

BIODIVERSITY OF MANGROVE ECOSYSTEM

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BIODIVERSITY OF MANGROVE ECOSYSTEM

- **Mangroves occurring in 112 countries and territories.**
- **24 million hectares (Twilley et al., 1992).**
- **10 million hectares (Bunt, 1992).**
- **14-15 million hectares (Schwamborn and Saint Paul, 1996).**
- **18 million hectares (Spalding, 1997) with 41.4 % in south and Southeast Asia and additional 23.5% in Indonesia.**



Distribution

Region	Area (Sq. km)	Percent
South and Southeast Asia	75,170	41.4
America	49,096	27.1
West Africa	27,995	15.4
Australia	18,788	10.4
East Africa & Middle East	10,348	5.7



Distribution

- Mangroves are occurring limited in Japan, Bermuda, New Zealand, Australia and east coasts of South Africa
- No mangroves in Hawaiian islands, since the early 1900's. later 6 species have been introduced.
- The red mangrove (*Rhizophora mangle*) is the most common species in southern Florida, Caribbean and the Gulfs of California and Mexico.
- Other species of *Rhizophora* found common on tropical coasts.
- The black mangrove, *Avicennia germinans* and white mangrove, *Laguncularia racemosa* are found along the Caribbean and Atlantic coasts.



Distribution

- Most of the species of mangroves are found along the shores of western Pacific and Indian Oceans.
- There are two main centres of mangroves: the Eastern hemisphere and Western hemisphere.
- The Eastern hemisphere is Indo-Malesia and Australia.
- The Western hemisphere is Atlantic East pacific region that includes West America, East America and West Africa.



Distribution

- The Eastern Africa is considered as a place of origin for mangroves with 49 species and hence the region is called as the “old world mangroves”.
- The Western hemisphere as the “new world mangroves” with 11 no. of species (Duke, 1992).
- The genera like *Peliciara*, *Conocarpus* and *Laguncularia* are present only in the new world whereas *Osbornia* and *Camptostemon* exist only in the old world.



Distribution

<i>Country</i>	<i>Mangroves (1000 ha.)</i>	<i>Global %</i>
Indonesia	4250	30
Brazil	1376	10
Australia	1150	8
Nigeria	970	7
Malaysia	641	5
Bangladesh	611	4
Myanmar	570	4
Vietnam	540	4
Cuba	530	4
Mexico	525	4
Senegal	440	3
India	360	3
Colombia	358	3
Cameroon	350	2
Madagascar	327	2

Distribution

Country	Period of record	Estimated original mangrove area	Estimated present mangrove area	Percentage
Cuba	1969-1989	476000	448000	94
Bangladesh	1963-1990	685000	587000	86
Guatemala	1965-1978	58000	50000	86
Malaysia	1979-1986	113000	89000	79
Ecuador	1966-1989	235000	177500	76
Thailand	1961-1993	300000	219200	73
Vietnam	1969-1990	425000	286400	67
U.S.A	1958-1983	260000	175000	67
Colombia	1976-1989	480000	307000	64
Indonesia	1969-1986	4220000	2176000	52
Philippines	1968-1995	448000	140000	31
Singapore	1922-1989	700	180	26
Puerto Rico	1930-1985	26300	3000	11
South India (Kerala)	1911-1989	70000	250	4

STATE-WISE COVER OF MANGROVE FORESTS OF INDIA IN KM² (FAO, 2007)

State/UT	Year of assessment		Change of forest cover	
	2005	2007	2003-2005	2005-2007
Andhra Pradesh	329	353	0	-1
West Bengal	16	17	0	1
Gujarat	936	1046	20	55
Karnataka	3	3	0	0
Kerala	8	5	0	0
	158	186	0	0
Orissa	203	221	0	4
Tamil Nadu	35	39	0	3
	2118	2152	-2	16
Andaman and Nicobar	637	615	-21	-20
Daman and	1	1	0	0
	1	1	0	0
Total	4445	4639	-3	58

Mangrove zonation and composition

The above-tide forest

- Formed by the trunks and leaf canopy of the mangroves is an inhabited by terrestrial species.
- Birds, bats, lizards, crabs, snakes, snails, land crabs and mangrove crabs, spiders and insects are all common.
- The birds and bats are insectivorous or piscivorous, crabs are detritivorous or omnivorous.
- In some areas, domestic animals (cattle, goats or camels) may graze on the mangrove leaves.



