

THE NATURAL BIO WALL - MANGROVES

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ABSTRACT

Mangroves (Bio wall) are found all along the Indian coastline. They are salt tolerant ecosystem of the intertidal regions of the world. They are reservoirs of many species of plants and animals and are avenues to gainful employment of the people inhabiting these regions. Mangroves are rich in nutrients, so, different varieties of animals inhabit them. Mangroves are natural resources of the country and are of primary importance for its economic development; they serve as bio wall in protecting the coast against tsunami waves. Some of the mangroves are the source of flourishing apiary industry and wild life recreation centres. Mangroves are appreciated for they have a pivotal role to play and with judicious management they will be a source of perennial benefit to the Nation. Hence, the management and conservation of mangrove forests are very important for development and should aim primarily at protecting and augmenting the compendium of natural resources to optimum use. The mangrove forests should be first realized, (Bio Wall) as they conserve the coastal biodiversity against the pounding waves.

INTRODUCTION

Mangroves are special types of habitats found in the coasts of tropical and sub tropical countries paralleling the geographical distribution of the coral reefs. The word 'Mangroves' originated from 'Mangue', a combination of the Malay, Spanish, French (or) Portuguese for 'wood' and groove English for a small wood.

Mangroves form 'a type of coastal woody vegetation that fringes muddy saline shores and estuaries in tropical and sub tropical regions. Mangroves are bordered by shallow seawater and thus protected from direct wave action. Sometimes the estuary extends into the land to form 'Estuarine Mangroves'. Dominated by estuarine trees, they draw many of their physical, chemical and biological characteristics from the marine, fresh water and upland forests. They have been variously described as 'Coastal woodland', 'Mangal', 'Tidal forest' and 'Mangrove forest', where living conditions are suitable; they form extensive and productive forests.

CLASSIFICATION OF MANGROVES

The mangroves found all over the world were classified by Blatter (1908) into four zones; a) Coastal seawater and semifluid mud, b) Salt Marshes along the coast, c) Salt Marshes of the tidal creek, and d) Interior drier marshes.

In the year 1968, Champion and Seth, classified Forests of India, placed the tidal forests under Primary Seral Types of the Moist Tropical Seral formations. The classification of the tidal forests is, a) Low Mangrove forest (Mangrove forests), b) Salt-Water Heretiera forest (Heretiera forests), c) Freshwater (Heretiera forests).

The Mangrove ecosystem is dominated by specially adapted trees and hence the Mangroves are called 'Mangrove forests'. These trees have the ability to tolerate wide ranges of salinity from seawater to fresh water. Hence, they are Euryhaline. The Mangroves can tolerate dissolved oxygen levels as low as zero. They form a self-maintaining community.

The trees of this ecosystem are recognized by the presence of the root adaptations pneumatophores, prop roots, stilt roots and viviparous seeds. They grow in sheltered shores, penetrating into the estuaries of rivers, tidal creeks, backwaters, salt marshes and coastal mudflats where saltwater penetrates. They generally are developed in coasts, where the atmospheric temperature is never below 20°C even during the winter season. They are open systems since they are constantly subject to tidal flow and seasonal flooding. They are a human resource potential and help in building up and maintaining the coastline from erosion damage. They are a good habitat for a variety of organisms and are an excellent rearing area for juvenile fish, shellfish, reptiles and crabs, which are found in abundance. The production of a more-or-less continuous input of dead leaf material to the surrounding bodies of water provides the basic food input to the detrital

food web, which is the basis of secondary production in Mangrove-linked estuaries. They protect many shores from occasional high wave energy and storms. The mass of trunk, foliage and prop roots of mangroves serve as a physical buffer to waves and storm surges generated by hurricanes, typhoons and tropical storms.

They help to stabilize sediments and once established, they may enhance local sediment accumulation. They play an important role in the pathways of certain key elements such as nitrogen, phosphorus and sulphur, particularly in trapping organic nutrients. Mangroves thus act as an important zone of interaction between adjacent river, marine and terrestrial communities and by being nutrient, filters and synthesiser's of organic matter, they not only create a living buffer between land and sea but also play an important role in supporting the productivity of the associated marine environment.

