

Executive Summary

The sea around India is part of the great Indian Ocean and the Indian subcontinent forms a major physical division between the Arabian Sea and the Bay of Bengal of the Indian Ocean. Coral reefs are diverse and most vulnerable ecosystem in India. The reef bio-composition is quite significant and includes 180 species of benthic algae, 14 species of seaweeds, 12 species of seagrasses, 108 species of sponges, 4 species of lobsters, 103 species of echinoderms, 600 species of fin fishes and also a good number of species of crabs, bivalves, gastropods and cephalopods each in Lakshadweep and Andaman and Nicobar islands (Devaraj, 1997). About 844 species of marine algae are recorded from India (Venkataraman and Wafar, 2005). Of these, several species are exploited commercially on a large scale in the region. Marine invertebrate diversity is also high in India, and for some groups may show a similar trend to that for corals described above, however, there is not enough study in this group in India (Venkataraman and Wafar, 2005). Many invertebrates are harvested and are of economic importance; there is evidence that some molluscs and crustaceans have been overexploited, and species such as the coconut crab, horseshoe crabs, and certain molluscs are of conservation concern.

Five of the seven species of sea turtles found worldwide are reported to occur in Indian coastal waters (Kar and Basker 1982). These are the olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*). Except for the Loggerhead, the remaining four species nest along the Indian coastline. Globally threatened marine and coastal bird species such as the Spot-billed Pelican *Pelecanus phillipensis* and the Lesser Adjutant *Leptoptilos javanicus* are found in India.

About 25 species of marine mammals known to occur in Indian water (Venkataraman and Wafar, 2005). Apart from larger cetaceans such as baleen, sperm whales etc., there is also a large number of small cetaceans occur in Indian Ocean, some of which are not well known, and many of which are harvested either intentionally or incidentally. The Indian Ocean populations of the humpback dolphin *Sousa chinensis* and the spotted dolphin *Stenella attenuata* are considered to be at risk; the distribution of the latter appears to be closely correlated with mangroves. The distribution of the dugong extends over most of the region, but appreciable numbers are no longer found.

Despite tremendous ecological and economic importance and the existence of a policy and regulatory framework, India's coastal and marine biodiversity is under threat. Numerous direct and indirect pressures arising from different types of economic development and associated activities and climate change have adverse impacts. Rise in the sea level is likely to have significant implications on the coastal populations and agricultural productivity. Most importantly, lack of scientific information exacerbates the situation. Link between the management authorities of marine sources, local communities and other stakeholders is weak and has resulted in poor resources management and continuous diminishing of biodiversity

due to over exploitation. Further, lack of understanding of the sustainability of coastal ecosystem with respect to economic development is also a major hurdle. The major direct threats to marine and coastal biodiversity can be divided into five interrelated categories: pollution (from land based and other sources), over exploitation of marine living resources, introduction of alien species, habitat degradation caused by coastal development, and global climate change and ozone depletion. Some of the harmful human impacts on marine biodiversity stem from ignorance and lack of understanding of the importance of marine biodiversity and how it can be affected, which put marine resources on a lower priority level vis-à-vis land biodiversity. Unregulated use of resources, increase in demand for the resources and rapidly expanding coastal development put the marine resources at considerable risk. The belated realization of the need for action after the damage becomes apparent (and often when it is too late) perpetuates this destructive cycle.

The coastal region of the Maharashtra state has six districts viz. Thane, Greater Mumbai, Navi Mumbai, Raigad, Ratnagiri and Sindhurg, popularly known as Konkan. The entire region is hilly, narrow, highly dissected with transverse ridges of the Sahyadri hill ranges (Western Ghats) on its east and at many places extending as promontories, notches, sea caves, embayment, submerged shoals and offshore islands. These coastal ecosystems are important ecologically as well as economically. As the locals are dependent on these habitat for their daily needs such as fishing (artisanal as well as commercial), medicines etc. The 500 km coastline of Maharashtra exhibits everything that is good and bad. At one end of the spectrum it harbours locations and pockets of breath taking almost pristine beauty while at the other end it is reeling under the negative impact of mega city of Mumbai. Coastal areas between Alibag and Mumbai is continuously subjected to sewage, garbage, industrial effluent, constructional activities, and even oil spill that that result from heavy movement of ships and their cargo. At Chiplun and Roha industries have been established in complete disregard of their ecological and social impacts. Lands have been acquired for industrial purposes without considering the negative impact these activities will have on the area. Dams have been built that has led to submergence of vast expanse of land that has led to loss of biodiversity. Apart from industries, luxury tourism is being promoted and luxury resorts are being constructed in complete disregard of the interest of the locals and traditional communities. Piers, jetties, walls and other structures have been built in the sea without consideration of their effect on marine life. Erection of protective walls to stop ingress of sea water and to provide more land for agriculture has threatened the existence of mangroves and its biodiversity at places. Complete disregard of marine biodiversity in these areas has led to such a situation that plans for conservation of marine life has met with ire, bitterness and opposition from the locals. There has been almost complete disregard of the interest of local communities in almost all development plans as most of them have little long term benefits in terms of livelihood, traditional vocations and lifestyle.

