Marine biodiversity and its conservation methods in Gulf of Mannar and Palk Bay

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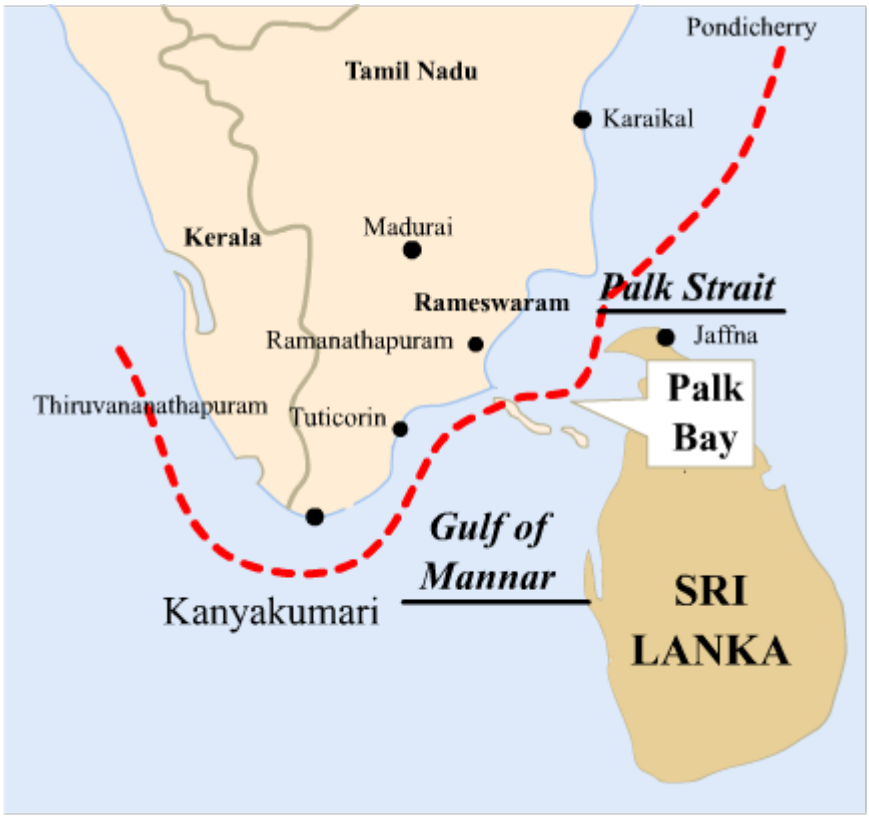
Introduction



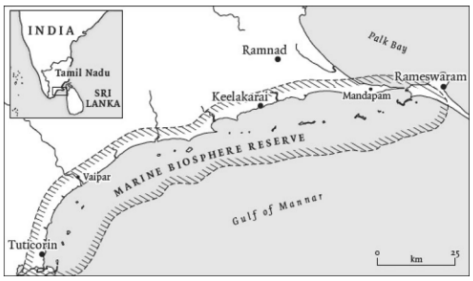
The coastline in Tamil Nadu can be broadly divided into three fishing zones. They are (1) Pulicat Lake to Point calimere that lies in the Coromandal coast; (2) Point calimere to Dhanushkodi that covers the Palk Bay and the Palk Strait; and (3) Dhanushkodi to Kanyakumari which covers the Gulf of Mannar.The Gulf of Mannar, the first Marine Biosphere Reserve in India as well in South East Asia covers a total area of 10,500km^2 from Dhanushkodi to Kanyakumari covering a coastline length of 365 km along the coast of Tamil Nadu between Longitudes 78^{0}08E to 79^{0}30E and Latitudes from 8^{0}35N to 9^{0}25N. This Marine Biosphere Reserveencompasses a chain of 21 islands with its fringing reefs from Ramanathapuram to Tuticorin district.

- Mandapam Group (7 islands): Shingle, Krusadai, Pullivasal, Poomarichan, Manoliputti, Manoli, Hare
- Keezhakkarai group (7 islands): Mulli, Valai, Thalaiyari, Appa, Poovarasanpatti (submerged), Valaimunai and Anaipar.
- Vembar Group (3 islands): Nallathanni, Pulivinichalli and Upputhanni.
- Tuticorin Group (4 islands): Kariyachalli, Vilanguchalli (submerged), Koswari and Vaan.

