ramessari – slightly inferior quality. The Bryozoan – *Tremograsterina granulata* has been recorded in Rameswaram area.



**Table. 3.8. Biodiversity of corals in Gulf of Mannar islands**

Name of species	Shingle	Krusadai	Pullivasal	Poomarichan	Manaulputti	Manauli	Musal	Mullai	Valai	Thalayari	Appa	Poovarasampatti	Pallyammunai	Anapar	Nallathanni	Pulivilanchalli	Upputhanni	Velanguchalli	Karatchalli	Kasuvvar	Van	
<i>Acropora corymbosa</i>																						
<i>Acropora erythraea</i>																						
<i>Acropora Formosa</i>																						
<i>Acropora humilis</i>																						
<i>Acropora multicaulis</i>																						
<i>Acropora nobilis</i>																						
<i>Coscinaraea monile</i>																						
<i>Echinopora lamellose</i>																						
<i>Favia pallida</i>																						
<i>Favia valenciennesii</i>																						
<i>Favites abdiata</i>																						
<i>Favites pentagona</i>																						
<i>Galaxea fascularis</i>																						
<i>Goniastrea pectinata</i>																						
<i>Goniastrea retiformis</i>																						
<i>Goniopora duofaciata</i>																						
<i>Goniopora nigra</i>																						
<i>Leptastrea transversa</i>																						
<i>Montipora digitata</i>																						
<i>Montipora divaricata</i>																						
<i>Montipora foliosa</i>																						
<i>Montipora verrilli</i>																						
<i>Platygyra lamellina</i>																						
<i>Pocillopora damicornis</i>																						
<i>Pocillopora danuae</i>																						
<i>Porites lichen</i>																						
<i>Porites mannarensis</i>																						
<i>Porites solida</i>																						
<i>Porites somaliensis</i>																						
<i>Psammocora contigua</i>																						
<i>Symphyllia recta</i>																						

## **Biodiversity of Palk Bay**

Two branches of Vaigai river forming an estuary, empties in the Palk Bay, one at Athankarai and other at Sethukarai. Among the finfishes, the major landings include silver bellies, jew fishes and cat fishes. Shrimps catch include *P.semisulcatus*, *Metapenaeus affinis*, *P.merguensis*. Berried *P.semisulcatus* is abundant during October to March. The rich algal resources may be the reason for their abundance (popularly called as 'Passi iral').

The coral reef area stretches along Mandapam peninsula and along the shore of Rameswaram in an east west direction. They are located 200 to 600m from the shore in broken patches and their total length is only about 30km. The outer side of the reef harbours ramose corals while inner side has massive corals with large polyps.

During the northeast monsoon, the inshore waters of Palk Bay becomes very turbid due to stirring up of bottom deposits leading to silting and causing mortality to many coral colonies. Silting on the shoreward side, influence the distribution of corals on this relief. The reef was mined once and was subjected to the tidal waves of the 1964 cyclone. Recolonization is on but slows since the reef in Palk Bay areas have shown that genus like *Acropora* could establish on hard rocks and it takes 10 to 15 years to recolonization. Those species with large polyps and capable of combating the deleterious effects of silting only survive on the shoreward side.

Most of the corals especially the massive forms such as *Porites*, *Favia*, *Favites*, *Goniastrea* and *Symphyllia* were totally removed and there were no signs of any reef frame work. The area is being now covered with sand where once reef existed. A notable feature of the coral assemblage in this area is the absence of many common genera found in other parts of the Indo-Pacific. *Seratopora*, *Stylopora*, *Alveopora*, *Herpolitha*, *Fungia*, *Podabacia*, *Diploastrea*, *Labophyllia* and *Euphyllia* are unknown in this area.

The Pamban pass is known for its algal wealth. *Gelidiella acerosa* is the most exploited species in northward Athankarai- Rameswaram area. The alginophytes are high in this area (Table 3.9). *Sargassum* sp., *Ulva reticulata*, *Halimeda opuntia*,

*H.tuna*, *Pocokiella* sp., *Turbinaria conoides*, *T.ornata*, *Gelediella acerosa*, *Chondrococcus harnemanni*, *Caulerpa racemosa*, *V.clavifera* are noticed in the reefs. The mean algal density (fresh weight) is 0.21kg/m<sup>2</sup> in this region (Table 3.10).

**Table 3.9. Marine algal resources**

Group	Quantity (tons)
Agarophytes	1180
Alginophytes	8990
Rest	7143
Total	17313

**Table 3.10. Algal resources**

Area	Productive area (ha.)	Standing crop (tons)
Including Appa island to Shingle island and southward coastline and northward Athankarai – Rameswaram)	8416	17313

### **Biodiversity of Chennai coast**

Fishes constitute one of the major faunal groups and the next vertebrate group occurring in the Chennai coast is sea snakes and turtles. The marine fauna is rich and varied. The coastline encompasses almost all types of intertidal habitat from hypersaline, brackish lagoons, estuaries and coastal marsh and mud flats to sandy and rocky shores. Each local habitat reflects prevailing environmental factors and is further characterized by its biota. About 11 animal phyla are represented in the marine ecosystem of Chennai coast. This includes sponges, cnidarians, crustaceans, mollusks, echinoderms, fishes, reptiles and mammals. The benthic macro fauna comprises of resident species such as scleractinian corals, molluscs and mud-burrowing fishes. Among invertebrates, sponges and echinoderms do not prefer estuarine ecosystem. In Chennai coast, the species diversity is the maximum in Mollusca with 273 species belonging to 151 genera under 72 families. Crustaceans are represented by 200 species belonging to 125 genera under 39 families.

Free swimmers or nektons are important components of marine biodiversity. The dominant taxa in the necton are fish, others being crustaceans, molluscs, reptiles and mammals. In Chennai, 200 species of crustaceans, 272 species of molluscs, 493 species of fishes, 19 species of reptiles and 6 species of mammals are reported (Table 3.11).

**Table 3.11. Marine faunal diversity of Chennai coast.**

No.	Group	Genus (No.)	Species (No.)
1.	Chaetognatha	3	10
2.	Brachiopoda	1	1
3.	Porifera	10	14
	<b>Coelenterata</b>		
4.	Hydromedusae	22	27
5.	Sea Anemones	7	9
6.	Gorgonids	3	3
7.	Scyphozoa	22	32
8.	Siphonophore	18	29
9.	Annelida	4	4
	<b>Arthropoda –Crustacea</b>		
10.	Pelagic crabs	7	28
11.	Benthic crabs	53	58
12.	Amphipoda	38	48
13.	Cirripedes	13	36
14.	Macruran shrimps	11	26
15.	Lobster	3	4
	<b>Mollusca</b>		
16.	Opisthobranchia	7	7
17.	Gastropoda	86	170
18.	Lamellibranchia	45	70
19.	Cephalopods	13	26

	<b>Echinodermata</b>		
20.	Crinoidea	2	2
21.	Asteroidea	7	9
22.	Echinoidea	13	16
23.	Ophiuroidea	5	5
24.	Holothuroidea	7	8
25.	Hemichordata	1	1
	<b>Protochordata</b>		
26.	Tunicata	18	45
27.	Larvacea	6	40
28.	Cephalochordata	2	3
	<b>Chordata</b>		
29.	Pisces	268	493
30.	Reptiles	14	19
31.	Hydrophiidae	7	12
32.	Lizards	1	2
33.	Turtles	5	5
34.	Crocodiles	2	2
35.	Mammals	6	6
36.	Total	730	1270

The turtles and sea snakes are generally oceanic forms but majority of these often swim near to the shore and visit the shore during some part of their life. Twelve species of sea snakes and five species of turtles have been reported from Chennai coast. Olive Ridley turtles visit the shore during breeding season to lay their eggs. Some turtle hatcheries are available along the Neelankarai coast for the protection of these turtle eggs.

The Chennai coast offers a variable feeding and breeding ground for a number of birds. However, no systematic data is available on the coastal dependent shore birds of Chennai. Marine mammals belong to three orders i.e. Sirenia, Cetacea and Carnivora. The stranding of sperm whales and spinner dolphins are regularly reported.

India has a total number of 23,690 species (both terrestrial and marine), out of which only 12,244 species (51.10%) are recorded from marine regions of India. Chennai coast has little over 10% of marine fauna recorded from India. The study conducted along the Chennai coast (from Ennore port to Thiruvanniyur) revealed the occurrence of 1270 species belonging to 730 genera (Table 3.12).

**Table 3.12. Recorded genera / species along Chennai coast**

**List of sponges recorded**

:

<i>Genus</i>	<i>Species</i>
<i>Axinella</i>	<i>Axinella donnani</i>
	<i>Axinella flabelliformis</i>
<i>Acanthella</i>	<i>Acanthella cavernosa</i>
	<i>Acanthella elongate</i>
<i>Oceanapia</i>	<i>Oceanapia arnosa</i>
<i>Sigmatocia</i>	<i>Sigmatocia fibulata</i>
<i>Callispongia</i>	<i>Callispongia diffusa</i>
<i>Dendrilla</i>	<i>Dendrilla membranosa</i>
<i>Sponginella</i>	<i>Sponginella pulvilla</i>
	<i>Sponginella tuberosa</i>
<i>Halicona</i>	<i>Halicona oculata</i>
<i>Mycale</i>	<i>Mycale madraspatana</i>
<i>Tedania</i>	<i>Tedania anhelans</i>
	<i>Tedania nigrescens</i>

**List of Chaetognaths**

<i>Sagitta</i>	<i>Sagitta bedoti</i>
	<i>Sagitta enflata</i>
	<i>Sagitta ferox</i>
	<i>Sagitta hexaptera</i>
	<i>Sagitta neglecta</i>

	<i>Sagittapacifica</i>
	<i>Sagitta pulcra</i>
	<i>Sagitta regularis</i>
	<i>Sagitta robusta</i>
<i>Pterosagitta</i>	<i>Pterosagitta draco</i>
<i>Krohnitta</i>	<i>Krohnitta pacifica</i>
	<i>Krohnitta subtilis</i>

### List of Medusae

<b>Anthomedusae</b>	
<i>Halitiara</i>	<i>Halitiara Formosa</i>
<i>Merga</i>	<i>Mergaa violacea</i>
<i>Amphinema</i>	<i>Amphinema dinema</i>
<i>Leuckartiara</i>	<i>Leuckartiara octona</i>
<i>Cytaeis</i>	<i>Cytaeis tetrastyla</i>
<i>Bougainvillia</i>	<i>Bougainvillia fulva</i>
<i>Kollikeria</i>	<i>Kollikeria constricta</i>
<i>Proboscidactyla</i>	<i>Proboscidactyla conica</i>
	<i>Proboscidactyla ornate</i>
<b>Leptomedusae</b>	
	<i>Staurodiscus tetrastaurus</i>
<i>Phialucium</i>	<i>Phialcium multitentaculata</i>
<i>Eutima</i>	<i>Eutima mira</i>
<i>Irenopsis</i>	<i>Irenopsis hexanemalis</i>
<i>Eirene</i>	<i>Eirene malayensis</i>
	<i>Eirene madrasensis</i>
<i>Octocannoides</i>	<i>Octocannoides ocellata</i>
<i>Octocanna</i>	<i>Octocanna solida</i>
	<i>Octocanna polynema</i>
<i>Aequora</i>	<i>Aequorea macrodactyla</i>

	<i>Aequorea pensili</i>
	<i>Aequorea parva</i>
<i>Zygocanna</i>	<i>Zygocanna buitendijki</i>
<b>Trachymedusae</b>	
<i>Gonionemus</i>	<i>Gonionemus suvaensis</i>
<i>Olindias</i>	<i>Olindias singularis</i>
<i>Liriope</i>	<i>Liriope tetraphylla</i>
<b>Narcomedusae</b>	
<i>Solmundella</i>	<i>Solmundella bitentaculata</i>
<i>Cunocantha</i>	<i>Cunocantha octonaria</i>
<b>Scyphomedusae</b>	
<i>Charybdeidae</i>	<i>Charybdea madraspatana</i>
<i>Tamoya</i>	<i>Tamoya alata</i>
<i>Chiropsalmus</i>	<i>Chiropsalmus quadrumanus</i>
	<i>Chiropsalmus buitendijki</i>
<i>Periphylla</i>	<i>Periphylla hyacinthine</i>
<i>Nausithoe</i>	<i>Nausithoe punctata</i>
<i>Atolla</i>	<i>Atolla wyvillei</i>
<i>Pelagia</i>	<i>Pelagia noctiluca</i>
<i>Chrysaora</i>	<i>Chrysaora helvola</i>
	<i>Chrysaora melanaster</i>
<i>Dactylometra</i>	<i>Dactylometra quinquecirrha</i>
<i>Cyanea</i>	<i>Cyanea nozakii</i>
<i>Aurelia</i>	<i>Aurelia solida</i>
<i>Cassiopea</i>	<i>Cassiopea frondosa</i>
	<i>Cassiopea andromeda</i>
<i>Netrostoma</i>	<i>Netrostoma thphlodendrium</i>
<i>Netrostoma</i>	<i>Netrostoma coerulescens</i>
<i>Mastigias</i>	<i>Mastigias ocellata</i>
	<i>Mastigias albipunctatus</i>
	<i>Mastigias papua</i>



<i>Mastigietta</i>	<i>Mastigietta palmipes</i>
<i>Versura</i>	<i>Versura anadyomene</i>
<i>Thysanostoma</i>	<i>Thysanostoma thysanura</i>
<i>Crambionella</i>	<i>Crambionella stuhlmanni</i>
	<i>Crambionella orsini</i>
	<i>Crambionella annandalei</i>
<i>Acromitus</i>	<i>Acromitus flagellatus</i>
	<i>Acromitus rabanchatu</i>
<i>Lobonema</i>	<i>Lobonema smithii</i>
<i>Lobonemoides</i>	<i>Lobonemoides sewelli</i>
	<i>Lobonemoides robustus</i>
<i>Rhopilema</i>	<i>Rhopilema hispidium</i>

Siphonophores are the most abundant in the Chennai coast and constitute an important fauna in the marine plankton collected with at the surface with a tow net and Nansen's net in the offshore collections (Table 3.12b).