Mangrove zonation and composition

Inter-tidal swamp

- Some organisms attach to the mangrove roots, others reside in or on the mudflat of mud banks.
- Barnacles and oysters are abundant epifauna, oysters are dominant one.
- Some species of isopods bore into the woody prop roots, Snails are found in abundance over the roots in the upper inter tidal zone
- Some polychaetes are also associated with surface. In intertidal mud flats numerous fiddler crabs *Uca* and sea cucumbers are commonly present
- Amphipods also available. Fishes like mud skippers, *Periophthalmus* are found



Mangrove zonation and composition

Subtidal zone

- Subtidal mangrove supports a rich epiflora and epifauna of algae, sponges, tunicates, anemones, hydroids and bryozoans
- In some areas turtle grass, *Thalassia* are present
- Crabs, shrimp and worms are common.
- Fishes also more common and many of them are plankton feeders



Associated faunal composition

S.No	Groups	No. of species
1	Insects	67,000
2	Molluscs	4000
3	Other invertebrates	6500
4	Fishes	1400
5	Amphibians	140
6	Reptiles	420
7	Birds	1200
8	Mammals	340

Mangrove associated flora

Bacteria

- Sulfate-reducing bacteria, *Desulfovibrio*, *Desulfotomaculu*, *Desulfosarcina* and *Desulfococcus*
- Methanogenic bacteria are abundant in sediment where *Avicennia* sp. dominate
- N₂ fixing *Azotobacter*, non N₂ fixer *Azospirillum brasilense* are present
- *Bacillus thuringiensis* insecticide against mosquito larvae *Anopheles maculatus*.
- Leaves of *Avicennia marina* and *Sesuvium portulacastrum* have *Flavobacterium* and *Vibrio* spp.



Mangrove associated flora

Fungi and Fungus-like protists

- 43 species of higher fungi; including 23 Ascomycetes, 17 Deuteromycetes and 3 Basidiomycetes (Kohlmeyer & Kohlmer, 1991)
- Hyde (1990) listed 120 species from 29 mangrove forests, these include 87 Ascomycetes, 31 Deuteromycetes, 3 Basidiomycetes
- The fungus like protists (Marine oomycetes) occur in mangrove communities
- Wood degrading fungi are well-known in mangrove habitats. 30 spp. are recorded in Malaysian mangals



Mangrove associated flora

Micro algae

- Plankton production in mangrove habitat ranges from 20-50%
- High turbidity, large salinity variations, small ratio of open water and low light levels and shading that limit productivity of the microalgae especially benthic forms
- Selvam et al (1992) found that phytoplankton productivity to be four times higher in mangrove waters than adjacent marine waters in South India.
- Production rate of Fly river delta of Papua New Guinea is $0.022\text{--}0.0693\text{ g Cm}^{-3}\text{d}^{-1}$. In lagoons of Mexico is $2.4\text{ g Cm}^{-3}\text{d}^{-1}$. Ivory coast is $5\text{ g Cm}^{-3}\text{d}^{-1}$.
- In India 146 species of phytoplankton and 182 phytoplankton occur in the West Bengal and Pichavaram respectively.



Mangrove associated flora

Macro algae

- Red algae, especially genera like *Bostrychia*, *Claoglossa* and *Catenella* are most commonly associated with mangrove and may be quite abundant.
- In Papua New Guinea-25 species; 61 species in Andaman Sea, 127 species in Mauritius were reported

Seagrass

- Seagrass biomass in mangrove areas may be quite high. In Andaman Sea seagrass biomass ranging from 55-1941 g wet wt. m^{-2} corresponding to 32-297 g dry wt m^{-2}
- *Thalassio hemprichii*, *Enhalus acoroides* and *Halophila ovalis* are the mangrove associated seagrass, *Halophila baccarii* occurs in intertidal mudflats of Indian mangals



Mangrove associated flora

Saltmarsh and other flora

- Saltmarsh species are generally not common in mangrove habitats, a large number of other non-mangrove plant species may be found coexisting with mangroves
- In India documented 1175 angiosperm species in 680 genera and 154 families
- Found approxi. 100 epiphytic species are reported



Mangrove associated fauna

Zooplankton

- Zooplankton abundances in mangrove habitats reaching up to 623 m^{-3}
- Krishnamurthy et al. (1995) found 81 species in the Pichavaram mangroves
- Tintinnids were the dominant microzooplankton with 50 species and densities ranging from 60 to 44,990 ind. m^{-3} . Most important genera were Tintinnopsis and Favella (Krishnamurthy et al., 1995). They also found 40 rotifer species in 17 genera
- Copepods are the most abundant group in the mangrove mesozooplankton, its reach 80, 740 ind./ m^{-3} , the genera Acartia and Acrocalanus, Macrosetella, Euterpina and Oithona are the most abundant.

