

Status of marine biodiversity in India

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Introduction

Biodiversity is defined by the Convention on Biological Diversity (CBD) as the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. It includes species diversity, genetic diversity and ecosystem diversity. Species diversity is the diversity of all the species on earth from single-celled bacteria and protists to all the species of the multicellular kingdom. Genetic diversity is the variation within species due to geographical separation and intraspecific variation within the population. Recent developments in the biotechnological applications utilizing genetic diversity are ready to supply several wonder drugs to mankind. Ecosystem diversity is the variation of different biological communities and their interaction with the biotic and abiotic environment. Marine ecosystem provides several important ecosystem services and goods to human beings for their welfare in the form of essential goods. Biological components are crucial for proper ecosystem functioning which provides essential ecosystem services to human beings.

The total marine fish landings from India were estimated as 3.83 million tonnes during 2017. Fisheries sector plays an important role in the Indian economy contributing about 1% to the national GDP. The sector provides livelihood to about 4 million fisherfolk population along the coastal line of 8129 km. The value of total marine fish landings at the retail level was estimated at Rs. 78,408 crores during 2017. Since 1950 the marine fish production in India has gradually increased from mere 5.8 lakh tonnes (1950) to 3.59 million tonnes (2014) showing a sixfold increase. Though the marine biodiversity scenario looks rich and promising several threats such as overexploitation of fisheries resources, habitat destruction and modification, loss of biodiversity, anthropogenic activities, pollution problems and dredging and reclamation of natural habitats are to be addressed properly for sustainability of ecosystem services and to live in harmony with nature.

Ecosystem diversity

Marine ecosystems: The topographical structures of the continental shelf and a dispersal array of fish and shellfish diversity in the coastal region as well as in the Exclusive Economic Zone (EEZ) differ from area to area along the Indian coast. Previous studies on the physical, chemical and biological oceanography of the seas around India have revealed that coastal waters (0-50 m) are fairly more productive. Diversity in the species composition, typical tropical seawaters and co-existence of dissimilar fish and shellfish species in the similar ground are significant features of Indian Marine Biodiversity. Historical readings



on the biology and fishery features of the vital groups revealed that most of the species supporting the fishery are short lived with a normal life span up to 3-5 years, but the fishery being mostly supported are by below a year old and one-year-old. They are prolific breeders and spawn over long periods typically with fractional spawning and display varied annual difference in recruitment. Several matters in the captive fisheries segment harmfully affect the marine biodiversity of the country, specifically in the fish ecosystem which greatly supports human survival. The difficulties like limitations of growth and production in the inshore trawling grounds, less cost-effectiveness and financial returns due to high cost of fishing operations, management difficulties in the framework of common property multi-user and multiple-choice nature of fisheries.

Mangrove ecosystems: A large number of Islands along the Indian coastline in the Gulf of Mannar, Gulf of Kutch, Lakshadweep and Andaman group and the massive mangrove networks along the coast of Goa, Karnataka, Kerala, Tamilnadu, Andhra Pradesh and West Bengal constitute rich marine biodiversity supporting a diversity of species of corals, sponges, ornamental fishes, crustaceans, molluscs and plants. The estimated total area of mangrove ecosystems in India was about 6,81,976ha and it gradually declined in the area due to several anthropogenic activities. Increasing the human dependency on mangroves for domestic needs and industry had destroyed large areas of mangrove forest in India.

