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Faunal Diversity of Mangrove Ecosystem in India- A Conspectus

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ABSTRACT

Mangroves are the most productive ecosystem, which protect water quality, provide nursery habitat for many commercial fish and shellfish, which generate about $7.6 billion seafood. This provides livelihood for millions of people besides harbouring array of faunal elements in its natural habitat. The Indian mangroves cover an area of 4921 sq. km with 4822 species of animals, which contributes 4.76% to Indian fauna. It is also noted that 3205 species of Invertebrates including 1422 species of Insects, and vertebrates contain 1344 species. In spite of enormous value of mangrove ecosystem, this unique biome is in great danger mainly due to human interference. The mangroves are being conserved through various project initiated by public and private institutions.

Introduction

The mangroves are threatened salt tolerant higher group of flowering plants that occur in relatively sheltered areas along estuaries, costal lagoons and backwaters in tropical and sub-tropical regions of the world. They are generally inundated and exposed during regular high and low tides respectively, and are nurtured by a mixture of fresh water from rain and land drainage with costal marine waters. The plants of mangrove vegetation are relatively poor in species diversity and show similarities in their general architecture and physiological adaptation - a case of convergent evolution. Typical mangrove species usually have pneumatophores or breathing roots (negative geotropic roots), stilt roots, knee roots, viviparous germination, xerophilous leaves and salt excretory glands.

The mangroves provide natural infrastructure and protection to the coastal population for their sustainable livelihood. They provide a strong barrier in the coastal areas in their dense roots help bind and build soils. The intrinsic network of root systems filter nitrates, phosphates and other pollutants from the water. The mangroves used to protect the coastal areas against oceanic waves, cyclonic effects, tsunami and absorbing atmospheric carbon. The decline of mangrove cover is exponentially high than the terrestrial forests. Considering the fact, it is essential to conserve mangrove ecosystem with its natural flora and fauna.

Mangroves in India

The mangroves are a variety of broad-leaved trees (10-40 feet high) lying in muddy creeks and tidal estuaries. They are diverse and highly productive ecological communities, which provide important ecosystem function. They are located at the land-sea interface and represent one of the best examples of ecotone. The mangroves grow well along tropical coastlines to meet their requirement for warm saline water.

The mangroves have a unique character of complex salt filtration system and complex root system to cope with salt-water immersion and wave action. They protect coastal areas against natural hazards such as cyclones and tsunamis, they retain terrestrial sediments and recycle nutrients thus supporting clear offshore waters, which in turn favours the photosynthetic activity of phytoplankton as well as growth and robustness of coral reefs, sea grass beds and reef-fish communities, they serve as an important habitats, nursery and refuge, providing humans.

These ecosystems are also vital carbon sink, either storing carbon temporarily within organic peat soils, or as dissolved organic carbon in ocean sediments at great depths, offsetting climate-active greenhouse gases for longer periods. They are also adapted to the low oxygen condition of water-logger mud. Mangroves occur worldwide in the tropics and sub-tropics mainly between latitudes 25°N and 25°S. They require high solar radiation to filter saline water through their roots.

It has been found that there are about 80

Table 1: Mangrove Cover in India -2019 (Area in sq. km.)

Sl No	State/UT	Very Dense Mangrove	Moderately Dense Mangrove	Open Mangrove	Total	Change with respect to ISFR 2017
1	Andhra Pradesh	0.00	213.00	191.00	404.00	0.00
2	Goa	0.00	20.00	6.00	26.00	0.00
3	Gujarat	0.00	169.00	1008.00	1177.00	37.00
4	Karnataka	0.00	2.00	8.00	10.00	0.00
5	Kerala	0.00	5.00	4.00	9.00	0.00
6	Maharashtra	0.00	88.00	232.00	320.00	16.00
7	Odisha	81.00	94.00	76.00	251.00	8.00
8	Tamil Nadu	1.00	27.00	17.00	45.00	-4.00
9	West Bengal	996.00	629.00	424.00	2112.00	-2.00
10	A &N Islands	398.00	169.00	49.00	616.00	-1.00
11	Daman &Diu	0.00	0.00	3.00	3.00	0.00
12	Puducherry	0.00	0.00	2.00	2.00	0.00
Total		1,476.00	1,479.00	2,020.00	4,975.00	54.00