ECOLOGICAL CONDITIONS OF MANGROVES

This ecosystem is always shallow in nature and rarely show high depth at certain regions. A unique characteristic feature of all mangroves is their muddy bottom due to the absence of wave action and strong water currents. The muddy bottom is exposed during low tides and contains high organic matter. High rainfall occurs in mangroves. The atmosphere is humid and always cloudy. The water shows high salinity due to the concentration of salts such as sodium chloride and magnesium sulphate. Besides, the water shows dissolved ions like manganese, molybdenum, etc. They are water logged (or) stagnant with high nutrients brought in by the incoming fresh water.

MANGROVE VEGETATION

The Mangrove water, as mentioned above is highly fertile due to the presence of trace elements such as iron, manganese, molybdenum, etc., which ensure a high degree of primary production. The rich vegetation is due to the presence of high nutrients in both water and soil of mangroves. Plants found in mangroves belong to different families.

DIVERSITY OF MANGROVE VEGETATION

The 'diversity' in mangrove is a characteristic feature of this ecosystem. The most consistent feature is in the vegetation itself, easily recognized because of only a few species and hence the community is distinct in its commonly expressed features. This depends on various factors like temperature, mud substrate, protection, salt water, tidal range, ocean currents and shallow shores. Every 'mangal' is composed of; (a) Genera and higher taxa which are found only in the mangrove habitat. (b) Species that belong to genera of inland plants but which are adapted for life in the swamp forest. The common plants are *Avicennia officinalis*, *Avicennia alba*, *Aegiceras majus*, *Aegialitis rotundifolia*, *Acanthus ilicifolius*, *Kandelia rheedii*, *Bruguiera caryophylloides*, *Sonneratia griffithii*

and *Carapa obovata*. Glandular hairs on the leaves are well developed in *Avicennia officinalis*, *Avicennia alba*, *Aegiceras majus* and *Acanthus ilicifolius*.

ADAPTATIONS OF MANGROVE VEGETATION

The mangrove vegetation possesses the following adaptations.

Salt-coping Strategy

They are halophytes growing well in saline waters but they depend to a great extent on fresh water to maintain an optimum salinity balance and to get nutrient salts.

- a. *Rhizophora* has a salt excluding device in the root system allowing passage of water and essential nutrients into the tree and not the salt.
- b. *Avicennia* freely allows salt to enter and pass through the leaf stomata during the transpiration, the salt excluding mechanisms being between the xylem and phloem.

Respiratory Mechanism

Pneumatophores are respiratory roots of mangrove trees for efficient aeration of the root system in water-logged conditions.

Viviparous Germination

The seeds of the mangrove trees exhibit viviparity (ie.) the seeds germinate when they are inside the fruits.
Eg. *Avicennia*, *Rhizophora*, etc.

Anchorage and Support

Prop roots and stilt roots grow from the main trunk of the tree for the efficient anchorage of the plants in the loose sandy soil thereby reducing the rate of erosion.

Succulent Stem

Mangrove plants are provided with a succulent stem. Succulence depends on the ratio of absorbed free ions in the plant cells rather than absolute amounts of sodium chloride or sulphate present.

Habit

Most of the plants of mangroves are shrubs and woody trees. Herbs are generally rare or absent.

SUCCESSION OF MANGROVE VEGETATION ON SEA COAST

In the mangroves the succession of vegetation takes place slowly in the following sequence.

- * In the deep water generally true mangroves grow, Eg. *Avicennia* species.
- * When the bottom of the sea is lightly raised up, mixed mangrove vegetation in the shallow waters is seen. Eg. *Avicennia*, *Rhizophora*, *Ceriops*, etc.
- * As the ground is exposed, true mangroves disappear and other halophytes gradually invade the land within a short period. Eg. *Excoecaria*, *Argiceras*, etc.

PLANKTONS IN MANGROVES

The important phytoplanktons of the mangroves are *Pleurosigma*, *Bacillaria*, *Navicula*, *Thalassiothrix*, *Biddulphia* and so on. Dinoflagellates such as *Ceratium*, *Peridinium* and *Prorocentrum*, are also quite common in the waters of mangroves.

FAUNA IN MANGROVES

The roots, the stems and the branches of the mangroves provide a good habitat for tropical animals. The pockets of organic mud held between the roots and stems of mangrove vegetation form a good dwelling place for organisms. Since mangroves are rich in nutrients, different varieties of animals inhabit them. The physiochemical factors of both the mangroves and estuaries are more or less the same. Therefore, the animals of the estuaries are found in the mangrove forests. Most of the mangrove forms are burrowing in habit, found buried in the muddy bottom. Mangrove is a unique ecosystem where animals of the terrestrial, fresh water and marine species inhabit.

