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Mangroves as Component of Coastal Ecosystems of the Andamans

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ABSTRACT

The mangrove ecosystems in different islands of the Andaman and Nicobar group have been described with respect to location, species distribution, productivity and roie in food web for resident and transient fauna. The significance of mangroves in aquaculture in the islands using different species of fishes and prawns and a need for preservation of the ecosystems is emphasized.

The Andaman and Nicobar Islands lying between 6° 45′ N and 13° 41′ N Latitude and between 92° 12′ E and 93° 57′ E Longitude are situated in the humid tropical belt and have a coastline of 1962 km characterised by numeous bays, lagoons and creeks which are colonised by dense mangrove communities. Together with the faunal assemblage drawn from the adjacent marine and terrestrial environment, the mangrove forests and swamps form an important component of the coastal ecosystems of the Andamans. The extent and distribution of the mangroves, the diversity of flora and fauna, the productivity of mangroves, fisheries and aquaculture significance and management aspects are highlighted in this account.

Extent and distribution of mangroves

It is estimated that there is a total area of over 10 million ha of mangrove forests and swamps in the tropical Indo-west Pacific region. About 20% of the World's mangrove forests have developed on the coastal areas of Indonesia, Malaysia, South Vietnam and Thailand. The deltaic region of the Ganges, Brahmaputra and Irrawady account for one million ha of mangroves. The vast areas of north eastern coast of Australia and southern coast of Pupua New Guinea have together 1.5 million ha of mangroves.

In India, the mainland coasts account for 250,000 ha of mangroves of which Subderbans cover about 2 lakh ha and next in importance to this is the well known mangrove area in the Union Territory of Andaman and Nicobar Islands which according to Blasco (1976) has about 1.15 lakh ha. During an indicative survey of the mariculture potential of the islands, scientists of CMFRI identified several important mangrove areas (Gopinathan and Rajagopalan, 1983; Mahadevan and Easterson, 1983). The extent of vegetational cover was observed to differ from island to island and depended on the coastal configuration and

ariations in substrata status. In general, the ollowing areas support a potential mangrove ecosystem of excellent preservation by ature.

lorth Andaman islands

Luxurient mangrove formations exists long Minerva Bay, shores of Blair Bay facing hatham Is., shores of entire Chatham Is., id Areal Bay. Patchy mangroves exist in tlanta Bay.

liddle Andaman Islands

Muddy shores of Mayabunder have luxurnt mangroves areas. Diverse species of angroves are found along muddy and vampy shores of Betapur and Rangat and iannel mangroves along the creeks of Yerrata.

itchies Archipelago

In the Henry Lawrence and John Lawrence lands mangroves occupy the shores interersed with rocky out crops. Curtain of angroves exists around Outram islands; alapathar creek in Havelock island, southern de of Neil island, Kyd and James islands.

outh Andamans

Thick mangrove vegetation extends to bout 10 km along the Bamboo Flat Bay; nd along both arms of Navy Bay at Junghat. Protected shores of Wandoor and hiriyatappu are dominated by monospecific ands of Rhizophora. Patchy mangroves are et in Minnie Bay and Corbyn's Cove.

ittle Andaman

Good mangrove formation is found along ie creeks and mangrove associated littoral egatation along the less muddy shores.

Nicobar group of islands

Thick mangrove curtain in Kimios Bay of Car Nicobar, good mangroves along the shores of Octavia Bay in Camorta Is., extensive mangrove vegetation in Spiteful Bay of Nancowry, patches along with coconut plantations in Trinkat, the creeks of East Bay in Katchal Is., channel mangroves along banks of Jubilee, Dogmar and Alexandra creeks in Great Nicobar Is are some mangrove formations in the Southern group of islands.

Species composition

Our knowledge about the mangrove flora of Andaman-Nicobar islands has been built up since the eighteenth century in the works of British naturalists and among them mention may be made of Gamble (1903) and Parkinson (1923). Among the Indian botanists, the floristic surveys of Sahni (1958) and Thothathri (1960, 1962) have added considerable information. More recently, Blasco (1976) has reviewed the mangrove vegetation of the Indian-subcontinent and Ellis (1986) has given an exhaustive list of the vegetation of the islands.

The following list of typical mangroves and the closely associated littoral vegetation would help to appreciate the species diversity in these islands :

Family	*Species*
Acanthaceae	*Acanthus ilicifolius* L.
	A. ebracteatus Vahl.
Avicenniaceae	*Avicennia marina* Vier
Euphoribiaceae	*Excoecaria agallocha* L.
Myrainaceae	*Aegiceras corniculatum* (L) Blanco