The Mumbai Metropolitan Region (MMR) spread over 4,355 sq. km. consists of 8 Municipal Corporations viz. Greater Mumbai, Thane, Kalyan-Dombivali, Navi Mumbai, Ulhasnagar,

Bhiwandi- Nizamapur, Vasai-Virar and Mira-Bhayandar; and 9 Municipal Councils viz. Ambarnath, Kurla-Badalapur, Matheran, Karjat, Panvel, Khopoli, Pen, Uran, and Alibaug, along with more than 1,000 villages in Thane and Raigad Districts. MMRDA is responsible for the balanced development of the MMR. The MMR has a large number of coastal and marine ecosystems representing different habitats such as estuaries, salt marshes, bays, creeks, sandy beaches, mud flats, marshes and mangrove forests that support a rich biodiversity. The shoreline is dominated by rocky coastal habitats between the high and low tide limits and estuarine habitats along the estuaries. Coral reefs and sea grasses are completely absent. Mangroves have been an integral part of the landscape of Mumbai since its inception. MMR has a coastline of 256km, on which 160 thousand people (fishing community) are solely dependent on for their livelihood.

Despite the benefits offered by these ecosystems, they are highly vulnerable to reclamation, urbanization, illegal dumping of waste and debris. Dumping sites at Mulund and Kanjurmarg are located right in the mangrove belts and the aerated lagoons treating the sewage at Ghatkopar and Bhandup are too located right in the mangrove areas. Approximately, 40% of the region's untreated sewage is discharged into the creeks, thus deteriorating the creek water quality which is very much evident from the assessment of the secondary creek water quality data. Further, oil spillage from freight movement and oil refineries is another major threat to the mangrove ecosystems. Parts of the coastal zone of MMR have also become increasingly susceptible to human induced environmental stresses and economic damage by natural geophysical factors such as erosion, siltation and coastal flooding. The waste generation and disposal pressures due to domestic and industrial activities have further contributed to the deterioration of coastal marine water quality and coastal fisheries. Although several attempts have been made by local government to improve the coastal environment, uncontrolled growth of population and economic activity of the region have hampered all of these. The main problems in MMR coastal region are land use pattern, residential and industrial water supply and waste disposal, transportation-related air, soil and noise pollution, coastal marine pollution, depletion of important coastal habitats like wetlands and mangroves.

In Greater Mumbai, there are 46 coastal features like rocky outcrops, beaches, mangrove stretch and developed coastal edges, as per an inventory prepared by HCP Design and Project Management Pvt. Ltd, Ahmedabad in February, 2012 for Mumbai Metropolitan Region – Environment Improvement Society (MMR-EIS). These above mentioned coastal features have been created due to the action of sea waves over a period of time.

Greater Mumbai has about 128 Km of coastline which is indented with large and small creeks. The long coastline is intersected at two points by creeks viz Manori, Malad and has two bays viz Mahim and Back Bay. So to identify the various coastline features, the entire coastal stretch from Gorai (MCGM boundary to west) to MCGM Boundary (above Airoli Bridge) was divided into 7 stretches, based on land form characteristics for ease of the study conducted by HCP Design and Project Management Pvt. Ltd.

Stretch 1: Gorai Rocky Outcrop to Gorai Village Boundary

The stretch 1 is located in Manori and Gorai area which is relatively at a distance from the main city, and hence it is predominantly used as a tourist spot during weekends. The major land use along these features are wild vegetation (20%), water bodies (17%) and scrub lands (14%) and the built land uses include various bungalows and other dwelling units outside the gaothans (10%), recreational activities (6%) and commercial setups like resorts and restaurants (3%). Activities like sand and stone quarrying are quite common. Further, due to inadequate numbers of dustbins in the stretch, locals and tourists throw their wastes on the beaches and rocky outcrops. Also, lack of public toilets forces locals and tourists to use the rocky outcrops for defecation.

