

# Biodiversity Conservation: A Literature Review

October 2014

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Biodiversity Conservation: A Literature Review

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Shweta Mujumdar, Sahyadri Nisarga Mitra

(SNM)

October 2014

CMPA Technical Report Series

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# List of Acronyms

<b>BOBP-IGO</b>	Bay of Bengal Programme-Inter-Governmental Organisation
<b>BMC</b>	Biodiversity Management Committee
<b>BMUB</b>	Nature Conservation, Building, and Nuclear Safety
<b>BNHS</b>	Bombay Natural History Society
<b>CITES</b>	Convention on International Trade in Endangered Species
<b>CMPA</b>	Coastal and Marine Protected Area
<b>CMFRI</b>	Central Marine Fisheries Research Institute
<b>CBD</b>	Convention on Biological Diversity
<b>COMAPS</b>	Coastal Ocean Monitoring and Prediction System
<b>CRZ</b>	Coastal Zone Regulation
<b>DRMP</b>	Disaster Risk Management Programme
<b>EEZ</b>	Exclusive Economic Zone
<b>EIA</b>	Ecologically Important Areas
<b>ENVIS</b>	Environment Information System
<b>GEF</b>	Global Environment Facility
<b>GHG</b>	Greenhouse Gases
<b>GIS</b>	Geographical Information System
<b>GIZ</b>	Deutsche Gesellschaft für Internationale Zusammenarbeit
<b>GKMNPS</b>	Gulf of Kutch Marine National Park and Sanctuary
<b>Gol</b>	Government of India
<b>GoM</b>	Government of Maharashtra
<b>IMCAM</b>	Integrated Marine and Coastal Area Management
<b>IP</b>	Intellectual Property
<b>IUCN</b>	International Union for Conservation of Nature
<b>MARPOL</b>	International Convention for the Prevention of Marine Pollution from Ships
<b>MFF</b>	Mangroves for Future
<b>MFRA</b>	Marine Fishing Regulation Act
<b>MoEFCC</b>	Ministry of Environment, Forests and Climate Change
<b>MHA</b>	Ministry of Home Affairs
<b>MPA</b>	Marine Protected Area
<b>MTDC</b>	Maharashtra Tourism Development Corporation
<b>PA</b>	Protected Area
<b>PBR</b>	People's Biodiversity Registers
<b>PSSA</b>	Particularly Sensitive Sea Areas
<b>RDBMS</b>	Relational Data Base Management System
<b>RISMA</b>	Resource Information System for Malvan
<b>RS</b>	Remote Sensing
<b>SAARC</b>	South Asian Association for Regional Cooperation



# Executive Summary

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In recognition of the urgent need for action, the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India, has entered into technical cooperation with the German Federal Ministry for Environment, Nature Conservation, Building, and Nuclear Safety (BMUB) for implementing the project 'Conservation and Sustainable Management of Marine and Coastal Protected Areas'. The BMUB has commissioned Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH to jointly implement the project with the MoEFCC. The project will focus on the areas around Velas, Kelshi and Anjarle in the Ratnagiri District of Maharashtra, India and will be implemented by Sahyadri Nisarga Mitra(SNM), Chiplun.

This desk review collates existing available information for the Velas-Anjarle coastal stretch, other coastal and marine sites of India and a few case studies that focus on the status and the management of coastal and marine resources. Results from previous and ongoing research, reports and interventions have also been collated. The review extracts and summarizes information relevant to the better management of coastal and marine protected areas. Secondary sources include previous research papers, newspaper and magazine articles, government reports and other sources of information.

The desk review follows a multi-disciplinary approach as development and management of participatory CMPAs encompasses various socio-economic and environmental aspects. It focuses on biodiversity, traditional knowledge and practices, socio-cultural aspects of managing natural resources, livelihood options for the local communities, tourism, industrial development, pollution in and around CMPAs, waste management, legal and institutional framework for CMPA, and current status of environmental education and outreach activities.

The objective of this desk review is to identify key gaps and to recommend best practices for the participatory management of proposed CMPA. Recommendations have been categorized into short-term and long-term activities, based on their priority, implementation time and resources required for their implementation. Listed below is a summary of key recommendations as identified by the desk review.