Rhizophoraceae	*Bruguiera gymnorrhiza* (L)
	Bruguiera parviflora (Roxb)
	Bruguiera conjugata
	Ceriops tagal (Perv)
	Rhizophora apiculata BL.
	Rhizophora mucronata Lamk
Sonneratiaceae	*Sonneratia alba* Sm
	Sonneratia caseolaris (L)
Meliaceae	*Xylocarpus granatum* Koeni
	Xylocarpns moluccensis Lamk
	Heritiera littoralis (Dry)
Palmaceae	*Phoenix paludosa* Roxb
	Nypa fruticans Wurmb
	Cerbera manghas
	Brownlowia lanceolata
Pteridaceae	*Acrostichum aureum* L.
	A. speciosum Wild
Guttiferae	*Calophyllum inophyllum* L.
Malvaceae	*Hibiscus tiliaceus* L.
	Thespesia populnea (L)
Papillionaceae	*Derris trifoliata* Lour
Caesalpinjaceae	*Cynometra ramiflora* L.
Lecythidaceae	*Barringtonia asiatica* (L)
	Barringtonia racemosa Roxb
Lythraceae	*Pemphis acidula* Forsk
Rubiaceae	*Scyphiphora hydrophyllaceae* Gaertn.
Goodeniaceae	*Scaevola frutescens*
Ebenaceae	*Diospyros undulata* Wall.
Boraginaceae	*Heliotropium indicum* L.
	Tournefertia ovata Wall.
Convolvulaceae	*Ipomoea pescaprae* (Linn.)
Verbeneceae	*Clerodendrum viscosum*
	Clerodendrum inerme (L)
Pandanaceae	*Pandanus tectorius*
Cyperaceae	*Cyperus brevifolius* (Roxb)
	C. diffusus Vahl.
	Fimbristylus littoralis Gaud

The mangrove species form ecological zones according to tidal inundation, soil consolidation and the penetration of tidal water into freshwater regimes. In the A & N Islands the water front is characterised by a dense curtain of *Rhizophora* spp and slightly inland *Bruguiera, Ceriops* and *Excoecaria* occur. The second zone may have also *Aegiceras* and *Xylocarpus* intermixing. In the channels and creeks the zonation may be altered with *Sonneratia* or *Avicennia* competing with Rhizophoraceae. As the salinity influence reduces, the zonation is characterised by species of *Heritiera, Barringtonia, Hibiscus, Thespesia, Callophyllum* and the inland creeks may be bordered with *Nypa fruticans, Acanthus ilicifolius* and *Acrostichum* spp. In the protected bays dominated by sandy/rocky substrata strand vegetation such as *Pandanus. Ipomoea, Clerodendrum* and *Heliotropium* may occur in association with *Avicennia* or *Rhizoophora* patches.

The elevated terrain in many islands brings a confluence of the mangrove fringe with the tropical rain forest vegetation. On the seaward side, the mangrove belt at times merges with seagrass, seaweed and coral-reef habitats as is seen in Nancowry and Camorta islands. With human interference kept to the minimum, the mangroves of Andamans make one of the best coastal eco-system in South Asia.

Mangrove ecosystem

Compared to other plant communities, mangroves may be considered as unique, in that they thrive at the interface between land and sea where the waves, tides and coastal currents bring ever changing physical, chemical and biological conditions from the marine environment and the seasonal influx of fresh water from the landward side adds its own contribution. While the plants have variously adapted to this harsh environment, the faunal components such as crabs, prawns, fishes and molluscs spend a part or whole of their life in the mangrove environment for food or shelter. These in turn, attract birds, reptiles and mamals from the landward side Thus, an efficient food web is formed in the mangrove ecosystem which sustains a high level of productivity.

Productivity : Gopinathan and Rajagopalan (1983) observed aquatic primary productivity in water bodies dominated by mangroves such as *Rhizophora, Sonneratia, Bruguiera, Avicennia* and *Excoecaria* at different localities in the A & N Islands. This ranged from 0.2 to 0.5 g C/m^2/day at Ariel Bay, Mayabunder, Rangat, Henry Lawrence and Neil. Slightly higher productivity of 0.5 to 1.0 g C/m^2/day was observed in the mangrove areas at Chiriyatappu, Wandoor, Corbyn's Cove, Kimios Bay and Nancowry. Ramachandran Nair and Gopinathan (1963) also observed very high production of 2.0 to 3.6 g C/m^2/day in the mangrove adjacent mud flats and creeks in Phoenix Bay and Corbyn's Cave. The mangrove and adjacent water bodies may be considered very productive when compared to the offshore waters of Bay of Bengal where the average production is 0.16 g C/m^2 day (Radhakrishna, 1978).

More than this aquatic productivity, the mangrove vegatation itself contributes significantly to the productivity of the waters through decomposition of mangrove litter, the production of which is estimated around 6-8 tonnes/ha/annum in Thailand and Malaysia (Christenson, 1978; Ong *et al.*, 1979). In the Andaman mangroves, which have dense stands of more than 10-15 m canopy height, a litter production of this magnitude can safely be assumed.

Food web : The mangrove leaf litter undergoes initial process of degradation through attack by ants and other insects. Fungi and bacteria contribute to the decomposition of leaves towards formation of detritus. Certain mangrove resident fauna like Sesarmid crabs chew the mangrove leaves lying on the floor and fragment them. Amphipods, gastropoda and soil meiofauna further contribute to the detritus formation as the degraded leaf material passes through the digestive tract of these animals in repeated cycles. Ultimately, the detritus comes the source of food especially for the post larvae and juveniles of prawns and fishes that use the mangrove environment as their nursery. The fact that the mangrove based detritus is the main source of energy in the food web of the ecosystem was demonstrated by Odum and Heald (1972). Their studies stimulated the mangrove workers world over towards an appreciation of the mangrove environment as an important ecosystem, and not a mere forest resource of less economic importance.