Source: India State of Forest Report 2019

different species of mangrove trees. The mangrove area of India covers 4921 sq. km. with 57% formation in east coast, 30% in west coast and 13% in Andaman and Nicobar Island (Kathiresan, 2018). Among the maritime states, West Bengal shares majority of the areas i.e., 2114 sq. km. while the least mangrove cover 2 sq. km. formed at Pondicherry (Kathiresan, 2018). Altogether 130 species of mangroves are reported from India, of which 44 species are true mangroves and 86 species treated as mangrove associates (Kathiresan, 2013). The species diversity of mangrove is high at east coast (88%) followed by Andaman and Nicobar Islands (75%) and west coast (62%). The mangrove cover in India is in a trend of increase over last three decades mainly attributed to plantation by the respective departments. However, during last 30 years due to change in land use pattern, there is constant increase in mangrove cover in the country. The wide ranges of coastal habitat along with riverine and estuarine ecosystem provide an ideal system of mangroves in India in terms of density and cover. Table 1. shows mangrove covers in India.

The details of mangrove forms in different maritime states are summarized below.

1. West Bengal

The mangrove forest of West Bengal mostly describes the mangrove cover as a part of Sundarbans Biosphere Reserve. Geographically Sundarbans is situated in the delta of river Ganges along with Brahmaputra and Meghna share the neighbouring country-Bangladesh covering 10,000 sq. km.

The Sundarbans Forest is the largest mangrove forest ecosystem in the world. The Indian mangroves contributes 38% of total mangrove covers in Sundarbans (Ghosh et al., 2015). Twenty-four species of true mangroves are documented from these areas and it is one of the most biodiverse zones of mangroves in Indo-West pacific region. A recent study reported 2626 species of faunal communities including Protozoa from Sundarbans region. Among the faunal communities besides Royal Bengal Tiger, 50 species of mammals under 39 genera and 23 families are known from Sundarbans. Interesting and frequently observed mammals in Sundarbans include different kinds of bats, Shrews, Indian flying Fox, Leopard cat, Fishing cat, Jungle cat, different types of Mongooses, Gangetic Dolphin, Spotted Deer, Pangolin, different kinds of rats and mouse, etc. Altogether 360 species of birds, among them Brahminy kite, Lesser Whistling duck, Norther Pintail, Stock-billed kingfisher, etc. are commonly found. Apart from saltwater crocodile (*Crocodylusporosus*), 61 species of reptiles including different turtle species, snakes, etc. have been recorded. Lastly, 350 species of fish have been reported from Sundarbans region.

2. Odisha

The mangroves in Odisha are distributed in five districts *viz.*, Baleshwar, Bhadrak, Jagatsinghpur, Kendra Para and Puri covering

an area of 243 sq. km. There are 30 species of true mangroves. Among the faunal communities, the most important ones are Gangetic Dolphin, Plumbus Dolphin, Fox, Jackal, Jungle Cat, common Grey Mongoose and small Indian Mongoose, Wild Boar, number of bird and reptile species mainly crocodile, Olive Ridley Turtle, snakes, lizards, etc.

3. Andhra Pradesh

The total cover of mangrove ecosystem in Andhra Pradesh is about 404 sq. km. distributed in Srikakulam, East Godavari, Guntur, Krishna, Nellore and Prakasham district. Among the faunal resources the important ones are common Golden Jackal, Smooth coated Otter, Fishing cat, Olive Ridley Turtle, Saltwater crocodiles and a number of bird species.