#### **For rules and regulations, conventions related to CMPA**

The exact legal status of CMPAs, and the role and responsibility of all stakeholders, based on the applicable laws in its management, should be clearly articulated and communicated to the stakeholders. A comprehensive study on links between relevant conventions, rules and regulations and CMPA may be conducted to understand which of these can be considered for better planning and implementation of CMPAs. Many international conventions offer funds, training, guidance and case studies for conservation of ecosystems and species. The above suggested study may consider identifying opportunities to strengthen a CMPA. Some Acts offer excellent scope for stakeholder participation in biodiversity management such as constitution of village level Biodiversity Management Committees (BMCs) and documentation through Public Biodiversity Registers (PBRs).

#### **For management of CMPA**

Comparative analysis of various conservation approaches (Ecosystem Vs. Indicator Species Vs. Habitat Restoration Vs. Incentives to Stakeholders) to identify a single or a combination of approaches most suitable to the proposed CMPA should be done. Growth in tourism increases the burden of CMPA management. A critical analysis of the tourism sector and evaluation of the economic benefits derived from ecological services (direct/ indirect) could help develop a disaster management plan based on risks identification and possible mitigation measures. This will strengthen the case of the proposed CMPA. A dialogue is needed among various Government agencies that have jurisdiction over a CMPA site (for ex. Forest Department, Fisheries Department, Maritime Board, Transportation Department, MTDC etc.) to share and evolve a common vision and negotiate permissible activities that may positively or negatively affect CMPAs. In general, fishing communities perceive CMPAs as tools to 'keep people out'. This challenge needs to be considered and addressed through adequate outreach and participatory management.

#### **Biodiversity management in CMPA**

A study on the diversity and composition of floral and faunal species will help towards a more comprehensive understanding of the health of ecosystems, uniqueness of CMPA, sustainable economic use by surrounding communities etc.

Mapping of habitats like sandy and rocky shores, mud flats, areas preferred by turtles for nesting, Casuarina plantations, and listing of any disturbances in these habitats, can help in evolving a conservation strategy for species, ecosystems and habitats of the proposed CMPA. Based on the analysis of the study, a mid-term and a long-term conservation plan can be prepared through a participatory process. The mangrove ecosystem owned by various government agencies can be handed over to the Forest Department.

A communication campaign can be conducted for private land owners on legislations applicable to mangrove conservation. The current conservation activities for sea turtles should be continued and expanded if all necessary resources are available. A study on efficiency of Turtle Excluder Devices (TED) followed by a plan to manufacture and use TEDs will help in reducing turtle mortality. Local fisherfolks may be trained and incentivized for use of TEDs. A training module and Marathi booklet can be developed for training of volunteers, Forest Department staff, local NGOs working on turtle rescue and treatment, management of turtle rescue centre and of hatcheries. A buffer zone may be created in CMPA to limit anthropogenic activities so as to restore the breeding grounds of the turtles.

This desk review does not cover dissertations on coastal and marine biodiversity and ecosystems by students from the coastal districts and other neighbouring areas due to restriction on time and resources. Hence, it is recommended to review and collate them too. The management of proposed CMPA should identify areas of research and collaborate with academic and research institutes to develop an authentic database which can be used for CMPA management.

#### **To strengthen ecotourism**

The homestay model by the Gram Panchayat and villagers, in consultation with SNM and the Forest Department at Velas, needs to be strengthened and continued at all existing and potential ecotourism sites. MTDC should advertise recently launched homestay scheme, prepared in consultation with SNM, and also conduct workshops and spot registration camps. Interested local villagers can be trained for eco-tourism. A rating system should be developed for homestay providers depending on the quality and quantity of services they provide. This will help tourists select appropriate homestay facility and minimize disputes. The tourists should be made aware of the significance of a CMPA and be educated in terms of required behaviour while touring the area. Guided tours should be provided so that visitors stay on specified routes and do not trample vegetation or disturb animals. Noise and the use of light at night (e.g. during visits to turtle nesting beaches) should be minimized. Local population should be encouraged and trained for guided tours. The Velas area harbours a