The 21 islands and the surrounding shallow coastal waters covering an area of 560 km^2 between Pamban and Tuticorin was declared as Marine National Park by the Government of Tamil Nadu in 1986 for the purpose of protecting marine wildlife and its environment. The Gulf of Mannar Biosphere Reserve (GoMMBR) covering an area of 10,500km^2 between Rameswaram and Kanyakumari was declared by the Government of India in 1989.Since time immemorial, the Gulf of Mannar is regarded for its pearl fishery and its rich fishery resources. There are about 4223 species of various flora and fauna has so far been found in this biosphere reserve.A unique endemic species of Balanoglossus - *Ptychodera fluva*, a living

fossil that links invertebrates and vertebrates, has been recorded only here at Kurusadai Island. Hence the Gulf of Mannar is famously called Biologist Paradise, however inthe past decades heavy exploitation has resulted in depletion of its resources.

Palk Bay, named after Sir Robert Palk (1717-1798) the then Governor of Madras Presidency (1755-1763), is situated in the southeast coast of India encompassing the sea between Point Calimere (Kodikkarai) near Vedaranyam in the north and the northern shores of Mandapam to Dhanushkodi in the south. It is situated between Latitude 9º 55' - 10º 45' N and Longitude 78º 58' - 79º 55' E. The Palk Bay itself is about 110 km long and is surrounded on the northern and western sides by the coastline of the State of Tamil Nadu in the mainland of India. Palk Bay and Gulf of Mannar to its south are connected by a narrow passage called Pamban Strait which is about 1.2 km wide and 3 to 5 m deep that separates the Island of Rameswaram from the mainland. The Palk Bay waters merge with those of the Bay of Bengal in the northeast and the Gulf of Mannar waters in the south. The Palk Strait is just 35 km of water that is narrower than the English Channel and separates the northerncoast of Sri Lanka from the southeast coast of India. Therefore the international boundary line is close to the shores of both the countries. The boundary is only 6.9 km away from Dhanushkodi, 11.5 km away from Rameswaram, 15.9 km away from Point Calimere, 23 km away from Vedaranyam and 24.5 km away from Thondi.



Gulf of Mannar Ecosystems

Gulf of Mannar covers a wide range of marine ecosystem that boasts marine life; they are

I. Coral Reef Ecosystem
II. Seaweed Ecosystem
III. Sea grass Ecosystem
IV. Mangrove Ecosystem
V. Lagoon and Wetland Ecosystem
VI. Other Resources

I. Coral Reef Ecosystem

Coral reef formation in the Gulf of Mannar is of Fringing type, which is bordered around the 21 uninhabited islands. Coral reef ecosystem is comparable with rain forest ecosystem on land and it support a wide variety of resources. The reefs of the Gulf of Mannar Biosphere Reserve and Palk Bay are the only major coral formations along the mainland coast of India. A discontinuous barrier termed Mannar Barrier extends over a distance of 140 Km from Tuticorin to Pamban in the Gulf of Mannar. The Mannar Barrier possesses a chain of 21 islands all along its length with fringing reefs around them. There are 117 coral species identified so far in Gulf of Mannar. They belong to 40 genera and 14 families. Of this, 106 8

species grouped in 30 genera are hermatypic and 11 species grouped in 10 genera are ahermatypic. Coral reef diversity of Gulf of Mannar and Palk Bay comprises of fourteen families, 40 genera and 117 species. Among the 89 genera recorded in India, only 40 are reported so far in this ecosystem. Species such as *Montipora monasteriata*, *M. informis*, *M. squamosa*,*M. turgescens*, *M. venosa*, *M. verrucosa*, *M. digitata*, *M. millepora*, *M. manauliensis*, *Acropora digitifera*, *A. secale*, *A. intermedia*, *Pocillopora verrucosa*, *Porites mannarensis*, *P. exserta* and *Goniopora stutchburyi* are common in these islands. Species such as *Montipora millepora*, *M. jonesi*, *M. manauliensis*, *M. edwardsi*, *M. exserta*, *Porites exserta* and *P. mannarensis* are reported only form Gulf of Mannar and Palk Bay. All coral species are protected under Schedule-I of the Indian Wildlife Protection Act (1972).

The following conservation and management strategies are outlined for Indian coral reef management.

- Identification of marine protected areas and their demarcation and protection.
- Coral Reef Monitoring Action Plans prepared and launched. Other significant international activities such as the Coral Reef Degradation in the Indian Ocean (CORDIP), India–Australia Training and capacity building programme (IATCB), initiated.
- National wide mapping of coastal areas by remote sensing techniques combined with land surveys to assess the rate of degradation initiated.
- Amendment and enactment of National policies (National Biodiversity strategy and Action Plan and National Biodiversity Bill) with relevance to the protection of respective ecosystem.
- Export trade control order.