Coastal Ecosystems: Indian Ocean is characterized by the upwelling, southwest monsoon, northeast monsoon, mud-bank along the southwest coast and high coastal production. Upwelling occur in the area between Kanyakumari and Karwar during the beginning of the southwest monsoon. It starts from the southern area and then spreads northwards with the development of the southwest monsoon. Southwest monsoon season is the period when mud-banks are formed in some places along the southwest coast of India particularly along the Kerala coast. Mud banks of the Alleppey region is formed by the subterranean mud which is provided by the Vembanad lake system. The mud-banks between Parapanangadi and Tanur are formed by the aggregation of coastal mud. The mud-banks at Chellanam, Narakkal, Valappad, Elathur, Quilandy, Muzhuppilangadi, Kattikulam, Adakathubali, Kumbala, Uppalaand Ullal are formed by the sediments and organic debris discharged from rivers and estuaries. Mud-banks at Vypeen are formed from dredging operations. The optimum hydrographic conditions exist in the southwest monsoon months; the salinity of water falls from 35ppt to 30-31ppt the temperature decreases from 31-32°C to 23-25°C and abundance of nutrients like phosphate, nitrate and silicate become abundant due to river discharges that makes maximum phytoplankton production which is higher than some of the fertile seas of the world.

Coral reef Ecosystems: India is blessed with vast sections of coral reefs in the Gulf of Mannar, Palk Bay, Gulf of Kutch, South-west coast, Andaman & Nicobar and Lakshadweep islands. Coral reefs are the most biologically productive and diverse of all other natural ecosystems. Reefs are equal to tropical rain forest for their rich biological diversity. Coral reefs with enormous amount of calcium carbonate form the raw material for numerous lime waste, cement and calcium carbide industries. They are also used as building blocks in many parts of India. The finfish fauna of coral reefs is very rich and diverse. A total of 225 species of corals are known from the Indian seas. The coral reefs of India face numerous



pressures from both natural and anthropogenic origin. Indiscriminate use of corals for many purposes, over exploitation of reefs associated fauna, dredging and reclamation are important anthropogenic factors for the damage of corals in India. Pollution, sea erosion, siltation, construction activities in brackish water lagoons also adds to this cause of destruction of reefs. Global warming, coral bleaching, cyclones, white band diseases, pest attacks by *Acanthaster planci* are some of the natural cause which affect mortality of corals.

Estuarine ecosystems:The total brackish water assets of India as projected by the Government of India is 1.44 million ha. Orissa, Gujarat, Kerala and West Bengal have vast brackish water assets. West Bengal is gifted with the rich brackish water zone, estimated to be 405,000 ha with Hooghly-Matlah estuary accounting for the 8,029 km² and part of Sunderbans to be 2,340 km². Orissa has an over-all brackish water resources of 417,537 ha. Estuaries, lakes and backwaters account for 247,850 ha, 79,000 ha and 8,100 ha correspondingly. The Mahanadi estuary lies in the Cuttack and Puri districts of Orissa and drains into the Bay of Bengal. The major fauna includes *Tenulosa ilisha*, *Nematalosa nasus*, *Sardinella* spp., *Ilisha* spp., *Mugil cephalus*, *Planiliza parsia* and other perches.

Lagoon Ecosystem:A lagoon is a low water body along the low lying coast, parted from the ocean by a barrier and also linked to the sea by creeks or estuary at one or two places. The major lagoons along the coast of India are Chilka Lake, Gulf of Mannar, Muthupet, Muthukkadu, Nizampatanam, Pennar, Pulikat Lake, Vembanad Lake, Ashtamudi Lake, Ettikulam, Paravur Lake, Murukkumpuzha, Talapady and Veli Lake. The lagoon ecosystems are the most susceptible ecosystems due to numerous anthropogenic actions which threaten the flora and fauna of the ecosystem. Pressures consist of pollution from industries, discarding of urban sewage, recreational boating, navigation, the growth of urban and rural settlements, reclamation, over exploitation of fish stocks, intensive aquaculture practices and effluents from different sources.

Species diversity

Food provisioning in the form of fish landings and aquaculture products is one of the most important services obtained from the marine and coastal ecosystems. Mangroves are essential in supporting fisheries owing to their function as fish nurseries and refuges. Mangroves help to increase fish production in the inshore waters near to it. Coral reefs also provide services like protection of breeders and larvae for the better survival and recruitment success of the resources. They form an important source of fisheries products for coastal populations and export markets. The coral reefs of the Gulf of Mannar, Andaman & Nicobar Islands, Lakshadweep Islands and Gulf of Kutch contribute substantially to the total marine finfish production of India. Other ecosystems like rocky intertidal, near shore mudflats, seagrass beds, mud bank areas, seamounts, brackish water, lagoons, estuaries, marshy areas and beaches also helps in the production of fish as food in one way or another. The rich biodiversity of different marine organisms makes India a mega biodiversity country.