mangrove ecosystem which needs to be conserved, and visitors should view it as part of their environmental education. Efforts can be taken to promote these areas as special sites to be visited. A guest book should be provided for noting their suggestions. Based on the Turtle Festival experience at Velas, and standard international guidelines, SNM and MTDC may develop a guiding manual for effective eco-tourism in the Konkan area. A holistic eco-tourism plan covering all stakeholders and management aspects may be developed and implemented in phase wise manner. If ecotourism grows in an unplanned manner, several environmental problems, cultural and social changes, disruption of traditional economic activities may occur. To avoid stress on local systems there is a need to assess carrying capacity in terms of physical, social economic aspects. Till this study is undertaken, tourism can be developed on above guidelines.

#### **To strengthen livelihoods**

A study of livelihoods directly and indirectly dependent on fishing and allied industries may give an idea of dependence of local population on CMPAs. Based on the results and analysis, a sustainable livelihoods plan may be prepared. Mapping of CMPA management activities and scope to involve local population in skilled and unskilled activities may generate support to CMPA among local stakeholders. For ex. local SHGs may be involved in waste management of CMPA and selling of services and products to tourists. Aquaculture activities, if necessary, should be regulated and carried out only at places where mangrove ecosystem is degraded. New livelihoods based on biodiversity, such as tourist guides, homestays, boat rides, making and marketing of local products such as plates and bowls made from leaf matter, may be encouraged.

#### **Traditional knowledge and socio-cultural aspects**

Traditional fishing practices and customs to be encouraged. A study on impact of mechanized trawlers on marine fauna with focus on turtle migration to be conducted. A plan to regulate fishing in shallow waters and mangroves, especially during the breeding season, to be prepared through consultation with fisherfolks. The tradition of not fishing during monsoons allows replenishment of fish stock through breeding. Such practices should be encouraged.

#### **Management of impacts of existing industrial sector**

A holistic regional environment impact assessment study can be conducted to understand whether and how industries in Ratnagiri and adjoining districts pollute the coastal and marine environment. A plan should be developed and implemented to involve industrial sector in management of CMPA through employee engagement initiatives, sponsorships, technical cooperations etc.

### **For waste management**

Research on composition and quantity of waste, its current disposal system and role of stakeholders in waste management would provide insights to address growing waste in CMPA. For instance, instead of burning plastic waste, it can be utilized to build village roads. Since finding scrap dealers and recycling agencies that give appropriate returns to the waste collected has been a problem, local SHGs may be involved in waste management of CMPA.

### **Conservation education and outreach activities**

School and college students should be involved in documentation of local biodiversity through the process of making Public Biodiversity Registers. Nature Clubs may be formed in the schools for this purpose. Three to five year participatory conservation education and outreach plan may be developed and implemented for effective management of CMPA. Awareness activities for conservation of ecosystems like mangroves, mudflats, sandy shores and flagship species like marine turtle, white bellied sea eagle should be carried out. Educational material for improving the knowledge about the habitats, resources, relevant legislations, policies and conservation strategies should be developed in regional language. Interpretation Centres should be developed in potential sites to provide information about the coastal and marine biodiversity, different ecosystems, the ecological benefits they provide and the need and advantages in protecting them. Local SHGs should be involved in Centre management and avenues provided to showcase local products to tourists. Information about sea turtles and other flagship species can be designed and distributed in form of pamphlets, brochures, stickers, etc. Material available in English can be translated into Marathi. Screening of documentary films, bird watching activities and conducting study tours can also be other ways in which environmental education and awareness can be carried out. The objectives of these activities should be to strengthen participatory research and management of CMPA.