II. Seaweed Ecosystem

About 90% of the species of marine plants are algae and about 50% of the global photosynthesisis algal-derived. The health of seaweeds is directly related to health of coastal and marine ecosystem. Based on their pigmentation, the seaweeds are broadly classified into Chlorophyceae (Green algae), Phaelphyceae (Brown algae) and Rhodophyceae (Red algae). In marine ecosytem the ecological services of seaweed is numerous viz., provide shelter for fish, invertebrates and food.

Seaweeds are used as food, feed, fodder and bio fertilizers, besides they form a source of iodine and bioactive substances. The important polysaccharides like agar-agar, alginic acid, and carrageenan are also obtained from the seaweeds. About 101 species of seaweeds are used for extraction of phycocolloids; out of them 33 are used for Agar, 27 are for Carrageenan and 41 for Alginates production.

Tamil Nadu has a 1076 km coastline. A recent survey encountered 282 species of which 146 were from Rhodophyta, 80 from Chlorophyta, and 56 from Ochrophyta. Gulf of Mannar supports around 181 species of seaweeds, comprising green algae, brown algae, red algae and blue-green algae. About 17 economically important species from agarophytes,carrageonophytes, alginophytes and edible seaweeds are recorded in this area. Commercial cultivation of *Kappaphycus alwarezii* is being carried out in the Palk Bay which is one of the important ingredients in the soft drink. The algal productive area along the coast line from Mandapam Camp to Kanyakumari is put at 17,125 ha. The stand crop estimate is about

22,050 tons within limited zones of intertidal area for the coastal stretch from Mandapam till Kanyakumari. *Gelidiella acerosa* is the most exploited species.

It is also interesting to note that most common red seaweeds of industrial importance *Gracilaria edulis* and *Gelidiella acerosa* (Rhodophyta)) have become locally extinct from some of the islands of the Gulf of Mannar due to the indiscriminate and unsustainable harvesting, whereas their natural resources existed in plentiful abundance a few decades ago. Although, it is very important to understand how species respond to anthropogenic activities, previous studies were only taxonomic or floristic account.

Seaweed Biodiversity Research Gaps and Challenges

- Filling Geographic Gaps to Comprehensively Document Species Diversity and Biomass
- Improving Data Access to the Scientific Community
- Expertise Short-Cut and the Need for Capacity-Building and Nationwide Expertise
- Developing Integrated Taxonomy

With only ~10% share in global seaweeddiversity and ~0.01% in farming, India still assume significant importance, as more than 20% of itscoastline is occupied by two island territories namely Andaman & Nicobar and Lakshadweep andlargely unexplored for its seaweed diversity. It may also be noted that, establishment of 100 marineprotected areas located in islands and costal union territories of India, coupled with identificationof nine critical habitats provide strong legal frameworks for protection and conservation of thiseconomically important resource.

III. Seagrass Ecosystem

Sea grasses are flowering plants from one of four plant families (Posidoniaceae, Zosteraceae, Hydrocharitaceae or Cymodoceaceae). They are productive near shore habitats that host many economically and ecologically important species. Sea grasses regulate water column dissolved oxygen, modify the physical and chemical environment, stabilize sediments,slow water movements and trap heavy metals and nutrient rich runoff, thus improving the water quality for coastal environment and associated communities.There are 15 species of sea grasses reported from the Gulf of Mannar and Palk Bay region.

1. *Enhalus acoroides*
2. *Halophila ovalis*
3. *H. beccari*
4. *H. ovata*
5. *H. stipulacea*
6. *Thalassia hemprichii*
7. *Cymodocea serrulata*
8. *C. rotundata*
9. *Halodule uninervis*
10. *H.pinifolia*
11. *H. wrightii*
12. *Halophila decipiens*
13. *H. ovalis var: Ramamurthiana*
14. *Ruppia maritima*
15. *Syringodium isoetifolium*

The seagrass species, *Halodule uninervis* is extensively distributed in Gulf of Mannar and is the dominant and primary species in the intertidal belt. It occurs both on sandy and muddy substratum with a thin layer of sand. It isalso observed on coral debris. *H. uninervis* plays an important role both as stabilizers and sediment accumulator and occurs either as a bed of monospecific community or a mixed vegetation with *Cymodocea rotundata*, *Cymodocea serrulata*, *Halophila ovalis* and *Enhalus acoroides*. *Cymodocea serrulata* occurs extensively in most of the islands of Gulf of Mannarand forms a significant browsing ground for the endangered dugong. *Thalassia hemprichii* and *H. uninervis* beds are the important habitat for Holothurids commonly known as sea cucumbers. The studies on seagrass in Gulf of Mannar are very limited and the baseline data has to be collected recently on the status, density, diversity and distribution.