4. Puducherry

The Puducherry state has 30.6 km. long coastline with 2.0 sq. km. mangrove region which contains 18 species of true mangroves. Saravanan et al. (2008) documented 39 species of fishes, 5 species of prawns, 9 species of brachyuran crabs, 9 species of gastropods, 4 species of bivalves and 14 species of birds. In addition, 76 species of benthic faunal communities have been reported (Ramalakannan, 2015)

5. Tamil Nadu

Tamil Nadu is with 906.9 km. coastline in which total mangrove cover is 49 sq. km. with 17 species of true mangroves (Kathiresan et al., 2013; Ragavan et al., 2016). The Pichavaram mangrove area represents 147 species of fishes, 38 species of brachyuran crabs and 57 species of birds. The other mangrove regions contain many species of isopod, amphipod, polychaete, gastropod and bivalves.

6. Kerala

Of 569.7 km. long coastline, mangrove habitat is restricted with a total of 9 sq. km. (Kathiresan, 2018). Nineteen species of true mangroves are reported from Kerala. The mangrove ecosystem of Kerala harbours 87 species of fishes, 44 species of birds and 58 species of insects.

7. Karnataka

The mangrove area of Karnataka is 10 sq. km. with distribution of 17 species of true mangroves. Besides the occurrence of dolphin, deer, monkeys, reptiles and resident birds, there are availability of molluscs and crustaceans.

8. Goa

The small coastline state Goa is with a coastline of 160.5 km. Sixteen species of true mangrove species are distributed in only 26 sq. km. area.

9. Maharashtra

Maharashtra with a coastline of 652.6 km. long has twenty-one species of true mangroves in 304 sq. km. area. A total of 55 species of molluscs, 13 species of brachyuran crabs, 11 species of prawns and shrimps and many commonly observed birds are known from the mangrove areas of Maharashtra.

10. Doman and Diu

Daman and Diu harbours only 3 sq. km. of mangrove region on the coast of Arabian sea.

There are only four species of mangroves.Commonly observed animals including most groups are present in the mangrove ecosystem of Daman and Diu.

11. Gujarat

The extent of mangrove ecosystem in Gujarat covers 11 districts with 1140 sq. km. area with 10 species (Kathiresan, 2018) of true mangroves. The mangrove habitat of Kachchh region harbours 54 species including 14 species of gastropods, 10 species of bivalves, 15 species of crustaceans, 8 species of polychaetes and 3 species under other groups.

12. Lakshadweep

Only Minicoy Island of 36 islands in Lakshadweep has mangrove habitat with only three species of true mangroves. No definite reports about faunal communities of mangrove area in Lakshadweep are available.

13. Andaman and Nicobar Islands

These island groups comprise of 572 islands, islets and rocky outcrop with the coastline of 1962 km. Major mangrove cover i.e., 614 sq. km. is in Andaman group of islands while Nicobar group of islands are contributing less cover of only 3 sq. km. (Ragavan et al., 2014). Several workers studied the faunal diversity from mangrove ecosystem of Andaman and Nicobar Islands. Among the aquatic mammals, dolphins are commonly found. Among the terrestrial mammals Nicobar Tree-shrew, Nicobar long-tailed Macaque, Bats, Nicobar Flying Fox, Palm civet, Olive Ridley Sea turtle, saltwater crocodile, Sea turtles, different snakes and lizards, invertebrates specially insects and crustaceans are commonly occurred in the islands.

Faunal diversity of mangrove ecosystem

Mangrove ecosystem harbours almost all the faunal communities starting from protozoa to Mammalia. The following part contains the information about the animal groups present in mangrove areas.

1. Kingdom Protozoa (Protista)

The microscopic, unicellular and eukaryotic organisms belonging to the kingdom Protista which comprises of animals traditionally called Protozoa as well as some autotrophic groups. Their linear length varies from 5 μm to 250 μm, but some (Foraminifera and Radiolaria) are larger in size. Protista live as free-living, parasitic and symbiotic organisms and inhabit marine, estuarine, freshwater and terrestrial habitats. These primitive animals occupy all aquatic and terrestrial habitats from the highest mountain peaks to the deepest ocean bed. Planktonic Protista form an important component of zooplankton and play a significant role in the food wave as primary consumer in the aquatic part of mangrove.

