Chapter
13

Marine Biodiversity and Conservation in India

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The term "Earth" is a misnomer for this planet which is covered by oceans for 70% of its area. Life on Earth began from the oceans and they hold of the biological diversity of the planet. In 1992 the United Nations held the Earth Summit in Rio de Janiero, Brazil to discuss the state of the environment and the living beings which populate the Earth, which was attended by 172 nation states. A parallel summit of 2400 NGOs was also held. From the deliberation of the Summit arose three legally binding documents: "Convention on Biological Diversity, UN Framework Convention on Climate Change" and "UN Convention to Combat Desertification" which was subsequently signed by most of the attending states and the guiding principles of which laid the foundation for future legislation in the signatory countries. The term biological diversity was coined by Dasmann in 1968. The definition of biodiversity was given by United Nations, 1992 at the Earth Summit is as follows: **"**The variability among living organisms from all sources, including, *inter alia*, 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 genetic diversity, species diversity and ecosystem diversity.

Why is it important to conserve biodiversity?

In Nature we find food chains which comprise of hierarchical representations of prey and predator relationships from primary producers to tertiary consumers. However in real terms in an ecosystem the food chains are interlinked to each other. Had ecosystems comprised of linear food chains, many life forms would had been in danger of perishing is any of the links in the food chain were broken. When food chains are interlinked to form a food web, many life forms have an alternate option of food when one source becomes scarce or one link in the food chain is broken. Hence the more complex a food web, the more likely that the ecosystem remains stable, which translates into the more number of interdependent species in an ecosystem, the more stable it becomes.

In the history of the earth, it is gathered from fossil records that there have been six incidents of mass extinction of species namely during the Ordovician, Devonian, Permian, Triassic, Cretaceous and Quaternary eras. The earlier five were caused by geological and cosmological events whereas the last, which s prevalent during our times is mainly caused by the activities of a single species i.e. the Homo sapiens. Man has been causing such sweeping and irreversible changes to the environment through habitat destruction, pollution etc. that it is no longer sustainable for the maintenance of biological diversity on the scale which the Earth has known previously. To arrest this trend steps such as the Earth Summit and its follow up have been found necessary.

India is a land of tremendous biological diversity and is considered one of the "biodiversity hotspots" of the world. In terms of marine biodiversity, India has a coastline of 7517 km and an Exclusive economic Zone (EEZ) of 2.02 million square km. Together with a tropical climate, this vast marine realm offers myriad niches for the sustained growth of marine organisms and hence harbours substantial biodiversity. Of the 2, 63,581 marine species found worldwide, Indian marine biodiversity is comprised of 17,795 species which is about 6.8% of the total diversity. Our assessment of Indian biodiversity is incomplete as we have incomplete or little on groups such as Protista, Euglenophyta, Chrysophyceae, Dinomastigota, Radiolaria, Cubozoa, Isopoda,

Orthonectida, Ciliata, Nematomorpha, Priapulida, Chelicerata, Pogonophora, Cephalochordata and marine fungi.

Table 1: Marine Ecosystems in India

ECOSYTEM TYPE	AREA (SQ.KM.)	ECOSYTEM TYPE	AREA (SQ.KM.)
Estuaries	1540	Sandy beaches	4210
Lagoons	1564	Rocky coasts	177
Creeks	192	Salt marshes	1698
Backwaters	171	Salt pans	655
Mud flats	23621	Aquaculture ponds	769
Coral reefs	2330	Sea grass beds etc.	1391
Mangroves	3401		

Source: NBSAP, 2004

The most recalled marine ecosystem is the sandy beach, popularised due to tourism. It comprises of stretches of sand deposited along the coast. The organisms found to inhabit this ecosystem type are adept at burrowing and gathering food from the intertidal regions. Common forms are brachyuran crabs such as the ghost crab (*Ocypode* sp.) and the mole crab (*Hippa* sp.). Also common are burrowing worms such as the lugworm *Arenicola* sp. The marine ecosystem covering the maximum area in India are mudflats along the coasts which are teeming with life such as diatoms and algae, nereid worms, crabs and molluscs. These are rich staging grounds for resident and migratory birds such as flamingos, plovers, godwits, terns and gulls, to name a few. Mangroves comprise a marine ecosystem which has gone severe degradation in the past decades. The largest stand of mangroves, the Sunderban delta, lies partially in India. 69 species of mangroves are available in India, with *Rhizhophora, Avicennia, Sonneratia* and *Brugeierra* being the most commonly found genera. The Sunderban is home to endangered species such as

the Royal Bengal tiger, saltwater crocodiles (*Crocodylus porosus*) and the Gangetic Susu or Gangetic dolphin (*Platanista gangetica*). Rocky coasts are comparatively few in India. The organisms found here are adapted which withstand desiccation and wave action and are usually with tensile adaptations. Limpets, mussels (*Perna* sp.), barnacles (*Amphitrite* sp.) are the most common forms.

The coral reefs of India are distributed in limited areas mainly along its island territories and in two major areas on the east and west coast. In comparison to other areas of similar latitude the coral cover along the Indian mainland is less owing to large quantities of freshwater and silt brought by its rivers to the coastal regions which are not conducive for coral growth.