Mangrove associated fauna

Epibenthos, infauna and meiofauna

- Sheridan identified over 300 benthic taxa in red mangrove, seagrass and mud habitats in southern Florida, its ranged 22,591-52,914 ind./m²
- The fauna was composed primarily of annelids and tanaids with density of 31,388 and 35,127 ind. m⁻² respectively
- The epibenthos *Vallentinia gabriellae* is common in some south Floridan mangals
- Nematode abundances may reach 2117 ind/cm² with seasonal fluctuations



Mangrove associated fauna

Prawns and shrimp

- Chong et al. (1994) measured prawn densities of 4092 ind.ha⁻¹ in the mangal but only 2668 ind.ha⁻¹ in the adjacent mudflats
- The species like *Penaeus indicus*, *P.monodon*, *P.merguiensis*, *P.semisulcatus*, *Metapenaeus monoceros*, *M.dobsoni* are reported in mangrove waters.
- The *M.monoceros* and *P.indicus* are common in the Pichavaram mangroves



Mangrove associated fauna

Other crustaceans

- Barnacle, *Balanus amphitrite* can grow abundantly on mangrove roots and pneumatophores. Other barnacles genera were *Euraphia*, *Eliminius* and *Hexaminus* appear to prefer mangroves over other substrates
- Burrowing isopods (*Sphaeroma terebrans* and *S.peruvianum*) are kill the mangroves.
- Spiny lobster *Panulirus argus* use mangrove waters to temporary visit



Mangrove associated fauna

Crabs

- The mud crab *Scylla serrata* inhabits seagrass and algal beds in the mangroves of Pichavaram
- The mangrove roots are forming with hermit crab, *Clibanarius laevimanus* clusters of up to , 5,000 individuals.
- Some other species like the grapsid *Metopograpsus messor*, hermit crabs *Coenobita rugosus* and *Coenobita cavipes*, *Thalamita crenata* were present
- There are 18 species of brachyuran crabs belonging to 11 genera and four families from Prentice Island in Sundarbans



Mangrove associated fauna

Insects

- There are found 276 insect species in the mangals of Andaman and Nicobar Islands, of these 197 were herbivores, 43 were parasites and 36 were predators.
- Many of the insects are only temporary visitors to mangal, they provide linkages between the mangal and other environments
- The mangrove tunnels provide home to more than 70 other species of ants, spiders, mites, moths, roaches, termites and scorpions
- Recent records showed that the 28 species of dragonflies recorded in India. A total of 101 species of insects belonging to 9 orders and 42 families have been identified from the Pichavaram mangrove forest. Among the species, 52 species of insects exist in herbs, 23 species in trees, 17 species in soil, 8 species in grasses, and only one species from aquatic habitat



Mangrove associated fauna

Molluscs

- Molluscs are found throughout most mangrove habitats, composed primarily of bivalves and snails, other molluscs like nudibranchs, chitons and scaphopods are less obvious
- The reported molluscs were; snails, *Cassidula nucleus*, *Melampus ceylonicus*, *Bembicium auratum*, *Littoraria pallescens*: bivalves, *Enigmonia aenigmatica*, *Geloina erosa*, *G. expansa*, *Lucina pectinata*.
- Some molluscs are critical to the basic ecology of some mangals, mangrove snail, *Thais kioskiformis* plays a role in maintaining the productivity of mangroves in Costa Rica by cleaning their root systems of encrusting barnacles (Koch and Wolf, 1996)
- Mangroves provide ideal conditions for production of edible oysters *Crassostrea madrasensis*