Protistan species was first reported from Indian mangroves dates back to 1864. The second report was made by Annandale (1907) from brackish water of Port Canning, Sundarbans. Most of the records of protistans are made from the few areas of Sundarbans. Das and Nandi (1998) reported 106 species of protists from Sundarbans Biosphere Reserve. As many as 91

species of parasitic and 5 symbiotic protists have been collected from different vertebrate and invertebrate hosts of Sundarbans are reported by several workers.

Assessment analysis of protistan species reveals that a total of 1247 freeliving and 1892 parasitic protozoa including 226 species of symbiotic protozoa occur in India (Das, 1997 and Nandi and Das, 2010).

Most of the records of protozoans (protistans) have been made from the few mangroves such as Sundarbans, Pichavaram,Kerala and Goa.

2. Phylum: PORIFERA

Porifera belongs to metazoan group commonly known as sponges. These faunal communities mostly inhabit in marine zone and only a few species are known from freshwater ecosystem. Annandale (1911) recorded sponges from Sundarbans mangroves. Out of 545 species of sponges from Indian waters only 5 are known as mangrove fauna (Chandra and Raghunathan, 2018).

3. Phylum: CNIDARIA

The phylum Cnidaria includes seven classes *viz.*, Anthozoa, Cubozoa, Hydrozoa, Myxozoa, Polypodiozoa, Scyphozoa and Staurozoa. The records show that Annadale in 1915 initiated the study on this unique animal group. However, this group was later studied by several workers from mangrove ecosystem of West Bengal, and Godavari (Halder, 2001). Myxozoans in India were well studied by Kalavati and Nandi (2007). The report says that out of 1428 species from India 73 species of Cnidarians are known in the mangrove habitat.

4. Phylum: CTENOPHORA

Ctenophores are permanent inhabitant of marine habitat. These are commonly known as Comb Jellies. Presently 19 species of ctenophores are known from Indian waters of which 4 species are found in mangrove habitat of Sundarbans (Mitra and Zaman, 2016).

5. Phylum: PLATYHELMINTHES

The Platyhelminthes, commonly known as flatworms, are bi-laterally symmetrical soft-bodied animals, parasitic or non-parasitic in habit. The non-parasitic group of Platyhelminthes is the order Turbellaria. The parasitic group of Platyhelminthes such as Cestoda, Trematoda and Monogeneans represent parasitic mode of life. No work on this animal group present in Sundarbans was done except reporting one species from Sundarbans Mangroves.

6. Phylum: ROTIFERA

The rotifers are mostly found to live in fresh water habitat while some species occur in marine environment. These animals are microscopic in size ranges from 0.1-1.5 cm. The rotifers are not studied extensively in the mangrove ecosystem of Sundarbans. So far 466 species are known from India and of these only 53 are known from mangroves.

7. Phylum: GASTROTRICHA

The gastrotrichs are commonly known as hairy back found in freshwater and marine habitat. These microscopic animals vary in size from 0.06-3 mm. Only one species of Gastrotrich

was reported from the mangroves of Andaman and Nicobar Island (Das and Deb Roy, 1989).

8. Phylum: KINORHYNCHA

Das and Deb Roy (1989) reported one species of Kinorhynch from Andaman and Nicobar Islands. These animals are about 1mm. in size and prefer diatom or organic matter as their food. One species is also known from mangroves of Bitarkanika region.

9. Phylum: NEMATODA

The nematode species are minute in size and ranges from 0.1-2.5 mm. These faunal communities are known to live in fresh water, marine water ecosystem as well as in soil. The mangrove fauna of India includes 125 species of free-living nematodes.

10. Phylum: SIPUNCULA

The sipunculids are bi-laterally symmetrical marine benthic animals. Their size ranges between 2mm. and 720mm.