Significance of Mangroves in Aquaculture

Through diurnal tides and coastal currents the organic detritus is transported to the inshore environment which supports commercial fisheries. Thus the extent of mangrove

environment is vital to the coastal inshore fisheries including that of shrimp which earns sizeable foreign exchange. Many species of coastal fishes and shellfish ingress into the mangrove environment for food or shelter. Juveniles of many species of prawns such as *Penaeus indicus indicus* and *P. merguiensis* enter the calm mangrove waters for shelter and for food. The surplus detritus food and microflora may contribute to the diet of young prawns. Chong (1977) has shown that 40% of the diet of the mullet, *Liza melinoptera* consisted of mangrove leaf detritus and it was over 80% in the case of *Haplocheilus melastigma*, a common inhabitant of mangroves. Invertebrates such as *Aoetes*, mysids, mud snails (*Cerethidia*) provide detritus feeding linkage to fishes and prawns.

Mangrove dominated water ways are usually frequented by species of *Megalops, Anodontostoma, Stolephorus, Thryssa, Tetradon, Sillago, Scatophagus, Ambassis, Arius* etc. These may sustain localised fishing using gears such as cast net, small beach seines, dip net and traps. The mangrove and crab, *Scylla serrata* is a common inhabitant of mangrove estuaries and supports a good fishery in many parts of Indo-Pacific. The small shrimp *Acetes* also forms a good resource in mangrove areas.

At present the production from marine capture fisheries in the A&N Islands is around 10,000 t/annum. While the oceanic resources such as tunas, bill fishes elasmobranchs and squids are promising, the exploitation of these requires heavy investiment of capital, manpower and other infrastructure. However, the bays, creeks and small water bodies adjacent to mangroves can be utilized for local sustenance fishery as well as for mariculture of cultivable finfishes and shell-fishes.

The method of farming milkfish in 'Tambaks' in many mangrove areas of Java is well known. The soil excavated for culture pond is used for building the dykes which in turn, are planted with *Rhizophora* or *Avicennia* mangrove trees for stablization and preventing erosion. The stand of mangrove trees on the seaward side help to protect the pond from strong winds. Traditional methods of prawn culture in perennial ponds using the technique of 'filtration' or trapping and holding system and prawn-cum-paddy culture are well known in the coastal areas of Cochin and in West Bengal. One of the essential requirement in pond culture is availability of seeds of prawn and fishes.

During the survey of the islands in 1978 by CMFRI, Cochin, good quantity of seeds of *Penaeus merguiensis, Matapenaeus ensis* and *M. dobsoni* were located from mangrove areas in Diglipur, Mayabunder and Sipighat and the development of prawn ponds in the marshy areas between Port Blair and Wandoor was suggested (Silas *et al.*, 1983). As regards fin-fish, pen culture in mangrove channels and creeks and cage culture in protected bays in different islands were suggested by Lal Mohan (1983). Potential candidate species are *chanos*, mullets, perches and sand whiting. Sea bass, *Lates calcarifer* is alse a possible species for culture.

For oyster culture involving *Crassostrea madrasensis* and *Saccostrea cucullata* suitable areas in Ariel Bay, Mayabunder, Port Blair, Hut Bay in Little Andaman and Kimios Bay in Car Nicobar have been recommended in the account by Ramadoss (1983). The scope for details in culture of many other organisms is given in *CMFRI Bull.*/34 (1983).

Conclusions

The mangrove ecosystem of Andaman and Nicobar Islands is perhaps one of the well preserved ecosystems in the Indio-Pacific. They are extensive and possess great species diversity. Climatically the Islands are situated in an area of heavy rainfall during most months accompanied by severe storms and cyclones. The mangrove belt acts as a barrier against such adverse weather conditions and protects the coastal area against erosion and other physical damage. A variety of resident and migratory fauna especially the juvenile stages of prawns and finfishes inhabit the ecosystem for food and shelter. The ecosystem sustains a high level of productivity and supports fishing activities within the water ways fringed by mangroves as well as the coastal inshore waters. Most of the potential candidate species for coastal aquaculture such as prawns, milk fish, mullets, oysters and clams are inhabitants of the mangrove ecosystem. Hence it is worthwhile preserving this ecosystem against human interference. Along the mainland coasts of India, mangrove vegatation has been subject to considerable depletion and degradation due to indiscriminte exploitation for fuel wood charcoal and fodder and clearing of mangrove areas for development of harbours, residential flats, coconut and other plantations, paddy culture and traditional aquaculture. These developments have been the inevitable result of increasing population pressure in the coastal areas. Fortunately such a pressure does not exist at present in this Union Territory. However, in an accelerated programme of an economic development in the islands, pressure may build upon the coastal ecosystem and this calls for proper management strategies and long-term perspective of regulated usage of the mangrove areas for aquaculture development and other economic activities without seriously endangering the fragile ecosystem.

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