The following annelids are represented in the mangroves. *Arenicola*, *Dendronereis*, *Cossura delta*, *Loimia indica*, *Harmathoe*, *Nerine cirratulus*, *Ammotrypane aulogaster*, *Clymene annandalei*, *Sternaspis*, *Stylaroides*, *Ochetostomia septemyotum*, echiuroid worms, etc.

Crustaceans are abundant over here. Crabs are dominant among the crustaceans. *Uca* (fiddler crab), *Metaplex ceenulatus* (mudcrab), crabs such as *Birgus latro*, *Sesarma*, *Coenobita*, *Scylla serrata*, *Macrophthalmus*, etc. *Thalassina anomala* (mud lobster), etc.

Large numbers of barnacles are attached to the roots and stems of mangroves. The hermit crab, *Clibanarius logitarsus*, is abundant in mangrove.

Molluscs are abundant in the mangroves. Large numbers of oysters are found attached to the roots and stems of mangroves. Eg. *Crassostrea cucullata*. Littorinids inhabit the twigs and trunks of mangroves. Eg. *Littorina melanostoma*, *L. scabra* and *L. undulata*. Other molluscs are *Martesia striata*, *Bankia edmondsoni*, *Teredo juttingae*, *Onchidium verruculatum*, *Telescopium telescopium*, *Cerithidea fluviatilis*, *Trebealia palustris*, etc.

Among the fishes, the mudskippers are abundant in the mangroves, Eg. *Periophthalmus* and *Boleophthalmus*. They are small fish having large heads with protruding stalked eyes. When the tide goes out, the mudskippers breathe in air and use their leg like fins, to crawl and hop over the mud. They have special sucker-like fins to climb up mangrove roots and stems. If danger threatens, the fish quickly jumps or skips away.

Boiga dendrophila is a mangrove snake. It lives on birds. *Laticauda colubrina* is a sea snake of mangroves. The monitor lizard, *Varanus salvator* and the sea crocodile *Crocodilus palustris* are other reptiles. The birds of mangrove are the graceful fish eagles, *Haliaeetus leucogaster* and the tall adjutant storks *Leptoptilus javanicus*. Mammals of mangroves include *Macaca crus* (long-tailed monkey) and *Nasalis larvatus* (proboscis monkey).

MANGROVE VEGETATION

Mangrove vegetation of Gangetic estuary, particularly of Sundarban region is present in the Central zone, North-Eastern part, Southern Coastal strip and South-Western part. In Western India near the sea coasts of Bombay and Kerala, in the banks of Gomati and Godavari estuaries in South India particularly in the regions where rivers meet the ocean, and in Andaman and Nicobar Islands.

THE MANGROVES OF INDIA

India has a mangrove coastline of about 6090 Km and the area covered by mangroves is about 7000 Km. About 80% of the Indian mangroves are found in West Bengal and in the islands of India and Bangladesh. Mangroves are also well developed in Andaman and Nicobar Islands. The remaining 20% is found in other Indian east and west coasts.

The only mangroves in Tamil Nadu are those of Cauvery delta at the East Coast. They are the 'Pitchavaram Mangroves' and Muthupet Chatram Mangroves of South Arcot district. The former is the natural one and the latter is totally artificial in origin.

PITCHAVARAM MANGROVE

Pitchavaram mangrove forest is located 11°26' N, 79°48' E at the mouth of the river Uppanar. It is located in South Arcot Vallalar district. It is of estuarine type located at the end of a distributory of the Coleroon river called Uppanar. It occupies an area of 1,100 hectares and the reserve occupies 1,416 hectares. The depth of water is 0.5-1.5m; pH- 7.5-8.5; salinity is 25-40ppt. rainfall-North Eastern monsoon between October and December.

This mangrove gets its fresh water from the Coleroon river before its entry into the Bay of Bengal. The Khansaheb irrigation channel also contributes fresh water to the mangroves. An interconnecting system of channels links the adjoining Vellar estuary with Pitchavaram estuary. The seawater enters the Pitchavaram Mangroves during the high tides through Vellar estuary. It contains about 12 plant species of which *Rhizophora*, *Avicennia* and *Suaeda* are dominant. In Pitchavaram Mangrove about 90 species of diatoms, 40 species of dinoflagellates, 25 species of tintinids and 70 species of copepods have been recorded.