**Table. 3.12b. Recorded genera / species along Chennai coast**

Genus	Species
Physalia	<i>Physalia physalis</i>
Rhiophysida	<i>Rhiophysa eysenhardti</i>
	<i>Agalma okeni</i>
	<i>Agalma elegans</i>
Sulculeolaria	<i>Sulculeolaria chuni</i>
	<i>Sulculeolaria uadrivalvis</i>
	<i>Sulculeolaris turgid</i>
	<i>Sulculeolaris monoica</i>
Diphyes	<i>Diphyes dispar</i>
	<i>Diphyes bojani</i>
	<i>Diphyes chamissonis</i>
Abylopsis	<i>Abylopsis tetragona</i>
	<i>Abylopsis eschscholti</i>
Halistemma	<i>Halistemma rubrum</i>
Nanomia	<i>Nanomia bijuga</i>

Lensia	Lensia subtiloides
	Lensia Cossack
	Lensia hotspur
	Lensia gnanamuthui
	Lensia tottoni
Forskalia	Forskalia leukarti
Eudoxia	Eudoxoides mitra
Muggiaea	Muggiaea contorta
Chelophyes	Chelophyes contorta
Ceratocymba	Ceratocymba leuckartii
Bassia	Bassia bassensis
Enneagonum	Enneagonum hyalinum
Porpira	Porpita porpita
Veella	Veella veella

### Cirripedes

Genus	Species
Pollicipes	Pollicipes polymerus
Smilium	Smilium s uamuliferum
Ibla	Ibla cumingi
Lepas	Lepas anatifera
	Lepas anserifera
	Lepas pectinata
	Lepas bengalensis
Conchoderma	Conchoderma virgatum
	Conchoderma virgatum
Trilasmis	Trilasmis minuta
Octolasmis	Octolasmis tridens
	Octolasmis warwickii
	Octolasmis grayii
	Octolasmis lowei
	Octolasmis stella
	Octolasmis cor
	Octolasmis angulata
Balanus	Balanus tintinnabulum
	Balanus ebumeus
	Balanus amphitrite
	Balanus calidus
	Balanus perforates
	Balanus balanoides
	Balanus tenuis
	Balanus amaryllis
	Balanus longirostrum
	Balanus calceolus
	Balanus cymbiformis

Acasta	Acasta sulcata
Tetraclita	Tetraclita purpurascens
Chelonobia	Chelonobia tstudinaria
	Chelonobia caretta
	Chelonobia patula
Platylepas	Platylepas hexastylus
Chthamalus	Chthamalus stellatus

### Amphipoda

Family: Lysianassidae	Shoemakerella nasuta
Ampeliscidae	Ampelisca amboangae
	Ampelisca Cyclops
	Ampelisca lepta
Family: Haustoridae	Platyischnopus herdmani
	Urothoe spinidigitus
Family: Phoxocephalidae	Leptophoxus uncistrostratus
Family: amphilocheidae	Cyproidea ornate
	Amphilocheus schubarti
Family: Leucothoidae	Leucothoe spinicarpa
	Leucothoe madrasana
Family: Stenothidae	Stenothoe gallensis
Family: Oedicerotidae	Perioculodes longimanus
Family: Calliopiidae	Paracalliope indica
Family: Gammaridae	Eriopisa chikensis
	Megluropus agilis
	Melt fresnalli
	Maera uadrimana
	Maera othonides
	Uadrivisio bengalensis
	Elasmopus pecteniscrus
Family: Talitridae	Talorchestia martensii
	Hyale hawaiiensis
	Hyale honoluluensis
	Micropratopus maculatus
	Cheiriphotis megacheles
	Photis longicaudata
	Photis digitata
Family: Amphithoidae	Ampithoe indica
	Cymadusa filose
Family: Corophidae	Grandidierella bonnieri
	Grandidierella gilesi
	Cerapus abditus
	Ericthonius brasiliensis
	Corophium acherusicm
	Corophium madrasensis

Family: Podoceridae	Podocerus brasiliensis
Family: Lycaeopsidae	Brachyscelus cruscolum
Family: Oxycephalidae	Rhabdosoma armatum
Family: Caprellidae	Tritella pilimana
	Paracaprella lata
	Hyale affinis
	Hyale chevreuxi
	Hyale macrodactyle
Family: Photidae	Eurystheus togonensis
	Photis digitata

### Macrura

Genus: Solenocera	Solenocera crassicornis
Metapenaeopsis	Metapenaeopsis mogiensis
	Metapenaeopsis stridulans
Metapenaeus	Metapenaeus affinis
	Metapenaeus dobsoni
	Metapenaeus ensis
	Metapenaeus monoceros
Parapenaeopsis	Parapenaeopsis coromandelica
	Parapenaeopsis maxillipedo
	Parapenaeopsis sculptilis
	Parapenaeopsis stylifera
	Parapenaeopsis uncta
Parapanaeus	Panaeus longiceps
Panaeus	Panaeus canaliculatus
	Panaeus japonicus
	Panaeus merguensis
	Panaeus monodon
	Panaeus semisulcatus
Trachypanaeus	Trachypanaeus curvirostris
	Trachypanaeus granulatus
Acetes	Acetes erythraeus
	Acetes indicus
Exopalaemon	Exopalaemon styliferus
Nematopalaemon	Nematopalaemon tenuipes
Exhippolysmata	Exhippolysmata ensirostris
Scyllarus	Scyllarus rugosus
Thenus	Thenus orientalis
Family: Palinuridae	Panulirus ornatus
	Panulirus homarus
Brachyura	
Dromia	Dromia dehaani
Cochoecetes	Conchoecetes artificiosus
Dorippe	Dorippe frascione

Paradorippe	Paradorippe granulata
Arcania	Arcania undecimspinosa
	Arcania quinguespinosa
	Arcania septemspinosa
	Arcania erinaceous
Myra	Myra fugax
	Myra affinis
Ixoides	Ixoides cornutus
Ixa	Ixa inermis
	Ixa cylindrus
Parilia	Parilla alcockii
Philyra	Philyra globosa
	Philyra globulosa
	Philyra scabriscula
	Philyra verrucosa
Leucosia	Leucosia anatum
	Leucosia craniolaris
	Leucosia rhomboidalis
	Leucosia longifrons
	Leucosia pubescens
Calappa	Calappa lophos
	Calappa terraereginae
	Calappa phillargius
	Calappa gallus
	Calappa japonica
	Calappa pustulosa
Matuta	Matuta lunaris
	Matuta plainpes
	Matuta miersi
Inachoides	Inachoides dulichorhynchius
Naxoides	Naxoides mammillata
Phalangipus	Phalangipus hystrix
	Phalangipus filliformis
Chorilibinia	Chorilibinia andamanica
Hyastenus	Hyastenus aries
Doclea	Doclea ovis
	Doclea hybrida
	Doclea muricata
	Doclea canalifera
Parthenope	Parthenope longimanus
Playlambrus	Paltylambrus echinatus
Cryptopodia	Cryptopodia fornicate
	Cryptopodia angulata
Zebrida	Zebrida adamsi
Halimede	Halimede octodes
Liagore	Liagore rubramaculata

Demania	Demania scaberrima
Galene	Galene bispinosa
Actea	Actea savignyi
Ozius	Ozius rugulosus
Pilumnus	Pilumnus scabriusculus
Carcinoplax	Carcinoplax longimana
Eucrate	Eucrate sexdentata
	Eucrate crenata

### Cephalopods

Sepia	Sepia aculeate
	Sepia pharaonis
	Sepia koblenensis
	Sepia brevimana
	Sepia prashadi
Sepiella	Sepiella inermis
Aurosepina	Aurosepino arabica
Euprymna	Euprymna berryi
Inioteuthis	Inioteuthis japonica
	Inioteuthis maculosa
Loligo	Loligo duvauceli
	Loligo uyi
	Loligo bengalensis
Doryteuthis	Doryteuthis singhanensis
Sepioteuthis	Sepioteuthis lessoniana
Loliolus	Loliolus investagatoris
Octopus	Octopus aegina
	Octopus rugosus
	Octopus macropus
	Octopus fusiformis
	Octopus areolatus
	Octopus globosus
	Octopus cyaneus
Cistopus	Cistopus indicus
Gaplochlaena	Gaplochlaena fasciata
Berrya	Berrya hoylri

### Echinoderms

Family: Mariametrida	Lamprometra palmata
Family: Tropiometridae	Tropiometra carinata
Family: Luidiidae	Luidia hardwicki
	Luidia maculate
Family: Astropectinidae	Astropecten bengalensis
	Astropecten indicus

	<i>Astropecten zebra</i>
Family: Ophiasteridae	<i>Linckia laevigata</i>
Family: Oreasteridae	<i>Anthenea pentagonula</i>
	<i>Pentaceraster indicus</i>
	<i>Pentaceraster regulus</i>
Family: Goniasteridae	<i>Stellaster equestris</i>
Family: Echinasteridae	<i>Echinaster purpurus</i>
Family: Metrodiridae	<i>Metrodira subulata</i>
Family: Ophiactidae	<i>Ophiactis savignyi</i>
Family: Ophiothricidae	<i>Ophiothrix exigua</i>
	<i>Ophiocnemis marmorata</i>
	<i>Ophiopterion elegans</i>
	<i>Ophiothela danae</i>
Family: Diadematidae	<i>Astropyga radiata</i>
Family: Stomechindae	<i>Stomopneustes variolaris</i>
Family: Temnopleuridae	<i>Salmacis bicolour</i>
	<i>Salmacis virgulata</i>
Family: Temnopleuridae	<i>Temnopleurus toreumaticus</i>
Family: Toxopneustidae	<i>Pseudoboletia maculate</i>
Family: Clypeasteridae	<i>Clypeaster rarispinus</i>
Family: Fibularidae	<i>Fibularia volva</i>
Family: Laganidae	<i>Laganum depressum</i>
Family: Astriclypeidae	<i>Echinodiscus aurites</i>
	<i>Echniodiscus bisperforatus</i>
Family: Echniolampadidae	<i>Echniolampas ovata</i>
Family: Spatangidae	<i>Pseudomareia alta</i>
Family: Loveniidae	<i>Lovenia elongate</i>
Family: Brissidae	<i>Metalia sternalis</i>
Family: Holothuriidae	<i>Bohadschia marmorata</i>
	<i>Holothuria spinifera</i>
Family: Cucumariidae	<i>Stolus buccalis</i>
	<i>Leptopentacta imbricate</i>
Family: Phyllophoridae	<i>Phyllophorus parvipedes</i>
	<i>Phyllophorus brocki</i>
Family: Caudinidae	<i>Acaudina molpadiodes</i>
Family: Synaptidae	<i>Synaptula recta</i>

## Fishes

Family	Species
Pristidae	<i>Anoxypristis cuspidate</i>
	<i>Pristis zijsron</i>
Hemisclidae	<i>Chyloscyllium griseum</i>
Steogostomatidae	<i>Stegostoma fasciatum</i>
Lamnidae	<i>Isurus oxyrinchus</i>

Sphyrnidae	Sphyrna lewini
Carcharhinidae	Carcharhinus dussumieri
	Carcharhinus melanopterus
	Galeocredo cuvieri
	Hemipristis eleongates
	Rhizoprionodon acutus
	Rhizoprionodon oligolinx
	Scoliodon laticaudus
Narcinidae	Narcine brunnea
	Narcine maculata
	Narcine timlei
Narkidae	Bengalichthys impennis
	Narke dipterygia
Rhinodotidae	Rhina ancylostoma
	Rhinobatos granulatus
	Rhinobatus thouiniana
	Rhynchobatus djiddensis
Myliobatidae	Aetomylaeus nichofii
	Rhinoptera adpersa
Mobulidae	Mobula diabolus
Dasyatidae	Dasyatis imbricate
	Dasyatis kuhlii
	Dasyatis zugei
	Gymnura japonica
	Gymnura poecilura
	Himantura favus
	Himantura walga
	Hypolophus sephen
	Uroigymnus asperrimus
Muraenesocidae	Muraenesox cinereus
Congridae	Ariosoma anago
	Uroconger lepturus
Clupeidae	Anodontosoma chacunda
	Dussumieria acuta
	Escualosa thoracata
	Hils kelee
	Nematolosa nasus
	Sardinella brachysoma
	Sardinella fimbriata
	Sardinella gibbosa
	Sardinella longiceps
	Ilisha elongate
	Ilisha megaloptera
	Ilisha melastoma
	Ilisha striatula
	Ophisthopterus tardoore



	<i>Pelloina ditchela</i>
Elopidae	<i>Elops machnata</i>
Megalopidae	<i>Megalops cyprinoids</i>
Albulidae	<i>Albula vulpes</i>
Anguillidae	<i>Anguilla bengalensis</i>
	<i>Anguilla bicolor</i>
Muraenidae	<i>Thrysoidea macrura</i>
Ophichthidae	<i>Ophichthus apicalis</i>
	<i>Ophichthus microcephalus</i>
	<i>Pisodonophis boro</i>
	<i>Pisodonophis cancrivorus</i>
Engraulididae	<i>Coilia dussumieri</i>
	<i>Coilia reynaldi</i>
	<i>Encrasicholina heteroloba</i>
	<i>Setipinna taty</i>
	<i>Stolephorus andhraensis</i>
	<i>Stolephorus baganensis</i>
	<i>Stolephorus commersonii</i>
	<i>Stolephorus indicus</i>
	<i>Thryssa dayi</i>
	<i>Thryssa dussumieri</i>
	<i>Thryssa hamiltonii</i>
	<i>Thryssa malabarica</i>
	<i>Thryssa purava</i>
	<i>Thryssa mystax</i>
	<i>Thryssa setirostris</i>
<i>Thryssa vitrirostris</i>	
Chirocentridae	<i>Chirocentrus dorab</i>
	<i>Chirocentrus nudus</i>
Chanidae	<i>Chanos chanos</i>
Ariidae	<i>Ariodes dussumieri</i>
	<i>Arius arius</i>
	<i>Arius caelatus</i>
	<i>Arius jella</i>
	<i>Arius maculatus</i>
	<i>Arius sona</i>
	<i>Arius sumatranus</i>
	<i>Arius thalassinus</i>
	<i>Osteogeneiosus militaris</i>
Plotosidae	<i>Plotosus canius</i>
	<i>Plotosus lineatus</i>
Synodontidae	<i>Saurida micropectoralis</i>
	<i>Saurida pseudotumbil</i>
	<i>Saurida tumbil</i>
	<i>Synodus indicus</i>
	<i>Trachinocephalus myops</i>

Harpadontidae	Harpadon nehereus
Bermacerotidae	Bermaceros macclellandii
Carapidae	Carapus homei
Ophidiidae	Brotula multibarbata
Antennariidae	Antennarius hispidus
	Antennarius nummifer
Exocoetidae	Cheilopogon furcatus
	Cypselurus bahiensis
	Cypselurus spilopterus
	Parexocoetus mento
Hemiramphidae	Hemiramphus far
	Hyporhamphus limbatus
	Hyporhamphus xanthopterus
	Rhynchorhamphus malabaricus
Belonidae	Strongylura strongylura
	Tylosurus crocodiles
Atherinidae	Atherinomorus duodecimalis
Holocentridae	Myripristis murdjan
Pegasidae	Pegasus volitans
Fistulariidae	Fistularia petimba
Centriscidae	Centriscus scutatus
Syngnathidae	Hippichthys cyanospilos
	Microphis brachyurus
	Microphis cuncalus
	Trachyrhamphus longirostris
	Trachyrhamphus serratus
Dactylopteridae	Dactyloptera orientalis
Scorpaenidae	Apistes carinatus
	Centropogon indicus
	Choridactylus multibarbus
	Minous monodactylus
	Ptiodichthys amboinensis
	Pterois miles
	Pterois mombasae
	Pterois russellii
	Pterois volitns
	Scorpaenopsis strongia
	Trachicephalus uranoscopus
Ambassidae	Ambassis commersoni
	Ambassis dayi
	Ambassis gymnocephalus
	Ambassis interruptus
	Ambassis miops
	Ambassis urotaenia
Tetrarogidae	Tetraroge niger
Aploactinidae	Cocotropus roseus

Triglidae	Lepidotrigla omanensis
	Lepidotrigla riggsi
	Lepidotrigla spiloptera
Platycephalidae	Cociella crocodile
	Grammoplites scaber
	Grammoplites suppositus
	Inegocia japonica
	Platycephalus indicus
	Sorsogona tuberculata
	Suggrundus bengalensis
	Suggrundus rodericensis
	Thysanophrys celebica
	Centropomidae
Serranidae	Cephalopholis formosa
	Cephalopholis sonnerati
	Epinephelus areolatus
	Epinephelus caeruleopunctatus
	Epinephelus coioides
	Epinephelus diacanthus
	Epinephelus flavocaeruleus
	Epinepheluslatifasciatus
	Epinepheluslongispinis
	Epinephelusmalabaricus
	Epinephelus morrhua
	Epinephelus undulosus
	Teraponidae
Terapon jarbua	
Terapon puta	
Terapon theraps	
Priacanthidae	Priacanthus hamrur
	Priacanthus tayenus
Apogonidae	Apogon aureus
	Apogon bandanensis
	Apogon kallosoma
	Apogon multitaeniatus
	Apogon nigricans
	Apogon nigripinnis
	Apogon quadrifasciatus
	Apogon taeniatus
	Apogon thurstoni
	Apogonichthys ellioti
	Apogonichthys ocellatus
	Apogonichthys poecilopterus
Archamia lineolata	
Malacanthidae	Hoplolatilus fronticinctus
Lactaridae	Lactarius lactarius

Rachycentridae	Rachycentron canadus	
Sillaginidae	Silago lutea	
	Sillago sihama	
	Sillago soringa	
	Sillago vincenti	
Echeneididae	Echeneis naucrates	
	Remora brachyptera	
Carangidae	Alectis ciliaris	
	Alectis indicus	
	Alepes djedaba	
	Alepes melanoptera	
	Atropus atropus	
	Atule mate	
	Carangoides armatus	
	Carangoides caeruleopinnatus	
	Carangoides chrysophrys	
	Carangoides gymnostethus	
	Carangoides malabaricus	
	Carangoides oblongus	
	Carangoides praeustus	
	Carangoides talamparoides	
	Caranx ignobilis	
	Caranx carangus	
	Caranx para	
	Caranx sexfasciatus	
	Decapterus russelli	
	Elagatis bipinnulatus	
	Megalaspis cordyla	
	Parastromateus niger	
	Scomberoides lysan	
	Scomberoides tala	
	Scomberoides tol	
	Selar crumenophthalmus	
	Selaroides leptolepis	
	Seriolina nigrofasciata	
	Trachinotus mookalee	
	Coryphaenidae	Coryphaena hippurus
	Leiognathidae	Gazza minuta
Leiognathus berbis		
Leiognathus bindus		
Leiognathus blochii		
Leiognathus brevis		
Leiognathus daura		
Leiognathus dussumieri		
Leiognathus equulus		
Leiognathus fasciatus		