Mangrove associated fauna

Fish

- Mangroves have a rich and diverse assemblage of fish, some with commercial value
- 197 species occurs in the mangroves of the Embley River
- 117 species have been recorded in Matang mangrove waters of Malaysia (Sasikumar et al., 194)
- 260 species reported in Vietnam mangroves (Hong San, 1992)
- Mangals plays a role as nursery habitat for juvenile fish. Thollot (1992) found that 262 fish species from Southwest Lagoon, New Caledonia
- Ninety per cent of the total catch is contributed by 14 most dominant species. Among these, *Liza* spp., *Mugil cephalus*, *Chanos chanos*, *Elops machnata*, *Eetroplus suratensis*, *Megalops cyprinoides* and *Lates calcarifer* are commercially important ones in Pichavaram.
- The peaks of abundance of finfish juveniles are observed during summer and postmonsoon seasons with the lowest values during premonsoon or monsoon

Mangrove associated fauna

Amphibians and Reptiles

- Amphibian fauna of Sunderbans mangal includes four genera of frogs (Rana, Bufo, Microhyla and Rhacophorus). The ground frog, *Rana hexadactyla*, tree frog, *Rhacophorus maculatus* and toad *Bufo melanostictus* are common.
- About 35 reptile species are known from the Sunderbans. The most notable saltwater crocodiles (*Crocodylus porosus*), monitor lizards, (*Varanus bengalensis*, *V.salvator*, *V. flavascens*), King cobras (*Ophiophagus hannah*), Green pit vipers (*Vipera trimeresurus*), Rock pythos (*Python molorus*) and the olive ridley turtles (*Lepidochelys olivacea*) are present



Mangrove associated fauna

Birds

- Avifauna includes herons, storks, sea eagles, egrets, kingfishers, sandpipers, whistlers and flamingoes which are abundant in most of the mangrove areas.
- In Pichavaram mangroves and adjacent areas, there are 177 species of birds were reported
- About 160 species of birds belonging to 50 families that use Muthupet mangroves for feeding, nesting, roosting or other activities



Mangrove associated fauna

Mammals

- A variety of mammals make their homes in the mangal, Sundarbans are well-known for the Royal Bengal Tiger (*Panthera tigris*)
 - The common otter (*Lutra lutra*) have been reported in Coleroon and Uppanar rivers, in Pichavaram mangrove forest
 - Other important animals are: dolphins (*Platanista gangetica*), mangrove monkey (*Macaca mulatta*), and otter (*Lutra perspicillata*).
 - The endangered species like wild ass (*Asinus hemionus*) occurs only in Kachchh
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Total number of species of flora and fauna reported in mangrove ecosystems of India (Kathiresan and Qasim, 2005)

No.	Groups	No. of Species
<i>Flora</i>		
1	Mangroves	39
2	Mangrove associates*	86
3	Sea grasses	11
4	Marine algae**	557
5	Bacteria	69
6	Fungi	103
7	Actinomycetes	23
8	Lichens	32
<i>Fauna</i>		
9	Prawns and lobsters	55
10	Crabs	138
11	Insects	707
12	Molluscs	305
13	Other invertebrates	745
14	Fish parasites	7
15	Fin fish	543
16	Amphibians	13
17	Reptiles	84
18	Birds	426
19	Mammals	68
Total number of species		4011



Importance of Mangroves

Mangroves serve important coastal functions:

- **Protection against coastal storms;**
- **Critical habitats for coastal biodiversity;**
- **Spawning areas for coastal, marine, and inland aquatic and terrestrial species and birds;**
- **Waste treatment;**
- **Source of timber (construction material and fuel) and nontimber products (honey, brackish water organisms, etc.); and Recreation**
- **Poor communities in the vicinity of mangroves have traditionally depended upon them for income generation, often through sustainable management practices.**



Importance of Mangroves

Uses	Functions	Attributes
Forestry Agriculture Salt production Food, drugs, beverages Fuel wood, charcoal Fishing/aquaculture materials Household items Textile and leather production Agriculture Construction materials Water supply Wildlife protection Recreation/tourism Research site Education site Transport routes	Flood mitigation Prevention of intrusion of saline waters Storm protection Sediment trapping Toxicant removal Groundwater recharge Erosion control Nutrient export Wildlife habitat Fish/shellfish habitats Protection of offshore habitats (coral reefs, sea-grass beds)	Biological diversity value Socio-economic values Cultural Value Historic value Aesthetic value Wilderness value Educational value Research value