# Methodology

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The desk review has been conducted by an expert in consultation with the project team members. The steps undertaken for the desk review are:

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- Preliminary reading on CMPAs to acquaint with the concept, formation and management of CMPAs
- Identification of scope and content of the desk review
- Listing of subject experts from various organizations, contacting them and compilation of material available with them
- Collating research papers available with SNM
- Collating information from Government records, local NGOs, print and audio-visual media, and online resources
- Structuring relevant information for future use
- Analysis of the information to identify gaps and draft recommendations for CMPA
- Final report and review by project team members and submission to GIZ



## Chapter 1

# About India's Coastline

### Indian Coastline

India is the seventh largest country in the world covering an area of 3.28 million km<sup>2</sup>. Mainland India extends between 8° 4' N and 37° 6' North Latitude and 68° 7' and 97° 25' East Longitude. It has 29 states and 7 union territories. The Indian peninsula tapers southwards resulting in the division of the Indian Ocean into two water bodies - the Bay of Bengal and the Arabian Sea. India has a coastline of 7516.6 km of which the mainland coast measures 5422.6 km while island territories measure 2094 km. It has an Exclusive Economic Zone (EEZ) of 2.02 million km<sup>2</sup> and a continental shelf area of 3,72,424 km<sup>2</sup> spread across nine coastal states and five union territories, including the islands of Andaman and Nicobar, and Lakshadweep. The Indian mainland has 69 coastal districts,

while Andaman and Nicobar Islands have 3 and Lakshadweep just 1. Of the total Indian population of 1.27 billion (Census, 2011), 14.2% (171 million) resides in these coastal districts (ENVIS, 2014).

The extreme diversity of the Indian marine ecosystem can be attributed to the geomorphologic and climatic variations along the coast (Figure 2). The coastal and marine habitats include nearshores, gulf waters, creeks, tidal flats, mud flats, coastal dunes, mangroves, marshes, wetlands, seaweed and seagrass beds, deltaic plains, estuaries, lagoons and coral reefs. The large variety of known species of diverse taxa have been listed in Table 2. However, 1624.435 km of the mainland coastline and 132 islands are have been highly affected by erosion over the years (ENVIS, 2014).

Figure 1  
Map Depicting Maritime States and Union Territories of India



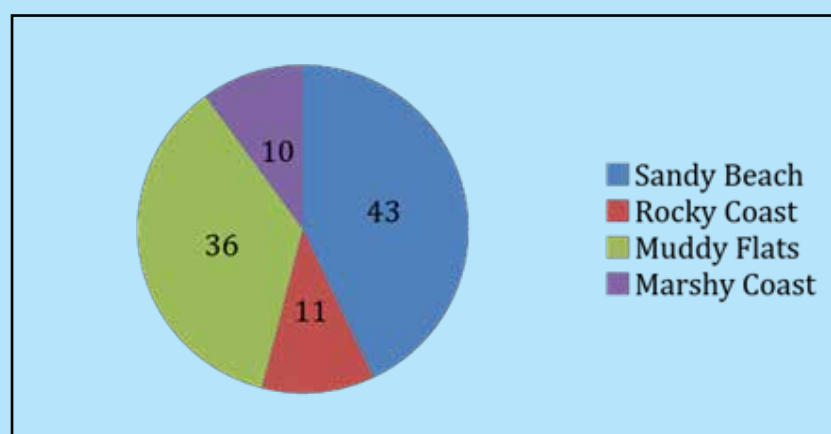
Source: [www.mapsofindia.com](http://www.mapsofindia.com)

Table 1  
Coastal and Marine Biodiversity of India

Taxa	No. of Known Species
Marine Algae	844
Seagrasses	14
Mangroves	39
Mangrove Associated Flora	420
Mangrove Associated Fauna	1862
Crustaceans	2934
Molluscs	3370
Echinoderms	765
Hard Corals	218
Fishes	2546
Reptiles	31
Birds	69
Marine mammals	25

Source: *Envis*, 2014

**Figure 2**  
**Coastal Geomorphology of the Indian Mainland**



Source: ENVIS, 2014

### Dependence of Communities on Coastal Ecosystems

According to the Central Marine Fisheries Research Institute, CMFRI, census of 2010, there are 3288 villages involved in marine fishing and the fishers community consists of about 4 million people (8,64,550 families). There are 6 major and 40 minor fishing harbours along the Indian coastline, while there are 1511 fish landing centres. The annual total marine fish landing is estimated to be approximately 3.8 million tonnes. There are almost 1,94,490 fishing crafts of which 37% are mechanized, 37% motorized and 26% non-motorized. The Indian coastline also has many ports which support Indian trade and economy. The State of Maharashtra has the highest number of ports (53), followed by Gujarat (40), while West Bengal and Puducherry have one port each.