	Leiognathus leuciscus
	Leiognathus lineolatus
	Leiognathus splendens
	Secutor insidiator
	Secutor ruconius
Lutjanidae	Lutjanus argentimaculatus
	Lutjanus fulviflamma
	Lutjanus fulvus
	Lutjanus johni
	Lutjanus kasmira
	Lutjanus lemniscalus
	Lutjanus lutjanus
	Lutjanus madras
	Lutjanus malabaricus
	Lutjanusrivulatus
	Lutjanusrusselli
	Lutjanus sanguineus
	Lutjanus sebae
	Lutjanus vittae
Gerridae	Gerres abbreviatus
	Gerres filamentosus
	Gerres limbatus
	Gerres lucidus
	Gerres oblongus
	Gerresoyena
	Gerrespoeti
	Gerromorpha setifer
	Pentaprion longimanus
Haemulidae	Diagramma pictum
	Plectorhinchus cuvieri
	Plectorhinchus gibbosus
	Plectorhinchus orientalis
	Plectorhinchus pictus
	Pomadasys argentatus
	Pomadasys argyreus
	Pomadasys furcatum
	Pomadasys kaakan
	Pomadasys maculatum
Sparidae	Acanthopargus berda
	Acanthopargus latus
	Argyrops spinifer
	Crenidens crenidens
	Rhabdosargus sarba
Lethrinidae	Lethrinus nebulosus
Monodactylidae	Monodactylus argenteus
Pempherididae	Pempheris molucca

Ephippididae	Ephippus orbis
Nemipteridae	Nemipterus bipunctatus
	Nemipterus japonicus
	Nemipterus nematophorus
	Nemipterus peronii
	Nemipterus randalli
	Scolopsis bimaculatus
	Scolopsis vosmeri
	Sciaenidae
	Dendrophysa russelli
	Johnieops dussumieri
	Johnieops macrorhynchus
	Johnieops sina
	Johnius belangeri
	Johnius carutta
	Johnius coitor
	Johnius dussumieri
	Johnius macropterus
	Kathala axillaries
	Nibea maculate
	Otolithes cuvieri
	Otolithes rubber
Pennahia macrophthalmus	
Protonibea diacanthus	
Mullidae	Mulliodes vanicolensis
	Parupeneus indicus
	Upeneus bensasi
	Upeneus luzonius
	Upeneus moluccensis
	Upeneus sulphureus
	Upeneus taeniopterus
	Upeneus tragula
	Upeneus vittatus
Platacidae	Platax pinnatus
Drepanidae	Drepane punctatus
Scathophagidae	Scathophagus argus
Chaetodontidae	Chaetodon collare
	Chaetodon decussates
	Chaetodon octofasciatus
	Chaetodon vagabundus
	Heniochus acuminatus
Pomacanthidae	Apolemichthys xanthurus
Cichlidae	Etroplus suratensis
Pomacentridae	Pristotis jerdoni
Cirrhitidae	Cirrhitichthys aureus
Cepolidae	Acanthocephala abbreviate

Mugilidae	Liza macrolepis
	Liza melinoptera
	Liza parsia
	Liza tade
	Liza vaigiensis
	Mugil cephalus
	Valamugil buchanani
	Valamugil cunnesius
	Valamugil speigleri
Sphyraenidae	Sphyraena forsteri
	Sphyraena jello
	Sphyraena obtusata
Polynemidae	Eleutheronema tetradactylum
	Polydactylus heptadactylus
	Polydactylus indicus
	Polydactylus plebeius
	Polydactylus sexfilis
	Polydactylus sextarius
Labridae	Cheilinus bimaculatus
	Xyrichtys pavo
	Xyrichtys pentadactylus
Scaridae	Scarus blochii
	Scarus dubius
	Scarus sordidus
Ophistognathidae	Ophistognathus rosenbergii
Uronoscopidae	Uranoscopus cognatus
	Uranoscopus guttatus
Trichonotidae	Trichonotus setiger
Mugiloidae	Parapercis pulchella
	Parapercis punctulata
Blenniidae	Omobranchus zebra
	Xiphasia setifer
Ammodytidae	Bleekeria kallelepis
Callionymidae	Callionymus japonicus
	Callionymus sagitta
	Eleutherochir opercularis
	Synchiropus lineolatus
Eleotridae	Eleotris fusca
	Prionobutis koilomatodon
Trichiuridae	Eupleurogrammus muticus
	Lepturacanthus savala
	Trichiurus lepturus
Trypauchenidae	Ctenotrypauchen microcephalus
	Trypauchen vagina
Istiophoridae	Istiophorus platypterus
	Makaria indica

Gobioidei	Brachyamblyopus urolepis
	Taenioides anguillaris
	Taenioides buchanani
Gobiidae	Acentrogobius cyanomos
	Acentrogobius ennorensis
	Acentrogobius globiceps
	Acentrogobius griseus
	Acentrogobius madraspatensis
	Acentrogobius ornatus
	Acentrogobius viridipunctatus
	Apocryptes bato
	Apocryptichthys cantoris
	Apocryptodon madurensis
	Awaous gutum
	Bathygobius ostreicola
	Boleophthalmus boddarti
	Boleophthalmus sculptus
	Brachygobius nusus
	Cryptocentrus gymnocephalus
	Favonigobius reichei
	Glossogobius biocellatus
	Glossogobius giuris
	Gobiopterus chuno
	Mahidolia mystacina
	Oligolepis acutipennis
	Oligolepis cylindriceps
	Oplopolus caninoides
	Oxuderces dentatus
	Oxyurichthys microlepis
	Oxyurichthys tentacularis
	Oxyurichthys formosanus
	Parachaeturichthys polynema
	Parapocryptes rictuosus
	Parapocryptes serperaster
	Periophthalmus chrysopilus
	Periophthalmus koelreuteri
Periophthalmus pearsei	
Periophthalmus variabilis	
Pseudopocryptes lanceolatus	
Stenogobius malabaricus	
Stigmatogobius javanicus	
Yongeichthys criniger	
Nomeidae	Psenes cyanophrys
Ariommatidae	Ariomma indica
Stromateidae	Pampus argentatus
	Pampus chinensis



Acanthuridae	Acanthurus bleekeri
	Acanthurus celebicus
	Acanthurus nigrofuscus
	Acanthurus triostegus
	Acanthurus xanthopterus
Siganidae	Siganus canaliculatus
	Siganus guttatus
	Siganus javus
	Siganus spinus
Scombridae	Euthynnus affinis
	Rastrelliger faughni
	Rastrelliger kanagurta
	Scomberomorus commersoni
	Scomberomorus guttatus
	Scomberomorus lineolatus
Psettodidae	Psettodes erumei
Citharidae	Brachypleura novemzealandidae
Bothidae	Arnoglossus intermedius
	Bothus pantherinus
	Crossorhombus azureus
	Crossorhombus valderostratus
	Engyprosopon grandisquama
	Laeops guntheri
	Pseudorhombus arsius
	Pseudorhombus elevatus
	Pseudorhombus malayanus
	Pseudorhombus triocellatus
	Cynoglossidae
Cynoglossus bilineatus	
Cynoglossus dispar	
Cynoglossus kopsi	
Cynoglossus lida	
Cynoglossus lingua	
Cynoglossus macrostomus	
Cynoglossus puncticeps	
Cynoglossus semifasciatus	
Paraplagusia bilineata	
Paraplagusia blochii	
Soleidae	
	Euryglossa orientalis
	Solea elongate
	Solea ovata
	Synaptura albomaculata
	Synaptura commesoniana
	Zebrias quagga
	Zebrias synapturoides

Balistidae	Abalistes stellatus
	Balistes vetula
	Canthidermis maculatus
Triacanthidae	Pseudotriacanthus strigifer
	Triacanthus brevirostris
Monacanthidae	Aluterus scriptus
	Paramonocanthus choirocephalus
	Psilopcephalus barbatus
Ostraciidae	Ostracion cubicus
	Rhynchostracion nasus
	Tetrosomus gibbosus
Tetradontidae	Arothron hispidus
	Arothron immaculatus
	Arothron leopardus
	Arothron nigropunctatus
	Arothron stellatus
	Canthigaster margritatus
	Chelonodon fluviatilis
	Chelonodon patoca
	Lagocephalus inermis
	Lagocephalus lunaris
	Lagocephalus spadiceus
	Takifugu oblongus
	Torquigener hypselogeneion

### Checklist of sponges in Gulf of Mannar

Order: Astrophorida	Family: Scleritodermidae	
	Aciculties orientalis	Amphibleptula herrdmani
	Family: Ancorinidae	
	Ancorina simplex	Asteropus simplex
	Ecionemia acervus	Ecionemia laviniensis
	Myriastria clavosa	Penares intermedia
	Rhabdastrella globostellata	Rhabdastrella providentiae
	Stelletta herdmani	Stelletta tethyopsis
	Stelletta vestigium	
	Family: Coppatiidae	
	Cryptotethya agglutinans	Jaspis bouilioni
	Jaspis penetrans	Jaspis investigatrix
	Jaspis reptans	Zaplethea diagnoxa
	Family: Geodiidae	
	Erylus carteri	Geodia areolata
	Geodia inconspicua	Geodia globostellifera
	Geodia perermata	Geodia lindgreni
	Geodia ramodigitata	Geodia picteti
	Family: Pachastrellidae	
	Halina extensa	Halina plicata
Pachastrella nana	Pachampilla dendyi	
Poecillastra schulzei	Poecillastra eccentrica	
	Sphinctrella annulata	
Order: Hadromerida	Family: Chondrillidae	
	Chondrilla kilakaria	Chondrilla sacciformis
	Chondrosia reniformis	
	Family: Clionidae	
	Cliona celata	Cliona anulifera
	Cliona lobata	Cliona carpentari
	Cliona margeritifera	Cliona ensifera
	Cliona orientalis	Cliona mucronata
	Cliona vastifica	Cliona quadrata
	Delectona pulchella	Cliona viridis
	Thoosa investigatoris	Thooce socialis
	Family: Latrunculidae	
	Latrunculia tenuinstella	
	Family: Placo spongiidae	
	Placospongia corinata	Placospongia melobesiodes
	Family: Spirastrellidae	
	Spirastrella coccinaea	Spirastrella aurivilli
	Spirastrella florida	Spirastrella cuspidifera
	Spirastrella inconstans	Spirastrella pachyspira
	Spirastrella punctulata	

Order: Hadromerida	Family: Subertidae	
	Laxosuberites conulosus	Aptos aptos
	Laxosuberites lacustris	Aptos unispiculus
	Laxosuberites proteus	Laxosuberites cruciatus
	Suberites carnosus	Pseudosuberites andrewi
	Teropios fugax	Suberites tylobtusa
	Family: Tethyidae	
	Tethya japonica	Tethya repens
	Tethya robusta	Tethya andamanensis
	Xenospongia patelliformis	
	Family: Timeidae	
	Kotimea moorei	Timea capitatostellifera
	Timea spinatostellifera	Timea curvistellifera
	Timea stelligera	Timea stellata
Timea stellivarians		
Order: Lithistida	Family: Corallistidae	
	Corallistes aculeate	Corallistes elegantissima
	Corallistes verucosa	
	Family: Theonellidae	
	Discodermia enigmatica	Discodermia laevidiscus
	Discodermia spinispirulifera	Discodermia papillata
	Discodermia sinuosa	Discodermia scepterllifera
	Theonella swinhoei	
	Family: Desmanthidae	
	Lophocanthus rhabdophorus	

### Checklist of hard corals in Gulf of Mannar

Family: Acroporidae	Montipora foliosa	Montipora aequituberculata
	Montipora tuberculosa	Montipora monasteriata
	Montipora informis	Montipora spumosa
	Montipora turgescens	Montipora venosa
	Montipora verrucosa	Montipora hispida
	Montipora digitata	Montipora millipora
	Montipora jonesi	Montipora manauliensis
	Montipora explanata	Montipora exserta
	Acropora rudis	Acropora humilis
	Acropora valida	Acropora digitifera
	Acropora solitaryensis	Acropora secale
	Acropora valenciennesi	Acropora muricata
	Acropora millepora	Acropora intermedia
	Acropora cytherea	Acropora hyacinthus
	Acropora granulose	Acropora microphthalma
	Astrepora myriophthalma	Acropora echinata
Family: Astrocoeniidae	Madracis kirbyi	
Family: Pocilloporidae	Pocillopora damicornis	Pocillopora verrucosa
	Pocillopora eydouxi	
Family: Euphyllidae	Euphyllia glabrescens	
Family: Oculinidae	Galaxea astreata	Galaxea fascicularis
Family: Siderastreaeidae	Pseudosiderastrea tayami	Psammocora contigua
	Coscinaraea monile	
Family: Faviidae	Favia stelligera	Favia pallid
	Favia speciosa	Favia fava
	Favites halicora	Favites pentagona
	Favites complanata	Favites abdita
	Goniastrea retiformis	Favites bestae
	Platygyra daedalea	Goniastrea pectinata
	Leptoria Phrygia	Platygyra sinensis
	Leptastrea transversa	Montastrea valenciennesi
	Cyphastrea serialia	Leptastrea purpuriea
	Echinopora lamellose	Cyphastrea microphthalma
Family: Poritidae	Porites lutea	Porites solida
	Porites compressa	Porites lichen
	Porites mannarensis	Porites exserta
	Goniopora stokes	Porites minicoensis
	Goniopora planulata	Goniopora stutchburyi
Family: Fungiidae	Cycloseris cyclolites	

Family: Pectiniidae	Mycedium elephantotus	
Family: Merulinidae	Hydnophora exesa	Hydnophora microconos
Family: Dendrophylliidae	Turbinaria peltata	Turbinaria mesenterina
Family: Mussidae	Symphyllia radians	
Family: Agariciidae	Pavona cactus	Pavona varians
	Pavona clavus	Pavona decussate
	Pachyseris rugosa	

### Check list of soft corals in Gulf of Mannar

Family: Alcyoniidae	Alcyonium flaccidum	Cladiella pachyclados
	Lobophytum compactum	Lobophytum batarum
	Lobophytum durum	Lobophytum crassum
	Lobophytum pauciflorum	Lobophytum latilobatum
	Sarcophyton cherbonneri	Lobophytum strictum
	Sarcophyton serener	Sarcophyton elegans
	Sarcophyton trocheliphorum	Sarcophyton stellatum
	Sinularia brassica	Sinularia abrupt
	Sinularia erecta	Sinularia dissecta
	Sinularia granosa	Sinularia grandilobata
	Sinularia intact	Sinularia hirta
	Sinularia mannarensis	Sinularia leptoclados
	Sinularia polydactyla	Sinularia numerosa
Family: Xeniidae	Sympodium granulorum	Sympodium pulchrum
	Xenia ternate	Xenia nana
	Xenia umbellate	
Family: Cornularidae	Cornularia cornucopiae	
Family: Subergorgiidae	Subergorgia reticulate	Subergorgia suberosa
Family: Paramuriceidae	Thesea flava	
Family: Ellisellidae	Ellisella amdamanensis	Juncella juncea
	Juncella miniacea	Nicella dichotoma
	Gorgonella umberculam	
Family: Umbellulidae	Umbellula indica	Umbellula pemdula
	Umbellula radiata	
Family: Briareidae	Muricella ramose	