Biodiversity of marine life of India (major groups)

Taxa	No. of species in India	No. of species in the World
Protista		
Protozoa	645	31250
Total (Protista)	645	31250
Plantae		
Rhodophyta	434	6200
Phaeophyta	191	1600
Chlorophyta	216	2500
Sea grass	14	60
Mangroves	39	90
Animalia		
Mesozoa	10	106
Porifera	486	5500
Cnidaria	842	9795
Ctenophora	12	166
Gastrotricha	100	400
Polychaeta	268	12000
Sipuncula	35	144
Mollusca	3370	52525
Echiura	43	176
Crustacea	2937	44950
Bryozoa	200	4500
Chaetognatha	30	121
Echinodermata	765	7000
Hemichordata	12	106
Protochordata	119	4932
Pisces	2492	16475
Reptilia	35	100
Mammalia	25	110
Others	3400	28794
Total	16720	229600

Diversify of marine fishes of India

Of the 33,059 total fish species of the world, India contributes about 2,492 marine fishes owing to 7.4% of the total marine fish resources. Of the total fish diversity known from India, the marine fishes constitute 76 percent, comprising of 2,492 species belonging to 941 orders, 240 families. Among the total 1700 species of marine fishes, 189 are pelagic and 150 are deep water, 830 are reef associated and around 43 belong to threatened groups and 270 belong to the dangerous category. Andaman and Nicobar

archipelago show the highest number (1,431) among the fish diversity-rich areas in the marine waters of India, followed by the east coast of India with 1,121 species and the west coast with 1,071 species. Around 91 species of endemic marine fishes are recognized to occur in the coastal waters of India. A total of 50 marine fishes identified from India fall into the Threatened category as per the IUCN Red List, and about 45 species are Near-Threatened and already on the path to vulnerability.

Protected marine organisms

The major protected marine organisms includes elasmobranchs, marine mammals, turtles, molluscs, corals, gorgonids, sea horses, holothurians and sponges.

Elasmobranchs: A total of 10 species of elasmobranchs including four species of sharks, three species of sawfishes, two species of rays and one guitar fish comes under the protected animals.

List of protected elasmobranch species in India

Species	Common Name	WPA	IUCN
<i>Rhincodon typus</i>	Whale shark	Schedule I	Vulnerable
<i>Anoxyprisits cuspidata</i>	Pointed sawfish	Schedule I	Endangered
<i>Pristis microdon</i>	Largetooth saw fish	Schedule I	Critically Endangered
<i>Prisitits zijson</i>	Longcomb sawfish	Schedule I	Critically Endangered
<i>Carcharhinus hemiodon</i>	Pondicherry shark	Schedule I	Critically Endangered
<i>Glyphis gangeticus</i>	Ganges shark	Schedule I	Critically endangered
<i>Glyphis glyphis</i>	Speertooth shark	Schedule I	Endangered
<i>Himantura fluviatilis</i>	Gangetic stingray	Schedule I	Not evaluated
<i>Rhyncobatus djiddensis</i>	Giant guitarfish	Schedule I	Vulnerable
<i>Urogymnus asperimus</i>	Thorny ray	Schedule I	Vulnerable

The CITES listed elasmobranchs

Appendix I: Pristidae spp.