11. Phylum: ANNELIDA

269 species of annelids including 224 species of Polychaeta, 21 species of Oligochaeta and 4 species of Hirudinea are known from mangrove ecosystem.

12. Phylum: ARTHROPODA

12.1 Class: ARACHNIDA

The class Arachnida forms the largest section in the group Chelicerata. The Arachnids are found in terrestrial as well as marine ecosystem.Some Arachnids are parasitic (ticks and mites) and others are free-living (spiders). A total of 5953 species of Arachnids are known from India. Of these, 309 species are known from Indian mangrove ecosystems including 148 species of mite and 160 species of spider from mangrove of India.

12.2. Class: MEROSTOMATA

Annandale (1909) and Roonwal (1944) documented Merostomata from mangroves of Sundarbans. Later in 1972 Rao and Rao and Tripathy et al., (2013) studied Merostomata from Bitarkanika, Odisha.

12.3. Subphylum: CRUSTACEA

Crustaceans include animals like prawns, shrimps, crabs, hermit crabs, woodlice, fice-lice, barnacles, lobsters as well as many planktonic forms. Their size varies from 0.1 mm. to 4.0 mm. The global crustacean database reported with 6,77,35 species while India represents 3835, whereas the mangrovesharbour 624 species from India.

12.4. Subphylum: HEXAPODA

12.4.1. Class: COLLEMBOLA

The collembolans are mostly less than 6mm. This faunal group is known very little from mangrove ecosystem of India. Out of 334 species known from India, only 38 species are recorded from mangrove ecosystems in India.

12.4.2. Class: INSECTA

The class Insecta includes highest number of species in comparison to all other animal groups. These are widely distributed in all types of ecosystems of the world. Insects are believed to contribute a significant portion of the fauna in many mangrove communities. They may be permanent residents of the mangroves or only transient visitors. Surveys

of mangrove insects reveal complex assemblages of species filling a wide variety of niches. Mangroves provide a habitat that supports a number of insects at different trophic levels. The mangrove ecosystem harbour 1422 species of insects against 65,222 species from India.

Table 2: Total no of insect species in mangrove ecosystem of different regions

Sl No.	Name of the region	No of species	Reference
1	Indo Malaysia	500	Spadling et al., 1997
2	Australasia	72	Spadling et al., 1997
3	India (all mangroves inclusive)	711	Kathiresan et al., 2005
4	Sundarbans, India	497	Ghosh, 1992-2001
5	Andaman &Nicobar Islands, India	276	Veenakumari et al., 1997
6	Pichavaram, India	101	Senthil and Varadharajan ,1995
7	Muthupet, India	113	Rahaman, 2002

Source: WWF Report-2017

Table 2 shows total number of insect species in mangrove ecosystems of different regions.

12.4.3. Class: CHILOPODA

This class includes centipedes and millipedes. Out of 101 species recorded from India only three species of Chilopod are known from mangrove ecosystem of Andaman & Nicobar Islands (Das and Dev Roy, 1989).

13. Phylum: BRYOZOA

The moss animals or Bryozoans inhabit in fresh water, brackish water and marine. Annandale (1908, 1911) reported one species of Bryozoan from mangroves of Sundarbans region. Presently two types of Bryozoans found in the mangrove environment.

14. Phylum: ENTOPROCTA

The Entoprocta group of marine and fresh water inhabiting animals are usually sessile. The size of these animals varies between 0.1 mm. to 7 mm. Annandale (1908) documented one species from mangroves of Sundarbans. Since then no further record is available.

15. Phylum BRACHIOPODA

This small group of animals are very rare and inhabit in Marine and brackish water.Eight species of brachiopods are known till now from Indian waters while a total of 392 species are known from the world's oceans (Chandra and Raghunathan, 2018).

16. Phylum CHAETOGNATHA

The Chaetognathans or arrow worms inhabit

on the sea surface and estuarine waters. The size of this worm ranges from 2 to 120 mm. Of the 44 species of Chaetognathans known from India 15 species are known from mangrove ecosystems of India.