**Check list of coral reef associated crustaceans in Gulf of Mannar**

Order: Decapoda	Family: Penaeidae	
	Aristeus semidentatus	Metapenaeopsis hilarula
	Metapenaeopsis andamanensis	Metapenaeopsis strudulans
	Metapenaeus burkenroadi	Metapenaeus affinis
	Metapenaeus lysinassa	Metapenaeus dobsoni
	Parapenaeopsis cornuta	Parapenaeopsis acclivirostris
	Parapenaeopsis uncta	Parapenaeopsis tenella
	Parapenaeopsis stylifera	Parapenaeopsis sculptilis
	Penaeus japonicus	Penaeopsis rectacuta
	Penaeus merguensis	Penaeus latisulcatus
	Penaeus semisulcatus	Penaeus indicus
	Family: Solenoseridae	
	Solenocera crassicornis	Solenocera hexti
	Family: Hippolytidae	
	Exhippolosmata ensirostris	
	Family: Palaemonidae	
	Macrobrachium hendersonium	Periclimenes bravycarpalis
Family: Nephropsidae		
Nephrops thomsoni		
Section: Anomura	Family: Galtheidae	
	Calcinus herbsti	Cacinus gaimardi
	Munidopsis cylingroththalmus	Galathea elegans
	Munidopsis trifida	Munidopsis requia
	Porcellanella trilobata	Munidopsis ceratophthalmus
	Porcellanella gaekvari	
	Family: Diogenidae	
	Dardanus megistos	Dardanus hessi
	Dardanus deformis	Dardanus asper
	Family: Coenobitidae	
	Coenobita rugosa	
	Family: Paguridae	
	Clibanarius arethusa	Clibanarius corallines
	Clibanarius merguensis	Clibanarius longitarsus
	Clibanarius cranantatus	Clibanarius clibanarius
	Clibanarius infraspinates	Clibanarius zebra
	Diogenes miles	Diogenes avarus
	Dioganes rectimanus	Diogenes planimanus
	Dioganes diogenes	Diogenes investigarotus
	Diogenes custos	Diogenes costatus
	Paguristes longirostris	Diogenes merguensis
	Paguras megistos	Paguristes incomitatus
	Paguras setifer	
	Family: Palinuridae	

	Panulirus homarus	Panulirus polyphagus
Section: Brachyura	Family: Portunidae	
	Portunus samoiensis	Portunus pupescens
	Portunus sanguinolentius	Portunus pelagicus
	Thalmita spinifera	Thalmita integra
	Thalmita prymna	Charybdis annulata
	Charybdis hellari	Charybdis cruciata
	Charybdis natator	Charybdis anisoden
	Charybdis lucifera	Charybdis orientalis
	Family: Grapsidae	
	Grapsus albolineatus	Metapograpsus thukura
	Pachygrapsus minutes	Metapograpsus frontalis
	Plagusia depressa	Sesarma bidens
	Percnon planissimum	
	Family: Ocypodidae	
	Ocypoda ceratophthalma	Uca annulipes
	Dotilla myctiroides	Uca marionis
	Macrophthalmus depressus	Macrophthalmus convexus
	Family: Xanthidae	
	Atergatis integerrimus	Actaea granulata
	Actaea interserrimus	Actaea ruppelli
	Corpilodes tristis	Corpilodes lophopus
	Cymo andoreosyi	Chlorodiella nigra
	Cymo tuberculatus	Cymo malanodactylus
	Estisus electra	Galena bispinosa
	Heteropanope laevis	Eurycarcinus grandieri
	Leptodius exaratus	Leptodius cavipes
	Ozius rugilorus	Leptodius euglyptus
	Pilumnus heterodon	Pilumnus nadersoni
	Tetralia glaberrima	Phymodius monticulosus
	Xantho scabarimms	Xantho crassimanus
	Family: Calappidae	
	Calappa lophos	Calappa hepatica
	Matuta lunaris	Calappa philargius
	Matuta planipes	
	Family: Leucosiidae	
	Leucosia pubescens	Philyra verucosa
Philyra adamis	Philyra globosa	
Family: Parthinopidae		
Aulacolumbrus hoplonotus	Lambrus longimanus	
Rhaptonotus pictus		
Family: Maiidae		
Acanthonyx macleayi	Doclea gracillips	
Micippa thalia	Menaethius monoceros	
Schizophrys aspera	Micippa phylira	



Section: Brachyura	Family: Dorippidae	
	Dorippe frascone	Dorippe granulata
	Dorippe polita	
	Family: Dromiidae	
	Dromidopsis cranioides	Dromia rumphii
	Pseudodromia integrifrons	Dromia dehani
	Family: Pinnotheridae	
	Pinnotheris deccanensis	Pinnotherus ridgewayi
	Family: Hymenosomidae	
	Elemia sindensis	

**Check list of corals associated molluscs in Gulf of Mannar**

Order: Lepidopleuridae	Family: Cryptoplacidae	
	Cryptoplax oculatus	
Order: Archaeogastropoda	Family: Patallidae	
	Patella flexuosa	Scutellastera flexuosa
	Family: Trochidae	
	Euchelus asper	Euchellus atratus
	Euchellus horridus	Euchellus circulates
	Family: Stomatellidae	
	Turbo marmoratus	
	Family: Neritidae	
	Nerita albicilla	Nerita chamaeleon
	Nerita squamulata	Nerita Maura
	Nerita plicata	Nerita polita
Order: Mesogastropoda	Family: Littorinidae	
	Littorina scabra	Nodilittorina millegrana
	Family: Planaxidae	
	Planaxis sulcatus	
	Family: Potamididae	
	Cerithedea cingulata	Cerithedea quadrata
	Telescopium telescopium	Telescopium fuscum
	Family: Cerithiidae	
	Cerithium adamsonii	Cerithium balteatum
	Cerithium echinatum	Cerithium columna
	Cerithium tenellum	Cerithium menkei
	Cerithium salebrosum	Cerithium tuberculatum
	Clypeomorus clypeomorus	Cerithium scabridum
	Clypeomorus batillariaeformis	Clypeomorus moniliferus
	Clypeomorus petrosagennisi	Clypeomorus delectum
	Clypeomorus splendens	
	Family: Epitoniidae	
	Arcilla acuminata	Epitonium immaculatum
	Epitonium lamellose	Epitonium latifasciatum
	Family: Janthinidae	
	Janthina globosa	Janthina roseola
	Family: Xenophoridae	
	Xenophora solaris	Xenophora corrugata
	Family: Calyptraeidae	
	Calyptraea extintorium	Cheilea equestris
	Crepidula walshi	Cheilea undulata
	Family: Strombidae	
	Strombus rubbosa	Strombus canarium
	Strombus gibberulus	Strombus mutabilis

Order: Mesogastropoda	Lambis lambis	Lambis chiragra
	Terebellum terebellum	Lambis scorpius
	Family: Capulida	
	Xenophora solaris	
	Family: Naticidae	
	Natica maroschiensis	Natica vitellus
	Natica linneata	Natica alapapilonis
	Natica tigrina	Natica orientalis
	Polinices zanzibarica	Polinices melanostomus
	Polinices effuse	Polinices peselphanti
	Polinices timudus	Polinices mamilla
	Sinum tumescens	Sinum neritoideum
	Family: Cypraeidae	
	Cypraea carputea	Cypraea arabica
	Luria isabella	Cypraea moneta
	Mauritia Arabica	Lucina lynx
	Family: Ovilidae	
	Erronea caurica	Dimnovula punctata
	Erronea erronea	Erronea listeri
	Erosaria caputserpentis	Erronea pulchella
	Palmadusta clandestine	Erosaria ocellata
	Pustularia childrenii	
	Family: Triviidae	
	Dolichupis globosa	
	Family: Cassididae	
	Phalium areola	Phalium canaliculatum
	Phalium bisulcatum	Phalium glaucum
	Family: Ficidae	
	Ficus ficus	Ficus ficoides
	Ficus vareigata	
	Family: Ranellidae	
	Cymatium nacobaricum	Cymatium pileare
	Cymatium pfeifferianum	Cymatium muricinum
Gyrineum gyrineum	Distorsio reticularis	
Family: Bursidae		
Bursa bufonia	Bufonaria rana	
Bursa spinosa	Bursa margaritula	
Tutufa bubo	Colubellina granularis	
Tutufa rubeta		
Order: Neogastropoda	Family: Muricidae	
	Chicoreus annandalei	Chicoreus capucinus
	Murex trapa	Murex tenuirostrum
	Murexilla andamanensis	Murex trinulus
	Thais rudolphi	Thais carnifera
Thais tissoti		
Order: Neogastropoda	Family: Buccinidae	

	Cantharus delicate	Babylonia zeylanica
	Engina alveolata	
	Family: Nassariidae	
	Nassarius nigra	Nassarius vittatus
	Nassarius albescens	Nassarius auricularius
	Nassarius callospira	Nassarius escitibus
	Nassarius olivaceus	Nassarius cemelus
	Family: Fascioliidae	
	Leucozonia smaragdulus	Latrius smaragdulus
	Family: Olividae	
	Olivella sp.	
	Family: Mitridae	
	Mitra guttata	Scabricola caerulea
	Family: Vasidae	
	Vasum ceramicum	
	Family: Harpidae	
	Harpa davidis	
	Family: Marginellidae	
	Marginella lateritia	
	Family: Turridae	
	Lophiotoma abbreviate	Lophiotoma cingulifera
	Family: Conidae	
	Conus distans	Conus andamanensis
	Conus biliosus	
Order: Arcoida	Family: Arcidae	
	Arca plicata	Arca symmentrica
	Barbatia tenella	Barbatia amygdalumtostum
Order: Mytiloida	Family: Mytilidae	
	Lithophaga laevigata	Modiolus philippinarum
	Family: Pteriidae	
Order: Pterioida	Pinctada fucata	
	Family: Isognomonidae	
	Isognomon perna	
	Family: Pectinidae	
	Excelichlamys histrionic	Cyclopecten fluctuates
	Pedum spondypoideum	Parvamussium cristellum
	Family: Anomiidae	
	Placuna sella	
	Family: Ostreidae	
	Crassostrea madrasensis	
	Family: Carniidae	
	Cardium asiaticulum	
	Family: Mactridae	
	Mactra decora	
Order: Pterioida	Family: Tellinidae	

	Macoma truncate	Macoma reticulata
	Tellina scobinata	
	Family: Donacidae	
	Donax incarnatus	Donax faba
	Gari pulcherrima	Donax compressus
	Sanguinolaria oblonga	Sanguinolaria elongata
	Family: Trapeziidae	
	Trapezium bicarinatum	
	Family: Veneridae	
	Clausinella callophyllia	Lioconcha philippinarum
	Meretrix meretrix	Meretrix casta
	Paphia textrix	Paphia textile
	Tapes deshayesi	Ruditapes philippinarum
	Venus toreuma	Timoclea marica
Order: Sepioida	Family: Sepiidae	
	Sepia pharaonis	Sepia brevimana
	Sepiella inermis	
	Family: Sepiolidae	
	Euprymna berryi	
Order: Teuthida	Family: Loliginidae	
	Sepioteuthis lessoniana	Loligo duvauceli
Order: Articulata	Family: Comasteridae	
	Comanthina timorensis	Capillaster multiradiatus
	Comatella stelligera	Comaster gracilis
	Family: Mariametridae	
	Tropiometra carinata	Lamprometra plamata
	Family: Calametridae	
	Neometra spinossima	
Order: Platyasterida	Family: Lulidiidae	
	Luidia hardwicki	Luidia maculate
Order: Paxilliosida	Family: Astropectinidae	
	Astropecten hemprichi	Astropecten griegi
	Astropecten polycanthus	Astropecten monacanthus
	Astropecten zebra	
Order: Valvatida	Family: Goniasteridae	
	Anthenea pentagonula	Dorigana nora
	Goniodiscus forficulatus	Pseudarchaster mozaicus
	Siraster tuberculatus	
	Family: Oreasteridae	
	Culcita schmideliana	Culcita novaeguinea
	Pentaceraster regulus	Pentaceraster affinis
	Protoreaster australis	Protoreaster lincki
	Asterodiscus elegans	Prototeaster indicus

Order: Valvatida	Family: Ophidiasteridae	
	Linckia multifora	Linckia laevigata
	Nardoa variolata	Nardoa novaecaledoniae
	Family: Asterinidae	
	Asterina burtoni	Asterina cornata
	Asterina sarasini	Asterina lorioli
Order: Spinulosida	Family: Echinasteridae	
	Echinaster luzonicus	Echinaster callosus
	Echinaster purpureus	
	Family: Metrodiridae	
	Metrodira subulata	
Order: Forcipulatida	Family: Asteriidae	
	Distolasterias mozophorus	
	Family: Ophiomyxidae	
	Ophiomyxa australis	
	Family: Asteroschematidae	
	Astroboa clavata	Ophiocnida echinata
Order: Ophiurida	Family: Ophiactidae	
	Ophiactis savignyi	Ophiactis delagoa
	Family: Ophiotrichidae	
	Macrophiothrix longipeda	Gymnolophus obscura
	Ophiogymna lineate	Macrophiothrix variabilis
	Ophiomaza cataphracta	Ophiomaza cacaotica
	Ophiothrix accedens	Ophiothela danae
	Ophiothrix nereidina	Ophiothrix exigua
	Ophiothrix savignyi	
	Family: Ophionereididae	
	Ophionereis dubia	
	Family: Ophiocomidae	
	Ophiocoma erinaceus	Ophiocoma pica
	Ophiocoma scolopendrina	
	Family: Ophiodermatidae	
	Ophionereis dubia	Ophiorachnella gorgonian
	Ophiorachnella infernalis	
Order: Cidaroida	Family: Cidaridae	
	Prionocidaris baculosa	
Order: Echinothurioida	Family: Echinothuriidae	
	Astropyga radiate	
Order: Phymosomatoida	Family: Stomopneustidae	
	Stomopneurus variolaris	

Order: Temnopleuroida	Family: Temnopleuridae	
	Salmacis bicolor	Salmaciella dussumieri
	Temnopleurus toreumaticus	

Order: Temnopleuroida	Family: Toxopneustidae	
	Gymnechinus robbillardi	Toxopneustes pileolus
	Tripneustes gratilla	
Order: Echinoida	Family: Echinometridae	
	Echinometra mathaei	
Order: Clypeasteroida	Family: Clypeasteridae	
	Clypeaster humilis	
	Family: Laganidae	
	Laganum depressum	Peronella orbicularis
	Family: Scutellidae	
	Echinidiscus auritus	Echinodiscus bisperforatus
	Family: Brissidae	
	Metalia sternalis	Gymnopatagus magnus
	Family: Loveniidae	
	Lovenia sternalis	
	Order: Aspidochirotida	Family: Holothuriidae
Holothuria atra		Holothuria edulis
Holothuria pardalis		Holothuria exilis
Holothuria leucospilota		Holothuria scabra
Holothuria cinerascens		Holothuria prompta
Holothuria spinifera		Holothuria arenicola
Holothuria hilla		Holothuria impatiens
Holothuria moebi		Labidodemas rugosa
Family: Stichopodidae		
Stichopus vareigatus		Stichopus chloronotus
Order: Dendrochirotida	Family: Cucumariidae	
	Leptopentacta typical	Hemithyone semperi
	Stolus buccalis	Pseudocholochirus violaceus
	Family: Phyllophoridae	
	Phyllophorus parvipedes	
Order: Apodida	Family: Synaptidae	
	Chondrocloea striata	Synaptula recta
	Protankyra innominata	
Order: Molpadida	Family: Molpadidae	
	Molpadia musculus	

**Coral reef associated fishes**

Order: Orectobiformes	Family: Hemiscyclidae	
	Chiloscyllium griseum	Chiloscyllium punctatum
	Family: Stegostomatidae	
	Stegostoma fasciatus	
Order: Lamniformes	Family: Lamnidae	
	Isurus oxyrinchus	
Order: Carcharhiniformes	Family: Carcharhinidae	
	Charcharhinus dussumieri	Charcharhinus hemiodon
	Charcharhinus longimanus	Charcharhinus limbatus
	Charcharhinus melanopterus	Charcharhinus macloti
	Galeocerdo cuvieri	Charcharhinus seali
	Hemipristis elongates	Laxodon macrorhinus
	Rhizoprionodon acutus	Negaprion acutides
	Scoliodon laticaudus	Rhizoprionodon oligolinx
	Family: Sphyrnidae	
	Sphyrna blochii	Sphyrna lewini
Order: Pristiformes	Family: Pristidae	
	Anoxypristis cuspidatus	Atelomycterus marmoratum
	Pristis zijsron	Pristis microdon
	Family: Narcinidae	
	Narcine brunnea	Narcine maculata
	Narcine tinglei	
	Family: Narkidae	
	Bengalichthys impennis	Narke dipterygia
Order: Rajiformes	Family: Rhinobatidae	
	Rhina acnylostoma	Rhinobatos granulatus
	Rhinobatos thouiniana	Rhinobatos lionotus
	Zanobatus schoenleinii	Rhynchobatus djiddensis
Order: Myliobatiformes	Family: Myliobatidae	
	Aetomylaeus maculates	Aetobatus narinari
	Aetomylaus nichofii	Aetomylaeus milvus
	Rhinoptera adpersa	
	Family: Mobulidae	
	Mobula diabolus	
	Family: Dasyatidae	
	Dasyatis thetidis	Dasyatis kuhlii
	Dasyatis imbricate	Dasyatis zugei