Appendix II: *Carcharhinus falciformis*, *Carcharhinus longimanus*, *Sphyrna lewini*, *Sphyrna mokarran*, *Sphyrna zygaena*, *Lamna nasus*, *Alopias spp.* *Cetorhinus maximus*, *Carcharodon carcharias*, *Rhincodon typus*, *Manta spp.* and *Mobula spp.*

Molluscs: A total of 3,271 species of molluscs are distributed along the Indian coast which includes 220 families and 591 genera. Around 1,900 species of gastropods, 1,100 bivalves, 210 cephalopods, 41 polyplacophores and 20 scaphopods. Among these 8 species of oysters, 2 species of mussels, 17 species of clams, 3 species of pearl oysters, 3 species of giant clams, 1 species of window-pane oyster and gastropods such as Sacred Chank, *Trochus*, *Turbo* and 15 species of Cephalopods are exploited from the Marine sector of India.

List of the protected marine molluscs as per the Wildlife (Protection) Act, 1972 under Schedule I & IV are given below.

Species	Common name	WPA
<i>Cassis cornuta</i>	Horned Helmet	Schedule I; Part IVb
<i>Cypraecassis rufa</i>	Bull mouth Helmet	Schedule I; Part IVb
<i>Charonia tritonis</i>	Trumpet Triton	Schedule I; Part IVb
<i>Tudicla spirallus</i>	Spiral Vase	Schedule I; Part IVb
<i>Conus milneedwardsi</i>	Glory of India	Schedule I; Part IVb
<i>Nautilus pompilius</i>	Chambered Nautilus	Schedule I; Part IVb
<i>Tridacna maxima</i>	Elongate Giant Clam	Schedule I; Part IVb
<i>Tridacna squamosa</i>	Fluted Giant Clam	Schedule I; Part IVb
<i>Hippopus hippopus</i>	Bear Paw Clam	Schedule I; Part IVb
<i>Trochus niloticus</i>	Commercial Trochus	Schedule IV; Part 19
<i>Turbo marmoratus</i>	Great Green Turban	Schedule IV; Part 19
<i>Strombus plicatussibbaldii</i>	Sibbald's Conch	Schedule IV; Part 19
<i>Lambis chiragra</i>	Chiragra Spider Conch	Schedule IV; Part 19
<i>Lambis chiragraarthritica</i>	Arthritic Spider Conch	Schedule IV; Part 19
<i>Lambis crocea</i>	Orange Spider Conch	Schedule IV; Part 19
<i>Lambis truncata</i>	Truncate Spider Conch	Schedule IV; Part 19
<i>Lambis millepeda</i>	Millipede Spider Conch	Schedule IV; Part 19
<i>Lambis scorpius</i>	Scorpio Conch	Schedule IV; Part 19
<i>Cypraea lamacina</i>	Limacina Cowrie	Schedule IV; Part 19
<i>Cypraea mappa</i>	Map Cowrie	Schedule IV; Part 19
<i>Cypraea talpa</i>	Mole Cowrie	Schedule IV; Part 19
<i>Fasciolaria trapezium</i>	Trapezium Horse Conch	Schedule IV; Part 19
<i>Harpulina arausiaca</i>	Vaxillate Volute	Schedule IV; Part 19
<i>Placenta placenta</i>	Windowpane Oyster	Schedule IV; Part 19

Corals and Gorgonids: A total of 225 species of Scleractinian corals belonging to 37 genera are reported. The biodiversity value of corals to mankind is enormous. Gorgonids are popularly known as Seafan which are sessile coelenterates.

A total of 214 species are reported from the Indian Ocean. The list of protected Corals and Gorgonids as follows;

Scientific name	Common name	WPA
Coelenterate		
All Scleractinians	Reef Building Coral	Schedule I; Part IVA
All Antipatharians	Black Coral	Schedule I; Part IVA
<i>Tubipora musica</i>	Organ Pipe Coral	Schedule I; Part IVA
All <i>Millepora</i> species	Fire Coral	Schedule I; Part IVA
All Gorgonians	Sea Fan	Schedule I; Part IVA

Reptiles: Five species of sea turtles and a single species of crocodile are reported under WPA from India. CMFRI has developed a national research programme and surveyed the nesting grounds along the Indian coast, monitored their incidental catch and strengthened the National Resource Data of turtles. All the five species are included in the list of protected animals as per the Wildlife (Protection) Act, 1972 under Schedule I.