Table 2: Details of coral reefs in India:

Location	**Type of reef**	**Extent**	**Status**	**No. of species of corals**
Gulf of Kachch, Gujarat	Fringing reefs	352.5 km^2	Mostly in degraded state due to high sediment load. Live corals found on reef edge and crest.	49
Malwan, Maharashtra	Fringing reefs	29 km^2	Fairly healthy but prone to degradation	ˆ 11
Lakshadweep islands	Atoll	933.7 km^2 (510.7 km^2 lagoon, 147.7 km2 shelf region)	Near pristine in uninhabited Islands. Showing signs of degradation in inhabited islands	>130
Gulf of Mannar and Palk Bay, Tamil Nadu	Fringing (Palk Bay) and atoll reefs	75.93 km^2 (21 islands in GOM, 10.8 km^2 lagoon, 10.2 km^2 continental shelf region)	Degraded in places. Overgrown with seagrasses and algae in several areas.	96
Andaman and Nicobar islands	Fringing, atoll and barrier reefs	1021.46 km^2 (530 islands, barrier reef of 329 km)	Pristine in uninhabited islands, fringing reefs in inhabited islands show signs of degradation.	>400

Apart from these major areas there are patch and fringing reefs along the coast and islands scattered in the seas. Two such areas with patch reefs namely, Netrani Island (approx 1 km^2), Uttar Kannada district, Karnataka and Ennayam reef (approx 0.5 km^2), Kanyakumari district, Tamil Nadu

Threats to Marine Biodiversity:

The major threats to marine biodiversity can be summerised under the following:

1) *Unsustainable fishing*:

Overharvesting of marine living resources has led to the decline, depletion or collapses of fisheries the world over in several instances. It is estimated that 34% of the world fisheries are being exploited unsustainably. Overharvesting or fishing above the maximum sustainable yield could be a result of several factors such as excess fleet capacity, deployment of small meshed gear or excess units of gear, use of baits such as LED lights or fish aggregating devices, capture of spawning or migrating shoals, overproduction/overconsumption in years of abundance etc.

Overfishing is of two kinds: growth overfishing which results from the removal of excess numbers of juvenile fish from the stock which results in reduced numbers reaching maturity and the ability to spawn further generations and recruitment overfishing, when excess numbers of mature spawners are removed from the stock resulting in lower production of eggs for recruitment to the next fishery.

Some examples of collapsed fisheries due to overfishing are the Peruvian anchovy fishery and the Atlantic cod fishery. There is an estimated 74% decline in the stocks of tuna, mackerel and bonito and 50% of decline in populations of seabirds, mammals and reptiles globally in the period 1970-2010. On the southwest coast of India, stocks of barracuda, ribbonfish, tuna, anchovy, Indian mackerel, wolf herring, silver bellies, half beaks and sharks are currently seen to be in the declining phase, false trevally and silver pomfret in a depleted state and catfish fishery in a collapsed state. The populations of sand lobsters, gorgonids and sea cucumbers have been severely depleted due to overfishing. There is 55% overcapacity in the trawler fleet which contributes to 67% of marine landings.10-40% of the total catch ends up as discards or fishery

byecatch in trawler fishery. The loss to biodiversity is total where this catch is not taken as fishmeal. A large number of marine mammals and sea turtles also perish in fishery bye catch.

2) *Climate change*:

The number of tropical storms and cyclones are on the rise die to changes in global oceanic and atmospheric circulation changes accompanying rise in sea surface temperatures. This has a catastrophic effect on the world's population a huge majority of which lives along the coastline and in coastal metropolises. Foods and inundations caused during such inclemental weather phenomena have become a matter of routine in the past decade. Earlier it was hypothesized that the cloud cover would increase due to sea surface warming due to increased phytoplankton and consequently higher cloud seeding nuclei produced (CLAW hypothesis). However in actuality the phytoplankton numbers have been found to reduce due to increased SST causing fewer cloud seeding nuclei in the atmosphere and increased amount of radiation reaching the earth due to decrease in cloud cover (Anti CLAW hypothesis). Decreased productivity of the oceans is a looming threat with further increase in global temperatures. Coastal and inshore water anoxia is predicted to show an increased trend with rising temperatures, creating more dead zones in the sea.

3) *Ocean acidification*:

As a consequence of the increased amount of carbon dioxide in the atmosphere the pH of the oceans has been reducing due to its dissolution. In fact, the oceans pH has reduced by 28.8% since the preindustrial era levels and is expected to further lower by upto 69% by 2050. Acidification of the ocean would result in decalcification and dissolution of carbonates, decline in primary production, reduced survival of larvae, depressed metabolic rates and depressed immune systems of sea creatures. Coral bleaching, already enhanced by rise in sea surface temperature, would further intensify.

4) *Habitat destruction*:

Direct loss of habitat due to anthropogenic activities leads to critical loss of biodiversity and is most prominent in vulnerable ecosystems such as mangrove forests, coral reefs and estuaries.