	Gymnura japonica	Gymnura poecilura	
	Himantura favus	Himantura gerrardi	
	Himantura walga	Himantura uarnak	
	Urogymnus asperrimus	Hypolophus sephen	
Order: Elopiformes	Family: Elopidae		
	Elops machnata		
	Family: Megalopidae		
	Megalops cyprinoids		
	Family: Albulidae		
Albula vulpes			
Order: Anguilliformes	Family: Anguillidae		
	Anguilla bengalensis	Anguilla bicolor	
	Family: Muraenidae		
	Thysoidea picta		
	Family: Ophichthidae		
	Callechelys melanotaenia	Cirrihimuraena playfairii	
	Leiuramus semicinctus	Lamnostoma orientalis	
	Muraenichthys schultzei	Muraenichthys macropterus	
	Myrichthys maculosus	Myrichthys colubrinus	
	Ophichthus apicalis	Neenchelys buitendijki	
	Pisodonophis boro	Ophichthus microcephalus	
	Pisodonophis cancrivorus		
	Family: Muraenesocidae		
	Muraenesox talobonoides	Muraenesox bagio	
	Muraenesox cinereus		
	Family: Congridae		
	Ariosoma anago	Ariosoma mauritianum	
	Uroconger lepturus		
	Order: Clupeiformes	Family: Clupeidae	
		Amblygaster siram	Anodontosoma chacunda
Dusummieria elopsoides		Dusummieria acuta	
Herklotstichthys quadrimaculatus		Escualosa thoracata	
Hilsa kelee		Hilsa ilisha	
Nematalosa nasus		Hilsa toli	
Sardinella albella		Pellona ditchela	
Sardinella fimbriata		Sardinella brachysoma	
Sardinella longiceps		Sardinella gibbosa	
Family: Pristigasteridae			
Ilisha elongate		Ilisha filigera	
Ilisha melastoma		Ilisha megaloptera	
Ilisha striatula		Ilisha sirishai	
Pellona ditchela		Opistopterus tardoore	
Family: Engraulidae			

	Coilia neglecta	Coilia dussumieri
	Encrasicholina heteroloba	Coilia reynaldi
	Stolephorus andhraensis	Setipinna taty
	Stolephorus commersonii	Stolephorus baganensis
	Stolephorus heterolobus	Stolephorus devis
	Stolephorus punctifer	Stolephorus indicus
Order: Clupeiformes	Thryssa dussumieri	Thryssa dayi
	Thryssa malabarica	Thryssa hamiltonii
	Thryssa purava	Thryssa mystax
	Thryssa vitriostris	Thryssa setirostris
	Family: Chirocentridae	
	Chirocentrus nudus	Chirocentrus dorab
Order: Gonorhynchiformes	Family: Chanidae	
	Chanos chanos	
Order: Siluriformes	Family: Arridae	
	Ariodes dussumieri	Arius arius
	Arius jella	Arius caelatus
	Arius platystomus	Arius maculatus
	Arius subrostratus	Arius sagor
	Arius sumatranus	Arius sona
	Arius thalassinus	Arius tenuispinus
	Osteogeneiosus militaris	Batrachocephalus mino
	surus caelatus	Tachysurus arius
	Tachysurus dussumieri	Tachysurus thalassinus
	Family: Plotosidae	
	Plotosus canius	Plotosus lineatus
	Family: Synodontidae	
	Saurida micropectoralis	Saurida pseudotumbil
	Saurida tumbil	Saurida gracilis
	Synodus indicus	Saurida undosquamis
	Trachinocephalus myops	Synodus variegates
	Family: Harpodontidae	
	Harpodon nehereus	
Order: Gadiformes	Family: Bregmacerotidae	
	Bregmaceros maccllellandii	
Order: Ophidiformes	Family: Carapidae	
	Carapus homei	
	Family: Ophididae	
	Brotula multibarbata	
Order: Lophiformes	Family: Antennariidae	
	Antennarius coccineus	Antennarius commersoni
	Antennarius nummifer	Antennarius hispidus
Order: Cyprinodontiformes	Family: Exocoetidae	
	Cypselurus bahiensis	Cheilopogon furcauts
	Cypselurus furcatus	Cypselurus spilopterus
	Exocoetus monocirrhus	Cypselurus oligolepis

	Parexocoetus mento	Exocoetus volitans
	Rhynchoramphus georgii	
	Family: Hemiramphidae	
	Hemiramphus far	Hemiramphus lutkei
	Hirundichthys coramendelensis	Hemiramphus marginatus
	Hyporhamphus limbatus	Hyporhamphus dussumieri
	Rhynchorhamphus malabaricus	Hyporhamphus xanthopterus
	Family: Belonidae	
	Strongylura incise	Albennes hians
	Tylosurus acus melanotus	Strongylura strongylura
	Tylosurus gigantean	Tylosurus crocodilus
Order: Atheriniformes	Family: Atherinidae	
	Atherinomorus duodecimalis	
Order: Percyiformes	Family: Holocentridae	
	Neoniphon samara	Myripristis adusta
	Myripristis murdjan	
Order: Pegasiformes	Family: Pegasidae	
	Pegasus volitans	
Order: Syngathiformes	Family: Fistularidae	
	Fistularia petimba	Fistularia commersonii
	Family: Centriscidae	
	Aeoliscus strigatus	Centriscus scutatus
	Family: Syngnathidae	
	Choeroichthys sculptus	Choeroichthys intestinalis
	Doryramphus dactyliophorus	Doryichthys martensi
	Halicampus matafae	Doryramphus excisus
	Hippichthys heptagonus	Hippichthys cyanospilus
	Hippocampus kuda	Hippichthys spicifer
	Microphis cuncalus	Nicrophis brachyrus
	Syngnathoides biaculeatus	Phoxocampus tetrophthalmus
	Trachyrhamphus serratus	Trachyrhamphus longirostris
Order: Dactylopteriformes	Family: Dactylopteridae	
	Dactyloptena orientalis	
Order: Scorpaeniformes	Family: Scorpaenidae	
	Apistes carinatus	Centropogon indicus
	Dendrochirus brachypterus	Chordactylus multibarbus
	Minous monodactylus	Dendrochirus zebra
	Pteroidichthys amboiensis	Parascorpaena picta
	Pterois miles	Pterois antennata
	Pterois radiate	Pterois mombasae
	Pterois volitans	Pterois russellii
	Scorpaenodes cirrhosa	Scorpaenodes guamensis
	Scorpaenodes roseus	Scorpaenodes gibbosa
	Trachicephalus uranoscopus	Sebastapistes strongia
	Vespacula trachnoides	Vespacula depressifrons
	Family: Synanceiidae	

	Synanceia verrucosa	Polycaulus uranoscopus
	Family: Tetrarogidae	
	Tetraroge niger	Tetraroge barbata
	Family: Triglidae	
	Lepidotrigla omanensis	Lepidotrigla riggsi
Order: Scorpaeniformes	Family: Platycephalidae	
	Coceilla crocodile	Grammoplites scaber
	Inegocia japonica	Grammoplites suppositus
	Platycephalus crocodiles	Onigocia oligolepis
	Platycephalus scaber	Platycephalus indicus
	Suggrundus bengalensis	Sorsogona tuberculata
	Thysanophrys celebica	Suggrundus rodiricensis
	Thysanophrys carbunculus	
Order: Perciformes	Family: Centropomidae	
	Lates calcarifer	Psammoperca waigiensis
	Family: Ambassidae	
	Ambassis buruensis	Ambassis commersoni
	Ambassis gymnocephalus	Ambassis dayi
	Ambassis miops	Ambassis interruptus
	Aethaloperca rogae	Ambassis urotaenia
	Anyperodon leucogrammicus	Anthias squamipinnis
	Cephalopholis boenak	Cephalopholis argus
	Cephalopholis formosa	Cephalopholis cyanostigma
	Cephalopholis miniata	Cephalopholis microprion
	Cephalopholis urodeta	Cephalopholis sonnirati
	Epinephelus areolatus	Chromileptes altivelis
	Epinephelus coioides	Epinephelus caeruleopunctatus
	Epinephelus diacanthus	Epinephelus chlorostigma
	Epinephelus fasciatus	Epinephelus erythrurus
	Epinephelus lanceolatus	Epinephelus flavocaeruleus
	Epinephelus longispinis	Epinephelus latifasciatus
	Epinephelus malabaricus	Epinephelus macrospilos
	Epinephelus melanostigma	Epinephelus maculatus
	Epinephelus morrhua	Epinephelus merra
	Epinephelus quoyanus	Epinephelus ongus
	Epinephelus spilotoceps	Epinephelus sexfasciatus
	Epinephelus undulosus	Epinephelus tauvina
	Family: Grammistidae	
	Pelates quadrilineatus	Terapon jarbua
	Terapon puta	Variola louti
	Terapon theraps	
	Family: Priacanthidae	
	Priacanthus hamrur	Priacanthus cruentatus
	Priacanthus tayenus	
	Family: Apogonidae	

	Apogon coccineus	Apogon aureus
	Apogon cyanosoma	Apogon cooki
	Apogon endekataenia	Apogon bandanensis
	Apogon guamensis	Apogon fraenatus
	Apogon kallosoma	Apogon hyalosoma
	Apogon multitaeniatus	Apogon leptacanthus
Order: Perciformes	Apogon nigripinnis	Apogon nigricans
	Apogon quadrifasciatus	Apogon nitidus
	Apogon trimaculatus	Apogon taeniatus
	Apogonichthys ellioti	Apogon thurstoni
	Apogonichthys poecilopterus	Apogonichthys ocellatus
	Sphaeramia orbicularis	Archamia lineolata
	Family: Sillaginidae	
	Sillago chondropus	Sillago lutea
	Sillago soringa	Sillago sihama
	Sillago vincenti	
	Family: Malacanthiidae	
	Hoplolatilus fronticinctus	
	Family: Lactariidae	
	Lactarius lactarius	
	Family: Rachycentridae	
	Rachycentrus canadus	
	Family: Echeneididae	
	Echeneis naucrates	Echeneis remora
	Remora brachyptera	
	Family: Carangidae	
	Alectis ciliaris	Alectis indicus
	Alepes melanoptera	Alepes djedaba
	Alepes atropos	Alepes para
	Carangoides armatus	Atule mate
	Carangoides chrysophrys	Carangoides caeruleopinnatus
	Carangoides ferdau	Carangoides dinema
	Carangoides hedlandensis	Carangoides gymnostethus
	Carangoides oblongus	Carangoides malabaricus
	Carangoides praeustus	Carangoides pinnatus
	Caranx carangus	Carangoides talamparoides
	Caranx melampygus	Caranx ignobilis
	Caranx sem	Caranx para
	Decapterus macrosoma	Caranx sexfasciatus
	Elagatis bipinnulatus	Decapterus russelli
	Naucrates doctor	Magalaspis cordyla
	Parastromateus niger	Scomberoides commersianatus
	Scomberoides sanctipetri	Scomberoides lysan
	Scomberoides tol	Scomberoides tala
	Selar crumenophthalmus	Selar boops
	Selaroides leptolepis	Seriolina nigrofasciata

	Trachinotus blochii	Trachinotus baillionii
	Trachinotus mookalee	
	Family: Coryphaenidae	
	Coryphaena equestris	
	Family: Leiognathidae	
	Gazza minuta	Leiognathus berbis
Order: Perciformes	Leiognathus blochii	Leiognathus bindus
	Leiognathus daura	Leiognathus brevirostris
	Leiognathus equulus	Leiognathus dussumieri
	Leiognathus fasciatus	Leiognathus elongates
	Leiognathus lineolatus	Leiognathus leuciscus
	Leiognathus splendens	Leiognathus longispinis
	Secutor ruconius	Secutor insidiator
	Family: Bramidae	
	Steinegeria rubescens	
	Family: Lutjanidae	
	Aphareus furcatus	Aphareus rutilans
	Liphocheilus carnolabrum	Aprion virescens
	Lutjanus bohar	Lutjanus argentimaculatus
	Lutjanus decussates	Lutjanus biguttatus
	Lutjanus fulviflemma	Lutjanus erythropterus
	Lutjanus gibbus	Lutjanus julvus
	Lutjanus kasmira	Lutjanus johni
	Lutjanus lunulatus	Lutjanus lemniscatus
	Lutjanus madras	Lutjanus lutjanus
	Lutjanus monostigma	Lutjanus malabaricus
	Lutjanus russelli	Lutjanus rivulatus
	Lutjanus sebae	Lutjanus sanguineus
	Lutjanus vita	
	Family: Gerridae	
	Gerres abbreviatus	Gerres filamentosus
	Gerres lucidus	Gerres limbatus
	Gerres oblongus	Gerres macrocanthus
	Gerres poeti	Gerres oyena
	Pentaprion longimanus	Gerromorpha settifer
	Family: Pomadasysidae	
	Diagramma pictum	Plectorhinchus chaetodonoides
	Plectorhinchus gruseus	Plectorhinchus cuvieri
	Plectorhinchus orientalis	Plectorhinchus gibbosus
	Plectorhinchus polytaenia	Plectorhinchus pictus
	Plectorhinchus schotaf	Plectorhinchus rayi
	Pomadasys argyreus	Pomadasys argenteus
	Pomadasys jubelini	Pomadasys furcatum
	Pomadasys maculatum	Pomadasys kaakan
	Family: Sparidae	
	Acanthopargus bifasciatus	Acanthopargus berda

	Acanthopargus spinifer	Acanthopargus latus
	Chrysophrys datauia	Chrysophrys berda
	Chrysophrys crenidens	Chrysophrys sarba
	Chrysophrys indicus	Chrysophrys forsskalii
	Sargus noct	Rhabdosargus sarba
	Family: Lethrinidae	
	Gymnocranius elongates	Lethrinus nebulosus
	Family: Nemipteridae	
	Nemipterus bipunctatus	Nemipterus bleekeri
	Nemipterus luteus	Nemipterus japonicus
	Nemipterus mesoprion	Nemipterus nematophorus
	Nemipterus peronii	Nemipterus metopias
	Nemipterus tolu	Nemipterus randalli
	Scolopsis bilineatus	Nemipterus zysron
	Scolopsis cancellatus	Scolopsis bimaculatus
	Scolopsis dubiosus	Scolopsis ciliatus
	Scolopsis maragraterifer	Scolopsis leucotaenia
	Scolopsis taeniatus	Scolopsis personatus
Order: Perciformes	Scolopsis vosmeri	
	Family: Sciaenidae	
	Dendrophysa russelli	Johnieops dussumieri
	Johnieops sina	Johnieops macrorhynchus
	Johnius amblycephalus	Johnieops vogleri
	Johnius carutta	Johnius belangeri
	Johnius dussumieri	Johnius coitor
	Johnius macropterus	Johnius glaucus
	Johnius axillaries	Johnius vogleri
	Nibea soldadoi	Nibea maculata
	Otolithes cuvieri	Otolithes argenteus
	Otolithes maculates	Otolithes ruber
	Otolithes brunneus	Otolithes biauritus
	Pennahia macrophthatmus	Paranbea semiluctuosa
	Pterolithus maculates	Protonibea diacanthus
	Family: Mullidae	
	Mulloides flavolineatusi	Mulloides vanicolensis
	Parupeneus bifasciatus	Parupeneus barbarinus
	Parupeneus cyclostomus	Parupeneus cinnabarinus
	Parupeneus macronema	Parupeneus indicus
	Parupeneus trifasciatus	Parupeneus plerosigma
	Upeneus bensasi	Parupeneus trifasciatus
	Upeneus moluccensis	Upeneus luzonius
	Upeneus sudaicus	Upeneus sulphureus
	Upeneus tragula	Upeneus taeniopterus
	Upeneus vittatus	
	Family: Monodactylidae	
Order: Perciformes	Monodatylus argenteus	