16. Phylum MOLLUSCA

Molluscs are one of the most dominant faunal group in mangrove ecosystem and studied extensively by many researchers. The study results show that around 173 species of molluscs recorded associating with Indian mangroves.

18. Phylum NEMATODA

The Nematoceran animals prefer cervices to live. Only seven species of nematocerans are known from Indian waters and of these only one species inhabit in mangroves in India.

19. Phylum ECHINODERMATA

Echinoderms live both in marine and estuarine habitats. Mandal and Nandi (1989) and Sastry (1995, 2005) recorded echinoderms from the mangrove ecosystems of Sundarbans and Andaman and Nicobar Islands. A total of only eight species of echinoderms are known from mangroves in India.

20. Phylum HEMICHORDATA

This unique animal group Hemichordata found mostly in swampy as well as mangrove areas of the world. The size of Hemichordates within the range of 50cm. One species of Hemichordate is known from mangrove ecosystem of Sundarbans region.

21. Phylum CHORDATA

21.1. Subphylum UROCHORDATA

Urochordates are the primitive stages of chordates and are commonly known as tunicates. These animals mostly live in saline waters. Till date a total of 528 pieces of tunicates are known from Indian water and of these only 6 pieces are known from mangroves (Mondal, 2018).

21.2. Sub Phylum VERETEBRATA

21.2.1. Class PISCES

Fishes are the most common aquatic animals and represented by huge number of species recorded by many researchers in India. Altogether 659 species of fishes out of 3364 species from Indian waters recorded from mangrove habitats (Kamala Devi and Rao, 1997, 2007).

21.2.2. Class AMPHIBIA

Like distribution of fishes, amphibians are distributed in all the continents except Antarctica and their maximum diversity is found in the tropical regions of the world. A total of 443 species of amphibia are listed in India and of these only 14 species are known from Indian mangrove areas (Mitra and Pattanayak, 2013; Dutta, 2007).

21.2.3. Class REPTILIA

Reptiles are most ancient group of animals which live both on land and water distributed in all possible habitats. A total of 706 pieces of reptiles are known from India. Of these 57 species of reptiles are known from different mangrove regions (Mitra et al., 2010; Sasidhar and Rao, 2015).

21.2.4. Class AVES

The most attractive as well as important for

Table 3: Faunal Diversity of Mangrove Ecosystem of India

Kingdom	Phylum	Number of Species				
		World (living)	India	%	Indian Mangrove eco system	%
Protozoa (Protista)	Out of 16 phyla 10 in mangroves	36,400	3,525	9.68	349	9.90
Animalia	Mesozoa	122	10	8.19	-	-
	Porifera	8838	545	6.16	5	0.92
	Cnidaria	11,522	1,428	12.39	73	5.11
	Ctenophora	199	19	9.54	4	21.05
	Platyhelminthes	29,487	1,760	5.96	1	0.06
	Rotifera	2,049	466	22.74	53	11.37
	Gastrotricha	828	162	19.56	1	0.62
	Kinorhyncha	196	10	5.10	1	10.00
	Nematoda	25,033	2,949	11.78	125	4.24
	Acanthocephala	1,330	301	22.63	-	-
	Sipuncula	156	41	26.28	1	2.44
	Echiura	198	47	23.73	-	-
	Annelida	17,388	1,029	5.91	269	26.14
	Onychophora	183	1	0.54	-	-
	Arthropoda	12,57,040	79,793	6.02	2393	3.15
	Class Arachnida	1,12,442	5,953	5.29	309	5.19
	Class Crustacea	67,735	3,835	5.66	624	16.27
	Class Insecta	10,53,578	65,222	6.19	1422	2.18
	Phoronida	16	3	18.75	-	-
	Mollusca	84,978	5,205	6.12	173	3.32
	Echinodermata	7,550	778	10.30	8	1.03
	Chordata	71,526	6,656	9.30	1544	20.20
	Sub-Phylum Vertebrata	68,689	6,122	8.91	1338	21.86
	Class Pisces	34,362	3,364	9.78	659	19.69
	Class Amphibia	7,667	407	5.30	14	3.44
	Class Reptilia	10,450	584	5.58	57	9.76
	Class Aves	10,357	1,340	12.93	523	39.03
	Class Mammalia	5,853	427	7.29	86	20.14
	Total (Animalia)	15,29,953	97,642	6.38	4473	4.85
Grand Total (Protista+Animalia)		15,66,353	1,01,167	6.45	4822	4.76