Species	Common name	WPA
<i>Crocodylus porosus</i>	Saltwater Crocodile	Schedule I
<i>Crocodylus palustris</i>	Estuarine Crocodile	Schedule I
<i>Gravialis gangeticus</i>	Gharial	Schedule I
<i>Dermochelys coriacea</i>	Leatherback Sea Turtle	Schedule I
<i>Caretta caretta</i>	Loggerhead Sea Turtle	Schedule I
<i>Lepidochelys olivacea</i>	Olive Ridley Sea Turtle	Schedule I
<i>Eretmochelys imbricata</i>	Hawksbill Sea Turtle	Schedule I
<i>Chelonia mydas</i>	Green Sea Turtle	Schedule I

Besides these the *Dugong dugon* (Sea cow), *Oreaella brevirostris* (Irrawaddy/Snubfin Dolphin), *Platanista gangetica* (Gangetic river Dolphin), *Physeter microcephalus* (Sperm Whale), *Neophocaena phocaenoides* (Finless porpoise), Echinodermata (all Holothurians) and *Epinephelus lanceolatus* (Giant grouper), All Syngnathids (Seahorses and Pipefishes) are included in the Schedule I and all Calcareans (Sponges) are included in Schedule III of Wildlife (Protection) Act, 1972.

National Biodiversity Authority (NBA)

NBA was established in 2003 by Government of India to implement Biological Diversity Act (2002). It is a Statutory body and that performs regulatory and advisory function to Government of India on biodiversity conservation, utilisation, management of resource and fair equitable sharing of benefits of use. The NBA with its Headquarters in Chennai, Tamil Nadu, delivers its mandate through a structure that comprises of the Authority, Secretariat, SBBs, BMCs and Expert Committees. NBA had supported creation of SBBs in 29 States and facilitated establishment of around 74,063 BMCs.

Acts related to Biodiversity of India

No	Acts
1	The Fisheries Act, 1897
2	The Indian Forest Act, 1927
3	Import and Export (Control) Act, 1937
4	The Customs Act, 1962
5	The Wildlife (Protection) Act, 1972
6	Marine Products Export Development Authority Act, 1972
7	The Water (Prevention and Control of Pollution) Act, 1974
8	Territorial Water, Continental Shelf, Exclusive Economic Zone and other Maritime Zones Act, 1976
9	Maritime zones of India (Regulation and fishing by Foreign Vessels) Act 1980



- 10 Environment (Protection) Act, 1986
- 11 Protection of Plant varieties and Farmer's Rights (PPVFR) Act, 2001
- 12 The Biological Diversity Act, 2002
- 13 The Biological Diversity Rules, 2004
- 14 The Food Safety and Standards Act, 2006
- 15 Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006
- 16 The National Green Tribunal Act 2010

The Biological Diversity Act 2002: The Act controls the conservation, use of biological resources and associated knowledge occurring in India for commercial or research purposes, for the purposes of bio-survey and bio-utilisation. The Act offers a framework for access to biological resources and sharing the benefits arising out of such access and utilisation. The Act also contains in its domain the transfer of research results, knowledge and application for intellectual property rights (IPRs) relating to Indian biological resources.

Conclusion

Marine biodiversity of India, especially the species diversity and fragile ecosystem are facing severe threats of over exploitation of species, biodiversity loss and degradation of habitats which are to be addressed immediately. Many endangered and threatened species were listed under Indian Wildlife (Protection) Act, 1972 for conservation and protection of such species. IUCN and CITES listed threatened species in the appropriate categories for the conservation of the species in a global scale. Along with the documentation and inventories of the marine organism, awareness creation among stake holders, protection of traditional rights and establishment of marine protected areas may go a long way in the conservation and protection of our rich biodiversity.