Palk Bay is ashallow tropical marine water body wedged between Sri Lanka and India. It is connected to the Arabian Sea on its west through the Gulf of Mannar, and with the Bay of Bengal directly on its east. So far, 14 species of sea grasses are recorded from this area. The Palk Bay has more extensive sea grass growth compared to Gulf of Mannar because of its topography and sediment texture. The sea grass beds are present from the shore towards the sea up to 9 km distance. The area between Pamban and Athiramapattinam has approximately 254 km2 seagrass cover with dominant species, *Thalassia hemprichii*, *Syringodium isoetifolium* and *Cymodocea serrulata*.The luxuriant seagrass meadows in Gulf of Mannar and Palk Bay form a significant grazing ground for the sea cow, *Dugong dugon* and support the high number of dugong population presently in India.

The present major threat to sea grass meadows in Gulf of Mannar and Palk Bay is destructive fishing activities, deterioration of water quality and climate change.

IV. Mangrove Ecosystem

Mangroves are a group of trees and shrubs that live in the coastal intertidal zone.There are about 80 different species of mangrove trees. All of these trees grow in areas with low-oxygen soil, where slow-moving waters allow fine sediments to accumulate. Mangrove forests only grow at tropical and subtropical latitudes near the equator because they cannot withstand freezing temperatures.Mangrove forests stabilize the coastline, reducing erosion from storm surges, currents, waves, and tides. The intricate root system of mangroves also makes these forests attractive to fish and other organisms seeking food and shelter from predators. Mangroves, Sea grass and Salt marsh ecosystems are called Blue carbon ecosystems that can be up to 10 times more efficient than terrestrial ecosystems at absorbing and storing carbon long term, making them a critical solution in the fight against climate change.Overall, 17 species of mangroves and mangrove associate species were reported from 13 estuaries of the Palk Bay region.

Threats to Mangrove ecosystem

- Land reclamations for construction activity, aquaculture, agriculture, tourism
- Industrial and domestic pollution
- Port development
- Dumping of all kinds of waste and debris
- Deforestation for fuel wood
- Over harvesting of marine resources

Management issues in Mangrove ecology

- Reduction in freshwater: As the Muthupet mangrove wetlands are situated at the tail end of the Cauveryriverine system, fresh water reaching this region is very minimal due to the construction of many damsupstream of the Cauvery river. This affects agriculture and the nutrient and sediment transport to themangrove environment.
- Silt deposition in the mouth region of the lagoon in the last 20 years has caused shrinking of the lagoon, which ultimately caused the reduction in the migration of the fish, prawn and crabs and their juveniles into the mangrove wetlands.
- Silt deposition in the lagoon: In the eastern region of the lagoon siltation is severe where the depth ofthe water is not even 30 cm during high tide. Due to the shallowness marine fish that seasonally migrateinto the lagoon in large schools for breeding and feeding are no longer seen even near the mouth regionof the lagoon.
- Over-exploitation of the fishery resources in the nearby neritic water by trawlers.
- Restoration of large areas of degraded mangrove forests: It is widely accepted by the key stakeholders,Forest Department as management agency and local community as consumer of the mangrove resources,that restoration of mangrove forests will enhance the fishery potential of the region and also act as acyclone barrier.

V. Lagoon and Wetland Ecosystem

Wetlands are the ecotones or transitional zones between permanently aquatic and dry terrestrial ecosystems. Ramsar convention hasdefined wetlands as “areas of marsh, fen,peatland or water, whether natural or artificial,permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters”. A wide variety of wetlands like marshes, swamps, open water bodies, mangroves and tidal flats and salt marshes etc. exists in our country.

Lagoons form a particular type of natural capital which generates use values (fish, shrimp, fuelwood, salt, fodder, ecotourism, anchorage, recreation, etc.) and nonuse values (habitat preservation, biodiversity, ecosystem linkages, etc.) contributing positively towards improving the human wellbeing.