ZONATION IN PITCHAVARAM

Rhizophora zone: It is located along the banks of the tidal creeks and its width varies between 4-10m.

Avicennia zone: It immediately follows the Rhizophora zone. Its width varies from 20-80m depending on the size of the island.

Suaeda zone: It consists of dense bushes. It follows the Avicennia zone.

Barren zone: The portion next to Suaeda zone is barren or highly degraded.

SUNDERBANS IN WEST BENGAL

Sunderbans, a humid forest stretches within an area of 240 Km from East to West. The word 'Sunderbans' means 'Forest near the sea' (Sunder Vana). The total area is 4096 sq. Km, H₂O depth - 12m, pH - 8.5; salinity – 85ppt; Height – 2m. Tides are referred as 'bore's'. The unusual high tide is checked by narrowing of river channel. Inhabited area is 6,630 sq. Km with 2.6 million people; 25% are literate; Three-fourth have no regular jobs. There is no major industry due to the absence of power. 500 quintals of honey and 30 quintals of wax are obtained from rock bees per annum. Excreta of crocodiles provide nutrients to the aquatic animals and it has antitermite property. Heat from the fermenting leaves of Levital incubates the eggs of crocodiles.

ECONOMIC IMPORTANCE OF MANGROVES

The importance of mangrove research derives both from the commercial use of mangrove and the amenities provided by the resource; 1. Firewood. 2. Construction materials like timber. 3. Rail-road ties are provided. 4. It supplies boat and dock building materials. 5. House-hold items like furniture glue, hair dressing oils. 6. It provides tool handles and toys. 7. It acts as fodder and green manure. 8. They serve to hamper storm surges and high winds (tropical and subtropical coasts). 9. Avoids coastal erosion by acting as a buffer zone against floods. 10. It provides habitat for wild life and recreation. 11. Many economically significant animal populations like penaeids, callinectes, Mugilidae, Cynoscionidae have established their habitats in the mangrove ecosystem, due to plenty of food, still waters, shelter where they can lay eggs and larvae and can breed. 12. Many of the species are candidate species for coastal aquaculture. 13. There is a strong link between Mangrove ecosystem and prawn production in coastal waters. Eg. (a) Shrimp fisheries of Venezuela and Pakistan are located in and around the Mangroves. (b) In Mozambique, fishing of *Penaeus monodon* is found only in the area associated with Mangroves. (c) In south Java the only shrimp fishing ground is located nearby Segara anakan cilacap Mangroves (Herger, 1982).

Thus, they function as feeding sites and nursery areas for a wide range of aquatic species, including fishes and prawns, which are important sources of food and income for fishermen.

DISTURBANCES TO THE MANGROVE ECOSYSTEM

This ecosystem is under various stresses; man disturbs the ecosystem at varying degrees, ranging from trivial pressures to complete destruction. Known impacts on this ecosystem are as follows. The major disturbance to this ecosystem is caused by clear-cutting of vegetation and conversion into dry land, direct, deliberate physical disturbance including logging and the stripping of bark for tanning all of which results in the death of Mangroves. Oil spills and thermal effluents also cause harmful effects on Mangroves.

In riverside mangroves, such destruction allows terrigenous sediments to flow on to the seagrass beds and coral reefs, possibly causing temporary damage to the former and permanent damage to the latter. In case of fringing mangroves, there would be less effect as only superficial runoff is involved. However, smothering, shading and eutrophication are observed in such areas due to an excessive outflow of particulate and dissolved organic matter. This would reduce nutrient inputs to other ecosystems like seagrass beds, which in turn, become less productive. Finally, refuges and nursery grounds of various fishes and invertebrates will be destroyed and secondary productivity in seagrass beds and coral reefs will be reduced.

CONCLUSION

Thus mangroves are the special habitats of the tropical and subtropical countries like India. Unfavourable environmental conditions during the monsoon months and natural disasters like tsunami do have effect on mangroves; however, mangrove flora and fauna can withstand large variations in environmental factors. Man exploits the vegetation of the mangroves and every year many trees are being cut for domestic fuel thereby reducing the bio wall and its wealth. This results in the disturbance of animal life in that region. Unless preventive measures are taken, the mangrove swamps may disappear in due course of time and the natural fence (Bio wall) of the country to safeguard the coastal areas from natural calamities will be a question.

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