Diversion of mangrove forests for residential and industrial development has led to ill planned urbanisation where water logging and inundation during inclement weather phenomena is common. Coral mining is widespread in areas with coral reefs though extraction of corals for construction etc. is banned by law. Conversion of coastal wetlands for aquaculture when not carefully planned upsets the ecology and hydrology of the region resulting in poorly constructed farms with disease outbreaks.

5) *Marine debris and pollution*:

Waste disposal by humans into the sea and coastal regions is a major cause of the loss of biodiversity. Huge areas of coastal seas and adjoining water bodies are choked with plastics and the water eutrophied due to sewage and agricultural and industrial run offs. Plastic pollution along the coastline is ubiquitous and increasing. Increased shipping traffic is resulting in higher incidences of oil spills and wastes from ships entering the ocean. Even light pollution from human installations has a detrimental effect on marine biodiversity. In areas where there is sea turtle nesting, the hatchlings emerging at night inadvertently crawl towards the landward light source at night and perish. With increased human populations the pressure on coastal seas in terms of increased pollution levels is steadily increasing and is often not tackled with the urgency and scale it deserves.

Table 3: Pollutants Annually Entering the Coastal Seas

TYPE OF POLLUTANT	QUANTITY
Untreated Domestic sewage	1.41×10^9 cu.m.
Industrial effluent	50×10^6 cu.m.
River transported sewage	75×10^9 cu.m.
Solid wastes and garbage	34×10^6 tonnes
Fertilizers	5×10^6 tonnes
Pesticides	65000 tonnes
Detergents	130000 tonnes
Petroleum hydrocarbons	3500 tonnes

Source: NIO, 2008

6) *Invasive alien species*:

Many species of marine organisms are transported to our coastal regions through shipping of introduced for aquaculture and have since established themselves in our water bodies, often causing deleterious effects on the local ecology. Such marine invasives are a threat to local biodiversity. For example, the water hyacinth which was introduced as an ornamental plant by the British has overrun the backwaters of Kerala, causing choking of the waterways and eutrophication during certain seasons due to its prolific growth.

7) *Marine warfare*:

Only a few direct and more apparent consequences such as the oil pollution caused during the Gulf War are evident to the public as consequences of marine warfare. 6 million barrels of crude oil were released into the Arabian Sea and a slick 168 km x 68 km, 5 inches thick was formed. However in peacetime, underwater detonations and the use of sonars cause damage to marine life which is largely undocumented. Disturbances caused by sonars of ships and especially submarines are considered to be a plausible cause behind the mass stranding of whales and dolphins.

8) *Tourism*:

While regulated tourism is a major economic driver, the unsustainable use and neglect of the environment for this purpose results on axing the proverbial tree which bears the fruit. Diversion of natural habitat for tourism purpose and the accompanying pollution resulting from tourism cause irrevocable damage, especially in sensitive and fragile ecoregions such as coral reef islands and mainland beaches. The footfall of a large number of people on urban beaches is detrimental to the intertidal biota. Curiose and trophy hunting especially due to ignorance of existing legislation is a major cause of destruction to marine biota by tourists.

Conservation measures:

Taking into consideration all the threats to marine biodiversity and the urgency and importance of according it protection a number of national and international legal instruments have been put in place:

National:

1. The Biological Diversity Bill, 2002
2. Coastal Regulation Zone Notification, 1991
3. The Indian Wildlife (Protection), Act, 1972
4. The Environmental (Protection) Act, 1986
5. The Indian Fisheries Act, 1897
6. (State wise) Marine Fishery Regulation Acts
7. CMFRI initiatives: Monsoon trawling ban, Minimum Legal Size

International:

1. Convention on Biological Diversity, 1992
2. Convention on International Trade In Species of Wild Fauna and Flora (CITES), 1963
3. Convention of Migratory Species of Wild Animals, 1983
4. Ramsar Convention on Wetlands, 1971
5. MARPOL, 1973/78

Some Marine Conservation Initiatives

National:

1. Marine Protected Areas
2. National Biodiversity Strategy And Action Plan
3. Coastal Zone Management Plans
4. National And State Biodiversity Boards
5. COMAPS: 88 Stations Pollution-Ministry of Earth Sciences
6. Peoples initiatives such as the Versova beach cleanup.

International:

1. Census Of Marine Life
2. Oceanographic Biogeographic Information System

3. Global Ocean Observing System
4. International Coral Reef Initiative : Global Coral Reef Monitoring Network

***Marine Protected Areas in India*:**

6.79% of the total coastline under MPAs. Most of these in Andaman & Nicobar Islands. 24 MPAs in mainland India covering an area of 8214 sq.km (4.92% of PAs). Some of the major MPAs are Gulf of Kachch Marine National Park, Gujarat, Gulf of Mannar Marine National Park, Tamil Nadu, Sunderbans National Park, West Bengal, Bhitarkanika Wildlife Sanctuary, Orissa and Coringa Wildlife Sanctuary, Andhra Pradesh.

In order to conserve marine biodiversity it is necessary to enlighten, motivate and persuade the general public. Where there is exploitation due to compulsion, there is the possibility of providing alternate livelihoods or practicing judicious use. Educating future generations through school curriculums and field activities will go a long way in influencing the minds on future generations towards conservation.

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