Gulf of Mannar and Palk Bay includes two lagoon and wet land ecosystems combined it is geographical range viz., Muthupettailagoon and Gulf of Mannar lagoon. Muthupet is the largest mangrove wetland in Tamil Nadu covering an area of 11,900 hectares. It constitutes the western limit of the Ramsar Site and is located 50 km to the west of Point Calimere Wildlife Sanctuary. The wetland comprises of mangroves, creeks, a lagoon and mudflats. *Avicennia marina* is the dominant mangrove species in Muthupet and accounts for about 95% of the vegetative cover.

Ecological services of Wetlands and lagoons

Ecosystem services offered by wetlandsinclude floodwater storage and control, rechargeof aquifers, treatment of waste water andpollution abatement, general water qualityimprovement, habitats for fish, wildlife andseveral other animals and plant species, andbiological productivity. In addition, wetlands areof high aesthetic and heritage value providingopportunities for recreation, research, andeducation.

VI. Other bio-resources

Sea turtle diversity

The Gulf of Mannar is the onlyecosystem in India where all 5 sea turtlespecies have been reported. These are the olive ridley (*Lepidochelysolivacea*), green (*Cheloniamydas*), hawksbill (*Eretmochelys imbricate*)and leatherback (*Dermochelys coriacea*).The Loggerhead turtle (*Caretta caretta*). All the sea turtles thatoccur in these coastal waters are protected under Schedule I of the Indian Wildlife ProtectionAct (1972), as well as listed in Appendix I of Convention of International Trade inEndangered Species of Wild Fauna and Flora (CITES) which prohibits trade in turtleproducts by signatory countries. At present there exists no commercial or international tradeof marine turtles or turtle products in India. However, incidental capture in trawls is a well-knowncause of mortality for sea turtle.

Sea cow Habitat

Dugong dugon are commonly known as sea cows and are the only species in thegenus Dugong which comes under the order Sirenia. In India, the dugong occurs in the Gulfof Mannar and Kutch, the Palk Bay and in the Andaman and Nicobar Islands. All these areashave sea grass beds, which are good foraging ground for the Dugongs. The most favoreddugong habitats are the Gulf of Mannar and Palk Bay.Dugongs are sea grass specialists,uprooting whole plants when they areaccessible, but feeding only on leaves when thewhole plant cannot be uprooted. Dugongsprefer sea grasses, the genera Halophila andHalodule, which are lowest in fibre and highestin available nitrogen and digestibility. Sea cow is the flagship species of Gulf of Mannar and Palk Bay ecosystems.

Sea horse diversity

Seahorses are fish belonging to the Syngnathidae family which also includes seadragons, sea moths, and pipe fish. Seahorses are a saltwater vertebrate fish belonging to theorder Perciformes, family Syngnathidae, meaning with jaw, genus Hippocampus, literallyhorse of the sea. 4 species of sea horses and 7species of pipefish are found to occur in Gulf ofMannar region. Most Seahorses are found incoastal waters, typically at depths of 1 - 15 meters, occurring in relatively sheltered environmentsamong seagrasses, kelp beds, rocky reefs,mangroves and coral reefs. Unfortunately these aresome of the most vulnerable of marineenvironments, highly susceptible to disturbancecaused by human activities. Seahorses feed onbrine shrimp, tiny fish and plankton.

Sea cucumbers diversity

Sea cucumbers are economically andecologically important echinoderms, which areexclusively marine and inhabit in habitats suchas rocky shores, sandy beaches, muddy flats,coral reefs, mangrove swamps, sea grass andsea weed beds. In Gulf of Mananr, 28 specieshave been reported and among this only seven are commercially important. The Ministry ofEnvironment and Forests, Government of India, imposed a total ban on both fishery and tradeof sea cucumbers and also listed all sea cucumber species under Schedule 1 of the Wild LifeProtection Act of 1972 since 2001.

Gastropod and Bivalve diversity

The Gulf of Mannar is rich in Molluscan diversity and mainly gastropods are being regularly exploited. Studies on the Gulf of Mannar pertaining to the Molluscan diversity revealed, 484 species of molluscs from this region, out of which 260 species are gastropods.Bivalves offer one ofthe important examplesof marine resourcemanagement along theIndian coast. However,apart from the restrictionon the pearl oyster fishery by the Government of Tamil Nadu, and the management measures on the short neck clam fishery of Ashtamudi Lake, Kerala, there are no regulations for effective utilizationand conservation of these sedentary marine resources.

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