	Family: Pempheridae	
	Pempheris moluca	
	Family: Ephippidae	
	Ephippus orbis	
	Family: Platacidae	
	Platax pinnatus	
	Family: Drepanidae	
	Drepane punctatus	
	Family: Scatophagidae	
	Scatophagus argus	
	Family: Chaetodontidae	
	Chaeton auriga	Chaetodon citrinellus
	Chaetodon decussates	Chaetodon collara
	Chaetodon guttatissimus	Chaetodon falcula
	Chaetodon lunula	Chaetodon lineolatus
	Chaetodon meyeri	Chaetodon melanotus
	Chaetodon plebius	Chaetodon octofasciatus
	Chaetodon trifasciatus	Chaetodon triangulum
	Chaetodon xanthocephalus	Chaetodon vagabundua
	Heniochus acuminatus	
	Family: Pomacanthidae	
	Pomocanthus annularis	Pomocanthus imperator
	Pygoplites diacanthus	Pomocanthus semicirculatus
	Apolemichthys xanthurus	
	Family : Cichlidae	
	Etroplus suratensis	
	Family: Pomacentridae	
	Abudefduf bengalensis	Abudefduf natalensis
	Abudefduf sordidus	Abudefduf septemfasciatus
	Amblypomacentrus brevicepsi	Abudefduf vaigiensis
	Amphiprion clarkia	Amphiprion akallopisos
	Amphiprion ocellaris	Amphiprion epihippum
	Amphiprion sebae	Amphiprion polymnus
	Chromis chrysurus	Chromis caerulea
	Chrysiptera biocellata	Chromis ternatensis
	Chrysiptera leucopoma	Chrysiptera glauca
	Dascyllus aruanus	Chrysiptera unimaculata
	Dascyllus marginatus	Dascyllus carneus
	Disachistodus perspicillatus	Dascyllus trimaculatus
	Pristotis jerdoni	Lepidozygous tapeinosoma
	Pomacentrus lividus	
	Family: Cirrhitidae	
	Cirrhitichthys aureus	Cirrhitus pinnulatus
	Family: Cepolidae	
Order: Perciformes	Acanthodepola abbreviate	
	Family: Mugilidae	



	Crenimugil crenilabis	Liza carinata
	Liza parsia	Liza macrolepis
	Liza tade	Liza subviridis
	Mugil cephalus	Liza vaigiensis
	Rhinomugil corsula	Mugil dussumieri
	Valamugil cunnesius	Valamugil buchanani
	Valamugil speigleri	Valamugil sehlii
	Family: Sphyraenidae	
	Sphyraena barracuda	Sphyraena flavicauda
	Sphyraena jello	Sphyraena forsteri
	Sphyraena obtusta	Sphyraena langsar
	Family: Polynemidae	
	Eleutheronema tetradactylum	Polydactylus heptadactylus
	Polydactylus plebeius	Polydactylus indicus
	Polydactylus sextarius	Polydactylus sexfilis
	Family: Labridae	
Order: Perciformes	Callyodon harid	Cheilo inermis
	Cheilinus bimaculatus	Cheilinus chlorurus
	Cheilinus fasciatus	Cheilinus diagrammus
	Choerodon anchorago	Cheilinus trilobatus
	Cymolutaes praetextatus	Cymolutes lecluse
	Gomphosus caeruleus	Epibulus insidiator
	Halichoeres argus	Gomphosus varitus
	Halichoeres chrysus	Halichoeres centiquadrus
	Halichoeres kawarin	Halichoeres horulanus
	Halichoeres margritaceus	Halichoeres marginatus
	Halichoeres nebulosus	Halichoeres melanurus
	Halichoeres notopsis	Halichoeres nigrescens
	Hemigymnus melanopterus	Halichoeres scapularis
	PlatyGLOSSUS dussumieri	Labroides dimidiatus
	Macropharyngodon meligris	PlatyGLOSSUS marginatus
	Stethojulis albovittata	Novalichthys taeniorus
	Stethojulis phaekadoupleursi	Stethojulis axillaries
	Stethojulis trilineata	Stethojulis strigventer
	Thalassoma hardwicki	Thalassoma amblycephalum
	Thalassoma lunare	Thalassoma jansenii
	Xyrichtys pavo	Thalassoma quinquivittatum
	Xyrichtys pentadactylus	
	Family: Scaridae	
	Scarus dubius	Scarus blochii
	Scarus ghobban	Scarus frenatus
	Scarus rubroviolaceus	Scarus niger
	Scarus sordidus	
Order: Perciformes	Family: Ophisthognathidae	
	Ophisgnathus rosenbergii	
	Family: Uranoscopidae	

	Uranoscopus cognatus	Uranoscopus guttatus
	Family: Trichonotidae	
	Trichonotus setiger	
	Family: Mugiloidae	
	Parapercis clathrata	Parapercis hexophthalma
	Parapercis pulchella	Parapercis nebulosa
	Parapercis punctulata	
	Family: Blenniidae	
	Astrosalaris fuscus	Andamia heteroptera
	Bleniella cyanostigma	Bleniella bilitonensis
	Ecsenius lineatus	Bleniella periophthalmus
	Istiblennius dussumieri	Entamocardius striatus
	Istiblennius lineatus	Istiblennius edentulous
	Pteroscrites mitratus	Omobranchus zebra
	Salarias bleekeri	Rhabdoblennius snowi
	Xiphasis setifer	Salarias fasciatus
	Family: Ammodytidae	
	Bleekeria kallolepis	
	Family: Callionymidae	
	Callionymus japonicus	Callionymus sagitta
	Synchiropus lineolatus	Eleutherochir opercularis
	Family: Eleotridae	
	Butis butis	Bostrichthys sinensis
	Eleotris fusca	Electroides sexguttatus
	Ophieleotris aporos	Eviota distigma
	Prionobutis koilomatodon	
	Family: Gobiidae	
	Acentrogobius cyanomos	Acentrogobius bontii
	Acentrogobius globiceps	Acentrogobius ennorensis
	Acentrogobius madraspatensis	Acentrogobius griseus
	Acentrogobius reichei	Acentrogobius ornatus
	Amblyogobius albimaculatus	Acentrogobius viridipunctatus
	Apocrypteichthys cantoris	Apocryptes bato
	Asterropteryx semipunctatus	Apocryptodon madurensis
	Awaous stamineus	Awaous gutum
	Boleophthalmus boddarti	Bathygobius ostreicola
	Boleophthalmus dussumieri	Boleophthalmus dentatus
	Brachygobius nunus	Boleophthalmus sculptus
	Cryptocentrus gymnocephalus	Callogobius hasseltii
	Exyrias puntang	Ctenogobius andhraensis
	Glossogobius biocellatus	Favonigobius reichei
	Gnatholepis baliurus	Glossogobius giuris
Order: Perciformes	Gobius striatus	Gobiodon citrinus
	Gobiopsis woodsii	Gobiopsis quinquecincta
	Illana bicirrhosus	Gobiopterus chuno
	Istigobius ornatus	Istigobius goldmanni

	<i>Oligolepis acutipoennis</i>	<i>Mahidolia mystacina</i>
	<i>Oplopomus caninoides</i>	<i>Oligolepis cylindriceps</i>
	<i>Oxuderces dentatus</i>	<i>Oplopomus oplopomus</i>
	<i>Oxyurichthys microlepis</i>	<i>Oxyurichthys formosanus</i>
	<i>Oxyurichthys tentacularis</i>	<i>Oxyurichthys papuensis</i>
	<i>Parapocryptes rictuosus</i>	<i>Parachaeturichthys polynema</i>
	<i>Periophthalmus argentilineatus</i>	<i>Parapocryptes serperaster</i>
	<i>Periophthalmus kalolo</i>	<i>Periophthalmus chrysopilos</i>
	<i>Periophthalmus malaccensis</i>	<i>Periophthalmus koelreuteri</i>
	<i>Periophthalmus variabilis</i>	<i>Pariophthalmus pearsei</i>
	<i>Pseudapocryptes lanceolatus</i>	<i>Priolepis semidoliatus</i>
	<i>Scartelaos tenuis</i>	<i>Scartelaos viridis</i>
	<i>Stenogobius gymnopomus</i>	<i>Sicyopterus microcephalus</i>
	<i>Stigmatogobius javanicus</i>	<i>Stenogobius malabaricus</i>
	<i>Yongeichthys criniger</i>	<i>Stigmatogobius sadamumdio</i>
	Family: Goboididae	
	<i>Taenioides anguillaris</i>	<i>Brachyamblyopus urolepis</i>
	<i>Raenioides buchanani</i>	
	Family: Trypauchenidae	
	<i>Trypauchen vagina</i>	<i>Ctenotrypauchen microcephalus</i>
	Family: Acanthuridae	
	<i>Acanthurus bleekeri</i>	<i>Acanthurus elongates</i>
	<i>Acanthurus lineatus</i>	<i>Acanthurus leucosternon</i>
	<i>Acanthurus nigricauda</i>	<i>Acanthurus matoides</i>
	<i>Acanthurus strigosus</i>	<i>Acanthurus nigrofuscus</i>
	<i>Acanthurus xanthopterus</i>	<i>Acanthurus triostegus</i>
	Family: Siganidae	
	<i>Siganus canaliculatusi</i>	<i>Siganus cancellatus</i>
	<i>Siganus javus</i>	<i>Siganusguttatus</i>
	<i>Siganus spinus</i>	
	Family: Trichiuridae	
	<i>Eupleurogrammus muticus</i>	<i>Eupleurogrammus glossodon</i>
	<i>Trichiurus lepturus</i>	<i>Lepturacanthus savala</i>
	<i>Trichiurus muticans</i>	
	Family: Scombridae	
	<i>Acanthocybium solangri</i>	<i>Auxis rochei</i>
	<i>Euthynnus affinis</i>	<i>Auxis thazard</i>
	<i>Katsuwonus pelamis</i>	<i>Grmmatocrynus bicarinatus</i>
	<i>Rastrelliger kanagurta</i>	<i>Rastrelliger faughni</i>
	<i>Scomberomorus commerson</i>	<i>Sarda orientalis</i>
	<i>Scomberomorus guttatus</i>	<i>Scomberomorus lineolatus</i>



Order: Perciformes	Family: Istiophoridae		
	Isotiophorus platypterus	Makaira indica	
	Family: Nomeidae		
	Psenes cyanophrys		
	Family: Ariommatidae		
	Ariomma indica		
	Family: Stromateidae		
Pampus argenteus	Pampus chinensis		
	Family: Psettodidae		
	Psettodes erumei		
	Family: Citharidae		
	Brachypleura novaezeelandiae		
	Family: Bothidae		
	Arnoglossus intermedius	Bothus myriaster	
	Crossorhombus azureus	Bothus pantherinus	
	Engyprosopon grandisquama	Crossorhombus valderostratus	
	Pseudorhombus arsius	Laeops guntheri	
	Pseudorhombus javanicus	Pseudorhombus elevates	
	Pseudorhombus triocellatus	Pseudorhombus malayanus	
	Family: Cynoglossidae		
	Cynoglossus arel	Cynoglossus bilineatus	
	Cynoglossus disper	Cynoglossus carpentri	
	Cynoglossus kopsi	Cynoglossus dubius	
	Cynoglossus lingua	Cynoglossus lida	
	Cynoglossus puncticeps	Cynoglossus macrostomus	
	Paraplagusia bilineatus	Cynoglossus semifasciatus	
	Paraplagusia blochii		
	Family: Soleidae		
	Aesopia cornuta	Euryglossa orientalis	
	Paradachrius marmoratus	Heteromycteris oculusi	
	Solea elongata	Solea bleekeri	
	Synaptura albomaculata	Solea ovata	
	Zebrias quagga	Synaptura commersoniana	
	Zebrias synapturoides		
	Order: Tetradontiformes	Family: Triacanthidae	
		Pseudotriacanthus striglifer	Triacanthus biaculeatus
Triacanthus brevirostris			

Order: Tetradontiformes	Family: Balistidae	
	Abalistes stellatus	Balistapus undulates
	Balistoides virdescens	Balistes vetula
	Canthidermmis maculatus	

Family: Monacanthidae	
Cantherhines pardalis	Aluterus scriptus
Paramonocanthus cutorhynchus	Monacanthus nematophorus
Psilocephalus barbatus	Paramonocanthus choirocephalus
Family: Ostracidae	
Ostraction cubicus	Lactoria cornuta
Ostraction tuberculata	Ostraction meleagris
Tetrosomus gibbosus	Rhynchostracion nasus
Family: Tetradontidae	
Arothron hispidus	Amblyrhynchotes hypselogenion
Arothron immaculatus	Arothron hypselogenion
Arothron mappa	Arothron leopardus
Arothron nigropunctatus	Arothron melagris
Arothron reticularis	Arothron palembangensis
Canthigaster bennetti	Arothron stellatus
Chelonodonar fluviatilis	Canthigaster solandri
Lagocephalus guentheri	Chelonodon patoca
Lagocephalus lunaris	Lagocephalus inermis
Lagocephalus spadiceus	Lagocephalus scleratus
Torquigener hypselogeneion	Takifugu oblongus
Family: Antennaridae	
Antennarius commersoni	Antennarius coccineus
Antennarius pinniceps	

**Reptiles – Associated with corals reefs (Gulf of Mannar)**

<i>Chelonia mydas</i>	<i>Eretmochelys imbricata</i>
<i>Caretta caretta</i>	<i>Dermochelys coriacea</i>
<i>Lepidochelys olivacea</i>	
Family: Hydrophiidae	
<i>Enhydrina schistose</i>	<i>Hydrophis spiralis</i>
<i>Hydrophis mamillaris</i>	<i>Hydrophis cyanocinctus</i>
<i>Lapemis curtus</i>	<i>Hydrophis caeruleus</i>
<i>Microcephalaphis cantoris</i>	<i>Microcephalaphis gracilis</i>
<i>Pelamis platurus</i>	
Family: Phocoenidae	
<i>Neophocaena phocaenoides</i>	
Family: Delphinidae	
<i>Steno bredanensis</i>	<i>Sousa chinensis</i>
<i>Tursiops truncatus</i>	<i>Gampus griseus</i>
<i>Stenella longirostris</i>	<i>Stenella attenuata</i>
<i>Delphinus delphis</i>	<i>Stenella coeruleoalba</i>
<i>Poponocephala electra</i>	<i>Lagenodelphis hosei</i>
<i>Pseudorca crassidens</i>	<i>Feresa attenuate</i>
<i>Globicephala macrorhyncha</i>	<i>Orcinus orca</i>
<i>Orcaella brevirostris</i>	
Family: Ziphiidae	
<i>Ziphius cavirostris</i>	<i>Mesoplodon densirostris</i>
<i>Mesoplodon ginkgodens</i>	
Family: Physeteridae	
<i>Physeter macrocephalus</i>	<i>Kogia breviceps</i>
Family: Balaenopteridae	
<i>Megaptera novaeangliae</i>	<i>Balaenoptera musculus</i>
<i>Balaenoptera edeni</i>	<i>Balaenoptera physalus</i>
<i>Balaenoptera acutorostrata</i>	<i>Balaenoptera borealis</i>

**Birds – Associated with coral reefs (Gulf of Mannar)**

Order: Ciconiforms	Family: Ardeidae		
	Egretta garzetta	Bubulcus ibis	
	Ardea cinerea	Ardea alba	
	Egretta gularis	Ardeola grayii	
	Ardea purpurea	Ardeola striatus	
	Egretta intermedia	Ardeola bacchus	
	Gorsachius melanophus	Egretta sacra	
	Ixobrychus sinensis	Ixobrychus cinnamomeus	
Order: Anseriformes	Family: Anatidae		
	Anas acuta	Anas panalope	
	Anas crecca	Anas clypeata	
	Anser indicus	Anas querquedula	
	Anas gibberiforms		
Order: Charadriiformes	Family: Haematopodidae		
	Haematopus ostralegus		
	Family: Charadriidae		
	Pluvialis squatarola	Charadrius leschenaultia	
	Vanellus indicus	Charadrius hiaticula	
	Neminius phaeopus	Vanellus malabaricus	
	Tringa glareola	Limosa lapponica	
	Tringa ochropus	Tringa nebularia	
	Arenaria interpres	Tringa terek	
	Gallinago minima	Gallinago gallinago	
	Scolopax rusticola	Gallinago stenura	
	Calidris ruficollis	Calidris minuta	
	Calidris temminckii	Calidris subminuta	
	Calidris tenuirostris	Limicola falcinellus	
	Curlews, Whimbrel, Godwits, Sand Piper	Subfamily: Scolopacinae	Numenius phaeopus
		Numenius arquata	Tringa stagnatilis
	Tringa erythropus	Phalaropus lobatus	
	Calidris alpina		
	Family: Recurvirostridae		
	Himantopus himantopus		
	Family: Burhinidae (Stone curlews)		
	Esacus magirostris	Burhinus oedipnemus	
	Family: Dromadidae (Crab plover)		
	Dromas ardelola		
	Family: Laridae (Gulls, terns)		
	Larus argentatus	Larus ichthyaetus	
	Larus brunnicephalus	Larus fuscus	
	Larus ridibundus		
	Family: Sternidae		
	Gelochelidon nilotica	Chlidonias hybrid	



	Sterna hiruno	Hydroprogne caspia
	Sterna bengalensis	Sterna albifrons
	Sterna anaethetus	Chlidonias leucopterus
	Sterna fuscata	Sterna dougalli
	Anos stolidus	Sterna sumatrana
	Anos tenuirostris	
Order: Pelecaniformes	Family: Phaethontidae	
	Aviceda leuphotos	Phaethon lepturus
	Accipiter nisus	Milvus migrans
	Accipiter virgatus	Accipiter solonensis
	Haliaeetus leucogaster	Spizaetus cirrhatus
	Circus pygargus	Circus macrourus
	Spilornis elgini	Spilornis cheela
	Pandion haliaetus	Spilornis klossi
	Family: Falconidae	
	Falco tinnunculus	
	Family: Rallidae	
	Rallus striatus	Porzana pusilla
	Gallinula chloropus	Amauornis phoenicurus
Order: Columbiformes	Family: Columbidae	
	Ducula aenea	Treron pompodora
	Ducula bicolor	Streptopelia transquebarica
	Chalcophaps indica	
Order: Psittaciformes	Family: Psittacidae	
	Psittacula alexandri	Loriculus vernalis
	Psittacula caniceps	Psittacula longicauda
Order: Cuculiformes	Family: Cuculidae	
	Eudynamys scolopacea	

## Mammal

Family: Dugongidae	Dugong dugong
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## **4. Vulnerable areas along Tamilnadu coast**

## **Introduction**

Oceanography of the Indian coastal region is dominated by three seasons, viz. southwest monsoon (June to September), northeast monsoon (October to January) and fair weather period (February to May). The continental shelf along the east coast is narrow, whereas along the west coast, the width of the shelf varies from about 340 km in the north to less than about 60 km in the south.