Stretch 2: Dahisar to Malavani

The stretch begins at Dahisar near the MCGM boundary, moves southwest up to Air Force Station Rocky Outcrops and takes a turn to the northeast abutting Madh Mangroves up to the Malavani. It is about 35 Km long stretch. It is also an important and popular recreational and tourist area, which is easily accessible by road from the main city. Some properties on this stretch belong to the defense, and hence are heavily guarded and inaccessible. Therefore, the major land use along the features in this stretch is water bodies (25%), open areas (15%) mudflats and scrub lands (11%). The built land uses include residences (13%), transportation and slums (4% each). Some portions of Akse, Bhati and Madh beaches were inhabited and used by local fishermen and their daily activities caused the beach to remain dirty and filled with solid waste. At some places along the stretch, construction debris was also dumped, damaging the coastline and the existing ecosystems.

Stretch 3: Mindspace to Bandra

The stretch begins at Mindspace, moves southwest towards Versova Beach and turns southward to end at Bandra Reclamation. It is about 20 Km long stretch. Juhu Beach, which is a part of this stretch, is an extremely important and popular recreational and tourist area of the city. It is completely open to public and accessible by road. This whole part of the suburbs was once marshy area which over decades have been reclaimed and developed upon, the latest being the Bandra reclamation area. The mouth of Poisar, Oshiwara & Mithi Rivers and Piramal Nagar, Mogra, Irla & SNTD Nalas open out into the sea along this stretch. The predominant natural land use along the features in this stretch are open areas (34%) and water bodies (26%) and the built land uses include residences of Juhu, Khar and Bandra (16%), transportation (8%) and gaothans (4%). The northern portion of Versova Beach is inhabited and used by local fishermen. Their daily activities cause the beach to remain dirty and filled with solid waste. Due to lack of public services like, these features are prone to solid waste dumping.

Stretch 4: Mahim to Girgaon Chowpatty

The stretch begins near Bandra Reclamation, moves along Mahim Bay, turns to the south up to Girgaon Chowpatty. It is about 20 Km long stretch. The stretch predominantly has

residential areas of Prabhadevi, Dadar, Cumballa hill and Malabar hill. The beach along the Mahim Bay as well the Girgaon Chowpatty is an extremely important and popular recreational and tourist spot. Some portion of stretch in Cumballa-Malabar Hill is heavily guarded and restricted as it is occupied by the Governor's residence and various other embassies. The mouth of Mithi River, Love Grove and Cleveland Bunder open out into the sea along this stretch.

Stretch 5: Girgaon Chowpatty to Gateway of India

The stretch begins at Marine Drive, moves south to Navy Nagar, turns to the northeast and ends at the Gateway of India. It is about 18 Km long. Most of the stretch is completely developed up to the edge and the sea is also not accessible. Hence the land use along the stretch included residential (20%), transportation (15%), recreational institutions (11%), slums (10%), commercial buildings (approx 10%) and public/semi public institutions (8%). The natural land use was quite minimal, and predominantly included parks and gardens (6%) and open areas (5%). Many outfalls open out on to this edge and let out foul smell. Also various slums have flourished along the edge and regularly dump solid wastes and untreated sewage into the sea.

Stretch 6: Gateway of India to Sewri fort

The stretch begins at Gateway of India and moves northwards up to Sewri Fort. It is about 15 Km long. It has a natural deep water harbour of 400 Sq Km, and hence has been reclaimed and developed as dockyards and ports since 1750. Since it is occupied by the naval and port authorities, the entire stretch is highly guarded and restricted. The major land use is industrial (70%), as it consists of docks and allied usage. The other land uses include public/semi public institutions (15%), transportation (10%) and slums (3%). Oil spills were seen in these parts of the waters which come during boat repairs etc near the docks and the ferry wharf. Similarly sewage and waste waters from the docks were also let out into the sea.

Stretch 7: Sewri fort to Airoli Bridge

The stretch begins from Sewri Fort, moves towards the north abutting the Mahul Creek, BARC and Bhandup/Mulund Mangroves and ends at MCGM boundary above Airoli Road. It is about 20 Km long stretch. The stretch is popular area for bird watchers. Some portion of the stretch in Trombay is heavily guarded and restricted as it is occupied by Bhabha Atomic Research Center (BARC). The entire stretch is not very accessible due to the presence of vast stretches of mangroves. The natural land use included water bodies (34%) and scrub land (7%). Further, large tracts of salt pans (26% of total land use) were observed in and around the mangroves. The other built land use along the features is quite minimal and include industries and transportation (5% each), public/semi public institutions (3%) and slums (2%). Further, it was observed that Mahul Creek receives a lot of organic sewage and effluents from oil refineries and waste water from the Thermal Power Station. The debris from construction activities carried to restore the Sewri Fort was also dumped in the nearby mangroves. Also

various settlements and slums have sprawled all along the coast, dumping untreated sewage and wastes directly into the mangroves and the sea.