ecosystem restoration, the avifaunal communities received special attention towards exploration of birds in all possible ecosystems. A total of 1346 species of birds are known from India. The mangroves attract several resident and migratory birds and around 523 species of birds have been reported from mangroves in India (Mukherjee, 1959; Chatterjee, 2003; Gopi and Pandav, 2007).

21.2.5. Class MAMMALS

The distribution of mammalian species in India vis-a-vis in mangrove regions are well documented by many researchers. Out of 432 species of mammals recorded from India, 86 species of mammals were documented from mangrove ecosystems of India (Anderson, 1872; Chakrabarti, 1978, 1984a, b; Bhatt and Kathiresan, 2011 and Rao et al., 2013).

Discussion

The Faunal diversity known from twelve mangrove regions in India shows that this unique ecosystem comprises 4822 species in 21 phyla (Table3). The dominant animal group Arthropoda is represented by 2393 species while Platyhelminthes, Gastrotricha, Kinorhyncha, Sipuncula, Entoprocta, Nematoda and Hemichordata are represented by a single species in the mangroves. It is to note that 349 species of Protista, 3129 species of invertebrates and 1344 species of vertebrates are known to occur in the mangrove ecosystems of India. Further it is noticed that 4.76% of Indian fauna are present in mangrove ecosystem. The distribution of various taxa in the mangroves of different maritime states of India shows that highest number of species (2628) occur in West Bengal, i.e. 54.5 % of organisms known from India till date. It is followed by Andaman and Nicobar Islands (1218 species; 25.3%) and Tamil Nadu (1043 species; 21.6%). The lowest being the Karnataka state (272 species 5.6%).

Growing Awareness of the protective, productive, ecological and economic importance of tropical mangrove ecosystems has highlighted the need to conserve and manage them sustainably. The periodically monitoring and to augment the cover in degraded areas, various measures are being taken by the Government of India for the conservation and management of mangroves through afforestation in force. The mangrove biome, spanning over 15,23,60 sq. km. of coastal areas in 123 countries (FAO, 2007) is under severe threat. Nearly 50% of biomes have been lost since the 1950s because of inadequate habitat alteration. If the current rate of mangrove loss continues, the whole mangrove biome will disappear in the next 100 years. There are about 70 mangrove species world-wide, compared to between 40,000 and 53,000 tropical forest tree species. Already 16% of mangrove species are critically endangered, endangered or vulnerable and 10% are near threatened. More than 40% of the mangrove - endemic vertebrates are now also at risk of extinction due to habitat loss.

The causes of gradual depletion of mangrove

ecosystem are urbanization and expansion of agricultural and aquaculture practices. Besides occurrence of storms, tropical cyclones and earthquake-cum-tsunami are major natural threats to mangroves. Sundarbans region of West Bengal is facing the pressure of habitat shift due to the sea level rise in greater extent as the submergence of some portion of coastal landmasses are predominant. Poverty, combined with periodic natural disaster arising from the powerful cyclones that sweep into the area from the Bay of Bengal, contributes to a situation in which a resource-trapped and highly vulnerable population is often forced to fall back upon forest resources, exploiting them illegally just to survive. Mangroves are also facing extensive pressure on the ecological imbalance due to the introduction of invasive alien species, especially in Sundarbans, Tamil Nadu and Andhra Pradesh region. It is the most important prerequisite to conserve and preserve the fragile mangrove ecosystem for maintenance of biodiversity to ensure sustainable management of livelihood for the people dependent on mangrove ecosystem.

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