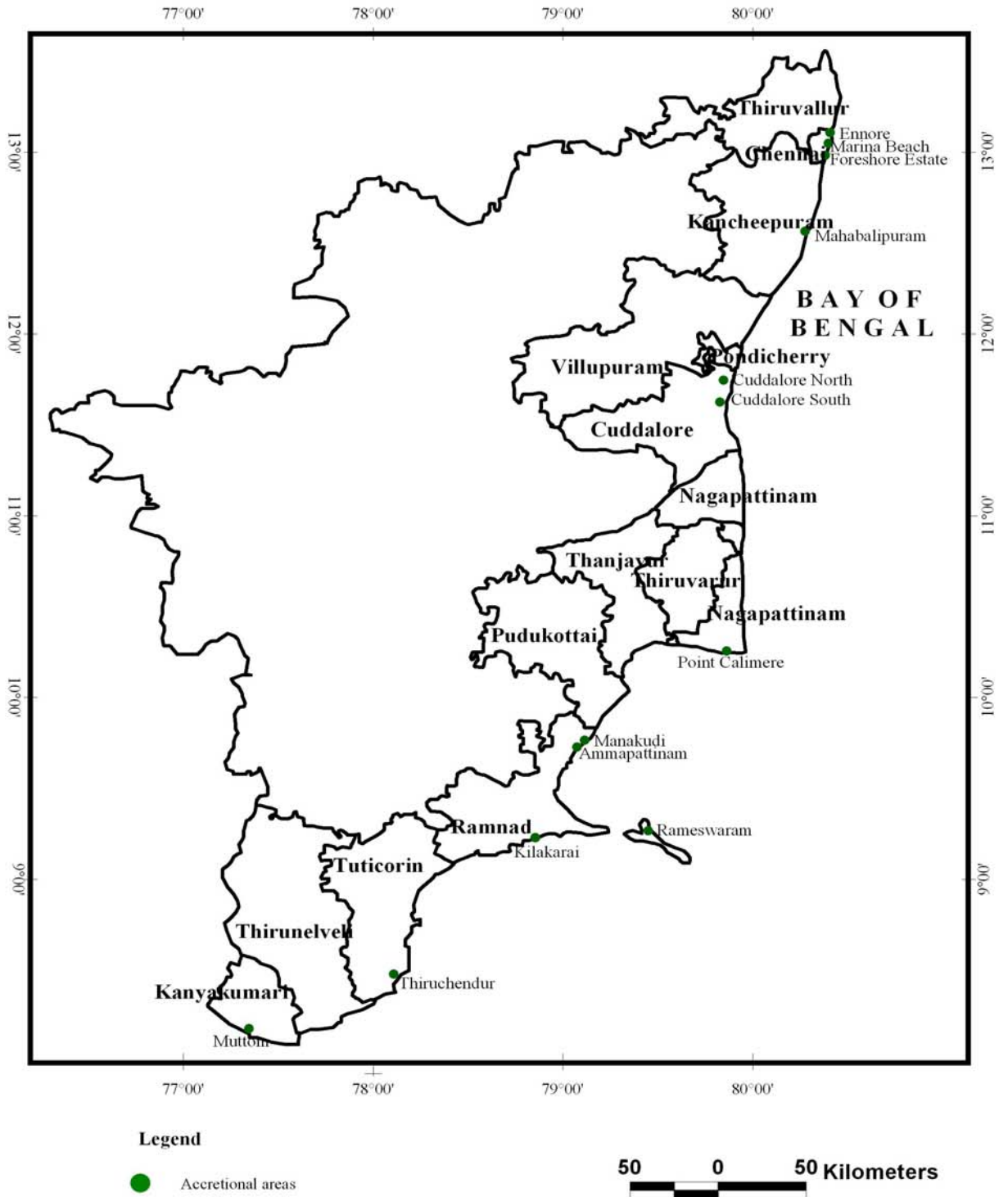
Beach erosion is a universal problem and it has been estimated that 70% of all the beaches in the world are eroding. Any attempt to handle the coastal problems either to arrest erosion or prevent deposition requires a thorough understanding of the factors and processes involved in the coastal geomorphological system. Information on winds, waves, tides, currents, geomorphology and rate of sediment transport along a coast is required for planning and design of coastal facilities.

The east coast is emerging and only selected parts are undergoing erosion which is mainly due to coastal developmental activities like construction of ports and harbours etc. In coastal erosion, there is a loss of invaluable land areas, habitat displacement / relocation, loss of beaches, loss of transport network, infrastructure and other installations (Fig.4.1 and 4.2)

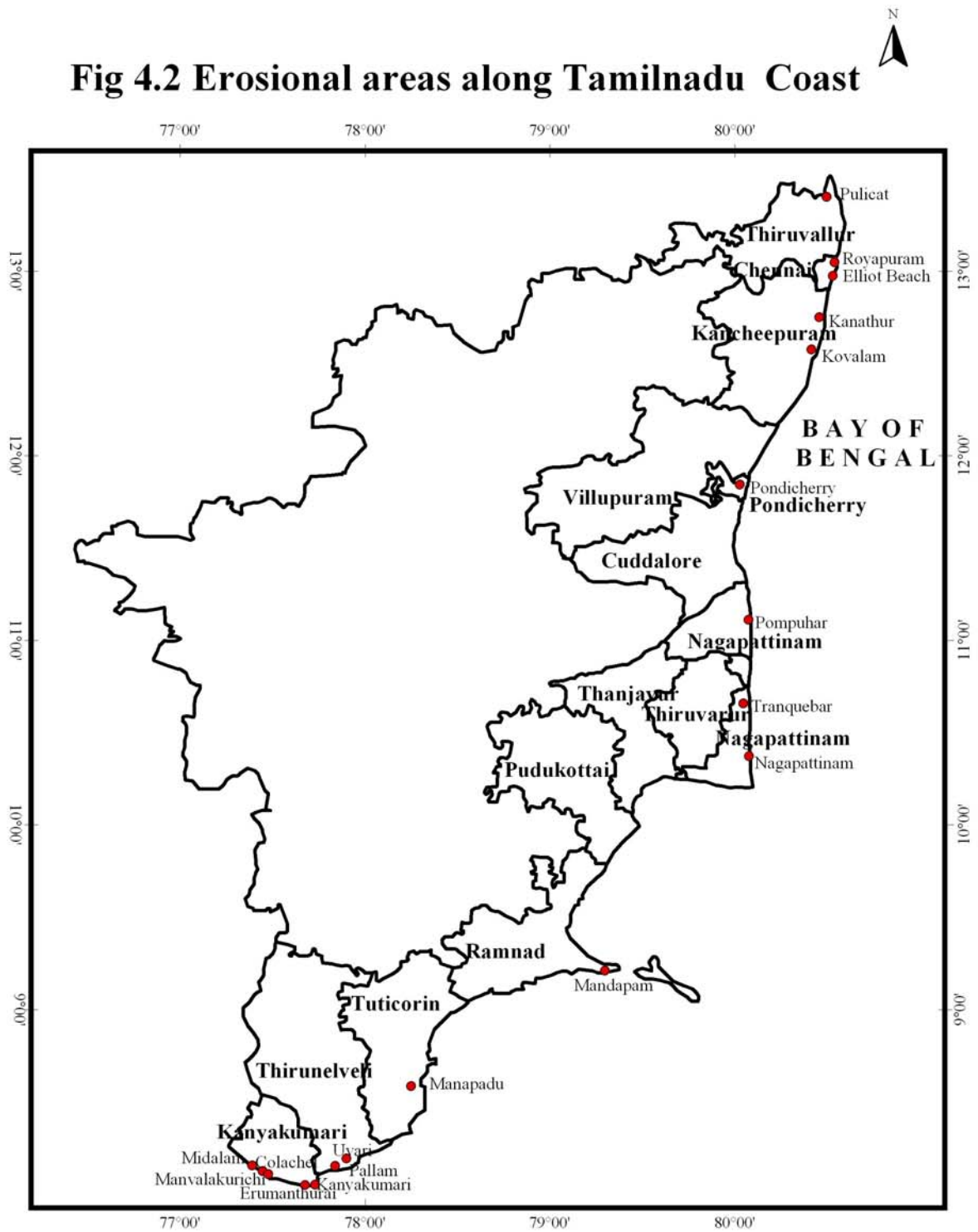
Most of the river and estuarine mouths are partly or almost closed during summer season which is mainly due to the formation of sand spit. Most harbours have the problem of sand deposition due to littoral drift.

The coast along Tamilnadu is most vulnerable to cyclones and storm surges that cause inundation of low lying coastal areas resulting in damages to crops and property. The greater danger is that the erosion could eat away the sand bar separating Pulicat lake from the Bay of Bengal. This lake owes its high biological productivity to the mixing of riverine freshwater with the tidal overflow from the sea. This delicate balance between fresh and saltwater is liable to be disturbed if the sea stretches itself into the lake.

**Fig 4.1. Accretional areas along Tamilnadu Coast**



**Fig 4.2 Erosional areas along Tamilnadu Coast**



**Legend**

● Erosional areas

50 0 50 Kilometers

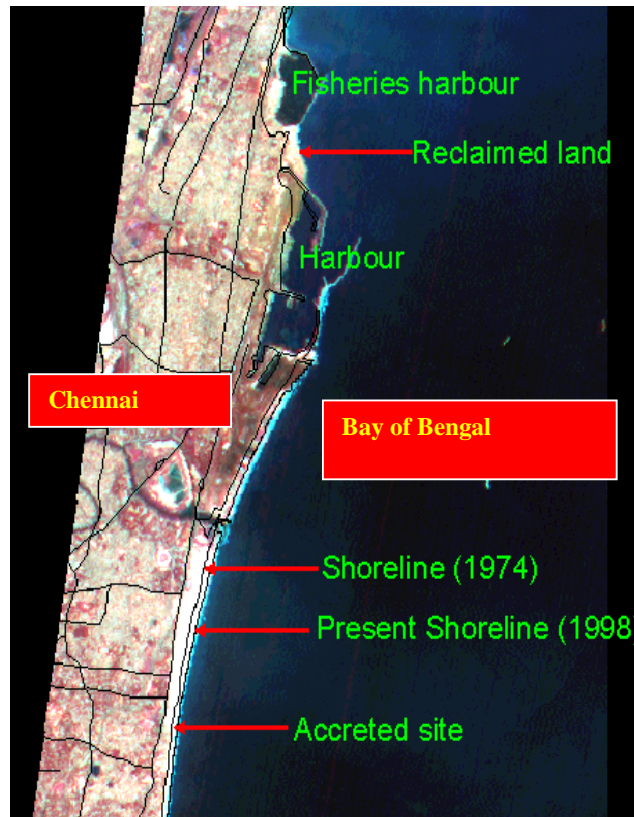
The road transport and adjoining areas are highly affected along Ennore coast (Fig.4.3). The analysis of shorelines of 1970 and 1992, it was estimated that about 1.7km<sup>2</sup> area of coastal zone has been eroded in this particular zone.



**Fig. 4.3 Groynes for coastal protection adjoining Ennore Expressway**

The long barrier wall of the Ennore satellite port has already started showing accretion along the mouth of the Ennore creek, thereby closing it. The Ennore creek mouth is closed frequently after the construction of Ennore satellite port to its north. The satellite port at Ennore is now adding a new dimension to the already existing problems. The northern part of north breakwater is now facing the problem of shoreline erosion and will ultimately affect the Pulicat lake and could even merge this lake with the sea, displacing the entire coastal dunes and beaches.

Experience has shown that the coast near Chennai is prone to erosion and accretion (Fig.4.4). These have been aggravated by constructions into the sea. While the walls built into the sea for the Chennai port gave the city a wide Marina beach. It nibbled away settlements, temples and roads in the northern part of the city.



**Fig.4.4. Erosion / Accretion along Chennai coast**

The construction of a pier by the British East India Company and construction of an artificial Madras harbor obstructed littoral drift of Bay of Bengal which resulted in the erosion of seacoast on the northern side of harbor and accretion on the southern side of the harbor. With the construction of Madras Port in 1875 to 1905, shoreline changes occurred severally to the north of Royapuram. Fifteen villages adjacent to the shoreline are facing the severe problem of erosion. It has been estimated that 77m<sup>2</sup> area of land is sacrificed to the sea every year due to erosion. Earlier studies also confirmed that there is a loss of land around 749m eroded in a 10 year period. One of the important coastal accretion is the Marina beach in Chennai coast. On the other hand, the area of Marina beach is accreting 40m<sup>2</sup> every year. This has also resulted in the closure of Adyar and Cooum river mouths. A sinking temple at Mahabalipuram during 1995 which is now completely submerged in the sea, is shown in the Fig.4.5.



**Fig.4.5. Sinking temple at Mahabalipuram**

Due to any storm or depression centered in the Bay of Bengal (Tamilnadu) whether it crosses the landform or not equilibrium of the Eastcoast shore-line gets affected much, resulting in sporadic coastal erosions of very severe nature. The number of storms and tropical cyclones has been reported to be 70 during the period 1877 to 2007.

**Accretion / Erosion areas:**

Four sites vigorously undergoing coastal erosion in Tamilnadu are 1) Ennore, 2)Mahabalipuram, 3)Rameswaram and 4)Kanniyakumari. Both erosion and accretion are taking place in Gulf of Mannar and Rameswaram. A coastline behavioural study has been therefore initiated by the Institute of Hydraulics and Hydrology, Poondi, Tamil Nadu, in an attempt to mitigate and manage these types of hazards. Low lying area like Nagapattinam has been identified as potential areas for inundation due sea level rise.