Challenges to conservation of marine and coastal biodiversity

The improved conservation and sustainable use of marine and coastal biodiversity presents a number of challenges:

1. The driving force behind coastal degradation has been large development and infrastructure projects along the coast as well as unplanned and unregulated growth in coastal areas.
2. Living bio-resources found in the coastal zone are heavily exploited, and often the exploitation is unsustainable.
3. The coastal zone receives waste generated by a number of point and non-point sources, especially sewage, industrial effluents, sediment, and agricultural chemicals, notably fertilisers and pesticides. These contribute to the degradation of the quality of coastal waters
4. Reduce impacts of natural and anthropogenic pressures on Ecological and Biological Sensitive areas (EBSAs).
5. Insufficient awareness by people of benefits they derive from marine and coastal biodiversity;
6. Governance challenges due to sectoral and fragmented approaches including those associated with the management of common property resources;
7. Poor integration of marine and coastal biodiversity concerns in the legal aspects of Environment Impact Assessment processes, and lack of awareness and sensitivity towards the issue of marine and coastal biodiversity among the judiciary, policymakers, decision-makers and administrators.
8. Additional challenges due to governance gap on biodiversity conservation in areas beyond national jurisdiction;
9. The inherent complexity of addressing multiple drivers of biodiversity loss with the spatial separation of causes and consequences;
10. Multiple and often competing interests (e.g: fishing; extractive industries; tourism; conservation; land-based industry and agriculture);
11. Lack of capacity to address these challenges.

Recommendations

Marine Spatial Planning (MSP)

Through Marine Spatial Planning (MSP), various management scenarios can be identified and evaluated and spatial trade-offs such as those between industrial developments and ecosystem services can be made in order to balance many potential uses of the ecosystem.

Establishment Marine Protected Areas (MPAs)

Properly designed and managed MPAs play important roles in conserving representative samples of biological diversity and associated ecosystems. It helps in protecting critical sites for reproduction and growth of species.

Effective marine biodiversity governance

Requirements for effective marine biodiversity governance in the face of a changing climate regime represent those conditions, ways of thinking and operating, structures and relationships that, when present, enhance the effectiveness of governance and management of marine ecosystems and biodiversity.

Blue carbon ecosystem services:

Placing an economic value on the carbon stored within coastal habitats such as mangroves, coral reefs, seagrass meadows and salt marshes allows comparison of the value of development against the value of carbon stored within these systems.

Integrated management of mangroves and coral reefs:

Mangroves and coral reefs can provide many goods and services to coastal communities, if properly managed. Management plans that could harness the full value of mangrove and coral reef ecosystem services need to be developed for integrating these values into national planning.

Improvement of scientific information and knowledge

To effectively implement measures for conservation and sustainable use of marine biodiversity, it is important to appropriately assess the current state of marine biodiversity and grasp the problems that may possibly occur in the future.

Identification of factors influencing marine biodiversity and implementation of measures to reduce them

To appropriately progress with the conservation of marine biodiversity, the cause of specific problems and the related entities who shall take charge of conservation must be identified.

Implementation of measures appropriate for characteristics of individual marine areas

Being areas most strongly linked with human activity, coastal areas have traditionally been the main subject of conservation measures. The importance of these areas shall not change hereafter and such measures should be further improved. It is important to implement an integrated conservation approach by expanding the perspective to the whole watershed.

Facilitation of public acceptance and involvement of various actors

Local governments are required to implement policies according to the natural and social condition of their area, while citizens are required to recognize the importance of biodiversity and the blessing from the oceans and make voluntary efforts for conservation and sustainable use of biodiversity. In addition, it is important to create a system that allows not only government but also businesses and citizens to include measures for conserving and

sustainably using biodiversity in their social activities, and allow cooperation and active participation by those stakeholders.

Public Involvement programmes:

Involvement of local schools and colleges in programmes related to the spread of awareness and protection of mangrove areas and of marine ecosystems could have a powerful effect.

Corporate Social Responsibility

It could be made mandatory that CSR projects focus on mitigation of damage caused directly by their industries and should be localized to these areas and environments. Companies should be made to make amends to the environment and people of the local community and not just offer services as compensation.

Monitoring of Wildlife:

Extensive and rigorous monitoring of wildlife should be taken up by the government with the help of local experts, students and researchers.

Citizen Science Programme:

Citizens involved in monitoring local or urban wildlife get sensitized to the natural wealth around them and hence become stakeholders of the environment. In turn large it becomes possible to set up large databases with little funding.

Waste Management:

Proper Waste management is absolutely necessary especially with the pathetic conditions that the dumping grounds such as those at Gorai and Deonar have reached. Separation of waste, along with proper disposal and management should be promoted at a local level.

Precaution during festivals:

During festivals such as those that require immersion of idols into the sea, the Government and local authorities should promote the use of Biodegradable material and offer certain incentives to do the same