The data from 30 selected sites from the period 1978 to 1988 shows the accretion/erosion in landform by the sea (1991). Accretion or erosion sites along Tamilnadu coast are alarming in nature with respect to land, lives and properties (Tables 4.1. and 4.2 )



**Table 4.1. Accretional areas along Tamilnadu coast**

No.	Site	Length (m)	Rate (m/yr)
1.	Cuddalore (N)	1538	8.00
2.	Point Calimere	966	3.40
3.	Cuddalore (S)	483	2.98
4.	Marina Beach	2968	1.70
5.	Ennore	3265	1.30
6.	Foreshore estate	2300	1.09
7.	Ammapattinam	3600	0.72
8.	Manakudi	3650	0.57
9.	Thiruchendur	1325	0.33
10.	Kilakarai	2900	0.29
11.	Mahabalipuram	5450	0.25
12.	Muttom	3000	0.17
13.	Rameswaram	3295	0.06

**Table 4.2. Erosional site along Tamilnadu**

	Site	Length (m)	Rate (m/yr)
1.	Royapuram	5380	6.60
2.	Pulicat	710	3.20
3.	Tranquebar	760	1.80
4.	Kanniyakumari	700	1.74
5.	Kanathur	240	1.40
6.	Elliot Beach	2090	1.28
7.	Kolachel	1750	1.20
8.	Manapadu	1600	1.10
9.	Pallam	2600	0.93
10.	Uvari	2600	0.86
11.	Midalam	2500	0.84
12.	Kovalam	3150	0.81

	Site	Length (m)	Rate (m/yr)
13.	Pompuhar	1905	0.65
14.	Manavalakurichi	3500	0.60
15.	Erumanthurai	5400	0.56
16.	Mandapam	2194	0.25
17.	Pondicherry	1190	0.15
18.	Nagapattinam	4270	0.11

The data shows that accretion or erosion in landform by the sea. The natural littoral transport processes along the coastal region leads to changes in the shoreline during the past 25 years. A large number of man made developments towards seaward alter the coastal dynamics.

Coastal erosion is a problem commonly met within different areas along the coastal Tamilnadu calling for protection to aquaculture lands, agricultural lands, valuable properties, seaside resorts and human habitats bordering along the shore. The most serious incidence of coastal erosion occurs during storms and tropical cyclones. The shorelines are observed to be shifting landward or seaward depending on the wave climate and shore environment. An example is the constant is the sedimentation occurs by the way of sediment transport on certain parts of Tamilnadu coast.

**Causes of coastal erosion:**

Coastal erosion is caused by the forces of nature sometimes enhanced by man made structures or man’s activities of removing the materials from the shore for building or other commercial purposes. Some of the causes leading to natural and man made erosion along the coast are given in Table.4.3.

**Table 4.3: Causes for coastal erosion**

No.	Nature	Man made
1.	Rise in sea level	Dams, dykes, other coastal structures.
2.	Protruding head lands, reefs and rocks.	Groins, break waters, jetties etc.
3.	Total entrances and river mouths causing interruption of littoral drift, protection of tidal entrances	Man made entrances causing littoral drift (jetties)
4.	Shoreline geometry causing rapid increase of drift quantity	Fills protruding in the ocean to an extent that they change local shoreline geometry radically. Such fills are often bulkheaded
5.	Removal of beach material by wind drift	Removal of material from beaches for construction and other purposes
6.	Removal of beach material by sudden outbursts of flood waters	Digging or dredging of new inlets, channels and entrances offshore dumping of materials

**Rameswaram - Dhanushkoti area:**

The Mandapam –Dhanushkoti area represents a coastal plain which is recognizable into i) erosional coast with a micro cliff and wave cut platforms and with long straight sandy beaches; ii) accretionary coast in which barrier islands, lagoons, mudflats, off/long shore bars, spits and fringed reefs of corals have been recognized. The currents in this area are swift. The sea is rough between April and August and calm during September. October–December bring northeast monsoonal rains. It is interesting to note that during northeast monsoon, there is less water throughout the whole space to the southward of the pass (Pamban pass). During the southeast monsoon, the reverse phenomenon occurs and the water levels are higher or lower in direct proportion to the wind force. The current passing through the pass frequently records a velocity of about 6knots/hr rendering the pass at times very difficult to take in even for fully powered steamers for transit. The data for the period 1978 to 1988 show accretion and erosion in land form by the sea (Table 4.4).

**Table. 4.4. Erosion and accretion in Rameswaram and Mandapam**

Area	Type	Length (m)	Rate (m/yr)
Rameswaram	Accretion	3295	0.06
Mandapam	Erosion	2194	0.25

**Accretion at Vedaranniyam coast:**

Satellite data acquired in 1998 has shown huge accretion of sediments and rapid land building activity off Vedaranniyam coast. The geomorphic interpretations carried out using IRS IA imagery and C<sup>14</sup> and archeological dating of such geomorphic features have shown that such ongoing sediment accretion phenomena off Vedaranniyam nose might in future connect the Vedaranniyam part of Indian peninsula with Jaffna peninsula of Sri Lanka if the sediment accumulation continues unabated.

The C<sup>14</sup> dates evaluated for the beach ridges show that the sea has gradually regressed due to the rapid accumulation of sediments and the development of cusped landforms in between Chettipulam and Kodyakkarai during the past 6000 years. The data collected has shown that the sea has regressed by 10km in 439 years from Chettipulam to Maranganallur, by 4km in 2076 years from Maranganallur to Tettagudi, by 8km in 2270 years from Tettagudi to Vedaranyam, by 8km in 220 years from Vedaranniyam to Kodyakkarai and by 28km in 1020 years from Kodyakkarai to present day offshore bars. These show that the beach ridges have grown at the approximate rate of 23m/yr from Chettipulam to Maranganallur, 2m/yr from Maranganallur to Tettagudi, 3.5m/yr from Tettagudi to Vedaranniyam, 36m/yr from Vedaranniyam to Kodyakkarai, 27.5m/yr from Kodyakkarai to recently developed offshore bars of 1990.

On an average, the land building activity is around 29 m/yr and if this accretion rate is maintained, Vedaranniyam nose will get connected to Jaffna peninsula, just 12km from the offshore bars in another 400 years.

### **Rajamadam - Manamelkudi coastline – Palk Bay**

Erosion by small rivers (Agniar, Ambullar, Vellar etc.) aided by rainwater is significant in this area. The main causes of this erosion are considered to be the less compactness of sandstone and sloping of the terrain. The removal of sediments from the plain alluvium is comparatively lesser than the vertical cutting which is in the process of the formation of gorges.

The terrestrial base sediments which are placed for the sudden deposition at the confluence point due to change in alkalinity, cause the growth of micro-delta. Due to this progradation and coastal deltaic formation, the shoreline gradually drifts bringing in force a change in the dynamics. The protruding nature of these deltas faces the waves and tides in its own way, in contrast, with the straight paleo shoreline. With reference to this action, the physical change of the energy in the coastal waters has been observed. It is evidenced from the formation of sub-aqueous shoals and bars resulting in a variation in the bathymetry of the Palk Bay.

The spit growth in Manamelkudi is of the order of 0.75m/year. (It is interesting to see that the maritime surveys conducted between 1960 and 1986 reveal the change of contour to the tune of 6m shallowness in the Palk Strait. That shows that around 24cm/year is being silted off in the Strait.) Similarly, one can visualize the growth of spit from the Talaimannar side. If both the spits grow in the existing rate of growth, one can visualize the merger of this two within the next 50 years. Once these spits join, the Palk Strait will become into two lagoons of north and south.

### **Ammapattinam, Mandapam and Rameswaram**

The southern portion of Palk Bay is accretionary throughout the year where as the northern portion experiences both erosion and accretion. Accretionary tendency is greater during the South West Monsoon period (June to August) and it is low (or erosion is high) during the North East Monsoon (October to January).

Accretion is high always in the period between June and August. It is low (or say erosion is high) in the period between November and January (Mandapam is an

exception as there is accretion in January). Annual mean berm crest fluctuation decreases as we go from north to south from Nagapattinam to Rameswaram from 20m to 2m.

### **Devipattinam - Keelakarai Beach Ridges**

The coastal zone between Devipattinam to Kilakkarai, define interesting piece of land furnished with peculiar arrangement of beach ridges. This sharp, triangular strip of land might have been drawn the support of tectonic activity mainly caused by Vaigai fault system during the course of its development. The coastal area lying north side of Vaigai river is comparatively having 2 to 3 series of beach ridges whereas the southern side is furnished with 6 to 7 series of beach ridges. It may be suggested that area of southern side of Vaigai River is attended by intensive marine action and deposition compared to northern area. The beach ridges along southern part of Vaigai river are curvilinear and showing complex pattern of arrangements of beach ridges extending from Mandapam point to Kilakkarai.

Beach erosion control studies for the southern Indian coast. These should include assessment of the characteristics of the coast such as long term and seasonal topographical changes of beaches, and the characteristics of littoral sand drift; and evaluation of technical options for erosion control work through modeling to predict coastal topographical changes caused by deployment of the coastal structure. Environmental and social impacts will also have to be examined.

### **Erosion /Accretion in Dhanuskodi - Tuticorin**

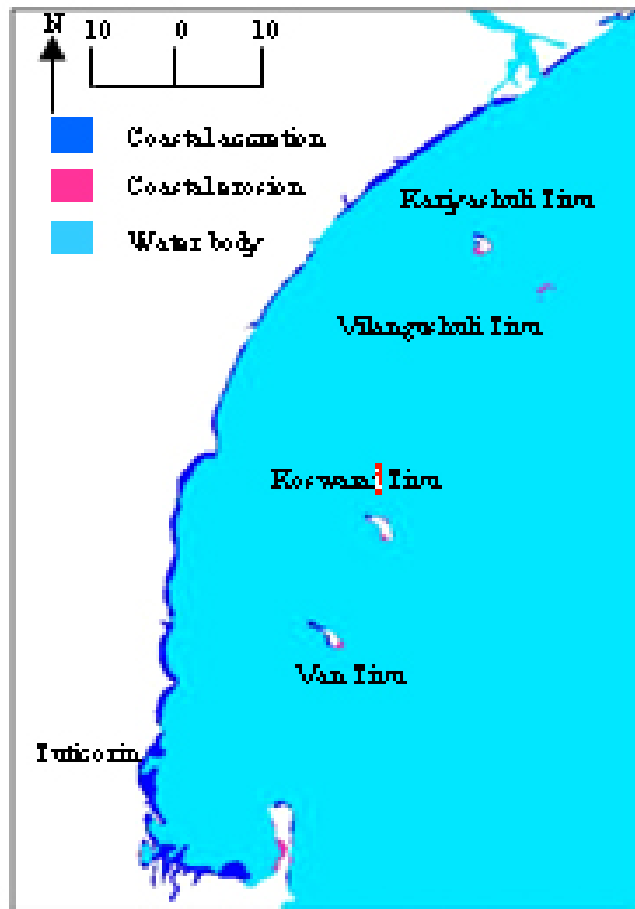
In the coastline between Dhanuskodi and Tuticorin, erosion and accretion areas have been identified. The areas of erosion and accretion have been estimated as 4.34 and 23.49 km<sup>2</sup>, respectively over a period of 30 years (1969 to1998). For coastal erosion and accretion studies the study area has been classified into (1) Shoreline between Tuticorin and Vaippar River, (2) Shoreline between Vaippar River and Gundar River, (3) Shoreline between Gundar River and Palar River, (4) Shoreline between Palar River and Kottangudi River, (5) Shoreline between Kottangudi River and Thoniturai and (6) Shoreline of Rameswaram Island.

Along the shore between Tuticorin and the Vaippar River, twelve accretion and seven erosional sites have been identified (Figure.4.6). The estimated average rates of accretion and erosion in this area are in the order of 4.3 and 2.73m/year respectively. In the area between the Vaippar River and the Gundar River, the entire shore has been observed to be an accretion zone. Mouths of these creeks and rivers are closed by muddy sand and mudflat occurs most of the time in a year except rainy season. The area of accretion is estimated as 3.35 km<sup>2</sup>. The estimated average rate of accretion is 6.42 m/year.

In the region between the Gundar River and the Palar River mouth, three accretional and two erosional sites were observed. Most part of this shore is covered by sandy materials except south of Valinokkam coast, where it is covered by calcareous sandstone. The estimated rates of erosion and accretion in between the Gundar and the Palar coast are 3.35 and 6.42m/year respectively during the period 1969 to 1998. Along the shore between the Palar River and the Kottangudi River, four erosion and seven accretion sites were observed. The areal extent of erosion and accretion were approximately 0.125 and 0.876 km<sup>2</sup>. The rates of erosion and accretion are 2.97 and 3.73 m/year respectively.

The shore between the Kottangudi River and Thonithurai has five erosional and accretional sites. The lengths of erosion and accretion sites along the coast were 12.61 and 2.49 km, respectively. The areas of erosion and accretion were approximately 0.34 and 2.11 km<sup>2</sup> respectively. The rates of erosion and accretion are 4.19 and 4.87 m/year respectively.

Along the shore of Rameswaram island both accretional and erosional features were observed. The areas of erosion and accretion along the coast were approximately 4.66 and 2.01 km<sup>2</sup> respectively. The average rates of erosion and accretion are 6.23 and 6.54 m/year.



**Figure 4.6. Shoreline change map between 1969 and 1998**

### **Changes in Islands of Gulf of Mannar**

Island erosion and accretion are caused mainly by the action of waves and wave-induced current and long shore currents along the shores of islands. The 21 islands in Gulf of Mannar are made up of a calcareous framework of dead reef and sand. They have a low and narrow sandy coast and some of them have rocky coast. Fringing reef along the windward side of the islands protects the islands from direct wave action. Morphology of sandy islands is very dynamic. The morphological variations of islands occur due to natural and anthropogenic stress. The natural agents include erosion, accretion, wave, current, sea level variation, neo-tectonic activity etc. Anthropogenic impacts are construction of breakwaters, discharging of effluents, mining of coral reef, etc. The comparison of 1969 and 1998 maps of islands of Gulf of



Mannar showed changes in their shape, size and location and these have been caused by erosion and accretion of shore. The total area of erosion and accretion were calculated as 4.16 km<sup>2</sup> and 3.31km<sup>2</sup> respectively during the 30-years period.

Mining of stony corals from the reef area, especially from, Tuticorin group of islands (Van, Kasuwar, Karaichalli and Vilanguchalli islands) for building, industrial and chemical purposes have also destabilised the formation of islands. Hence the waves hit directly on south, southeast and southwest shores of these islands, causing erosion. These eroded sediments are then transported by wave-induced currents and deposited at the leeward sides of these islands. By such repeated processes, the windward sides of the island get reduced and leeward sides of the islands are accreted. The total areas of erosion and accretion were estimated as 0.35 and 0.13 km<sup>2</sup>, respectively. Hence size, shape and location of these islands have changed.

All islands in Tuticorin group have been migrating towards mainland (Figure. 4.6). It is estimated that 528.74m of Van island, (2) 118m of Kasuwar island and 137m of Karaichalli migrated towards mainland between 1969 to 1998. The landward migration of islands in Tuticorin region are caused by sea level variation and mining of reef material. Vilanguchalli island is one of the islands in Tuticorin group, situated at 6.25 km from Sippikkulam. The entire part of this island was eroded due to the direct action of waves and may also be caused by coral reef mining. The direct wave attack on this island eroded the whole area below the sea level. The area of erosion was estimated as 0.06km<sup>2</sup>.

Keelakkarai and Mandapam groups of islands, have moved towards seaward side. The island erosion has been mostly identified along the northern shore of these islands (landward side). Some of the evidences such as submerged trees and sharp edged coasts are found along the northern shores of these islands. This is because the long shore current and tidal current are flowing north to south along the northern shore of islands. These eroded materials are transported and deposited on seaward side of the island coast. While high velocity waves are moving towards south shores of islands with the littoral sediments and coming across the coral reefs, when these sediments

are be dropped on the coral reefs; wave speed reduces and turns into a wave-induced current. By repeated action of such processes the area between Islands and reef edge get shallow and reefs have submerged. Submerged reefs in southeast of Krusadai Island are evidence for accretion of sediment at seaward side of the islands. The areas of erosion and accretion along the shore of these islands were estimated to be 3.81 and 3.18 km<sup>2</sup> respectively for the last 30 years between 1969 and 1998. Poovarasanpatti Island is one of the islands in Keelakkarai group, located 6.90 km from Kalachimundal coast. The entire island was eroded due to the direct attack of the waves and its level is below the sea level. The area affected by erosion is 0.05 km<sup>2</sup>.

#### **Impact of Tsunami (26<sup>th</sup> December, 2004) along the Tamilnadu coast**

The Tsunami has devastated extensive stretches of coastal areas of Nagapattinam, Kanyakumari, Cuddalore and Chennai. The damage was more in areas, which are low lying and flat devoid of any vegetation. Hence multi hazard vulnerability maps are to be prepared to prevent further natural hazards. The elevation, geology, geomorphology, sea level, horizontal shoreline displacement (erosion/accretion), tidal ranges and wave heights will be taken into account. The present as well as desirable type of land use pattern will be indicated. Suitable civil structures and bio-seals are to be proposed based on the need of the coastal area to prevent further damages.

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