### Coastal and Marine Protected Areas (CMPA)

India has a network of MPAs with 23 in the peninsula and 106 in the islands. (Annexure 1) International Union for Conservation of Nature, IUCN defines 'Protected Area' as "An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means." The Convention on Biological Diversity (CBD) defines an MPA as "any defined area within or adjacent to the marine environment, together

with its overlying waters and associated flora, fauna, and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings." A Marine Protected Area (MPA) is defined more specifically by IUCN as "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." Other definitions can be found, but the IUCN one tends to be the most widely accepted. A 'Coastal and Marine Protected Area' (CMPA) is not a specific category in the Indian legal context, and legal frameworks do not use the terms 'MPA' or 'MCPA'. Instead, national parks, sanctuaries or tiger reserves declared in coastal and/or marine areas under the WLPA are considered MCPAs. In addition to these categories, the central government also recognizes marine 'biosphere reserves' designated under the Man and Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO). Most of the MPAs/MCPAs listed in Annexure 1 are designated to protect and preserve flora and fauna and their habitats, and they are located in intertidal waters, estuaries, mangroves, creeks, wetlands, marshes, mud flats, coastal dunes, seaweed and seagrass beds, delta

**Table 2**  
**No. Of Ports in Maritime States and Union Territories**

Sr. No.	State/UT	Number of ports
1	Gujarat	40
2	Maharashtra	53
3	Goa	5
4	Daman and Diu	2
5	Karnataka	10
6	Kerala	13
7	Lakshadweep Islands	10
8	Tamil Nadu	15
9	Puducherry	1
10	Andhra Pradesh	12
11	Odisha	2
12	West Bengal	1
13	Andaman and Nicobar Islands	23

*Source: Indian Ports Association*

plains, lagoons and coral reefs. The Gahirmatha Sanctuary in Odisha is one of the few MCPAs designated to protect and preserve the nesting and breeding habitat of the Olive Ridley Turtle (*Lepidochelys olivacea*), while the Sundarban Tiger Reserve is designated to protect tigers in intertidal waters (which includes areas covering mangroves and estuarine waters). The Gulf of Mannar Biosphere Reserve was established to conserve marine biodiversity. Most of the protected areas were declared between 1975 and 1995, with very few changes in designations or size. It may be noted that most protected areas were established for habitat or species protection and not for fisheries management.

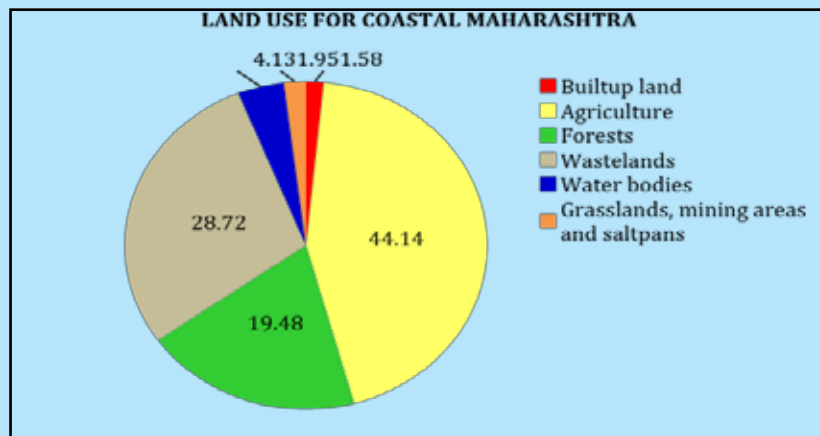
Communities are skeptical of conservation measures that ban all types of fishing activities (including low-impact fishing gear and operations), especially given that industrial and development activities within the vicinity of CMPAs are often allowed to continue (and even

expand in some cases). A lack of participation and consultation with communities, combined with a lack of recognition of communities as rights holders in the decision-making process, threaten the legitimacy and outcomes of the protected area creation process.

### 1.4 Coastline of Maharashtra

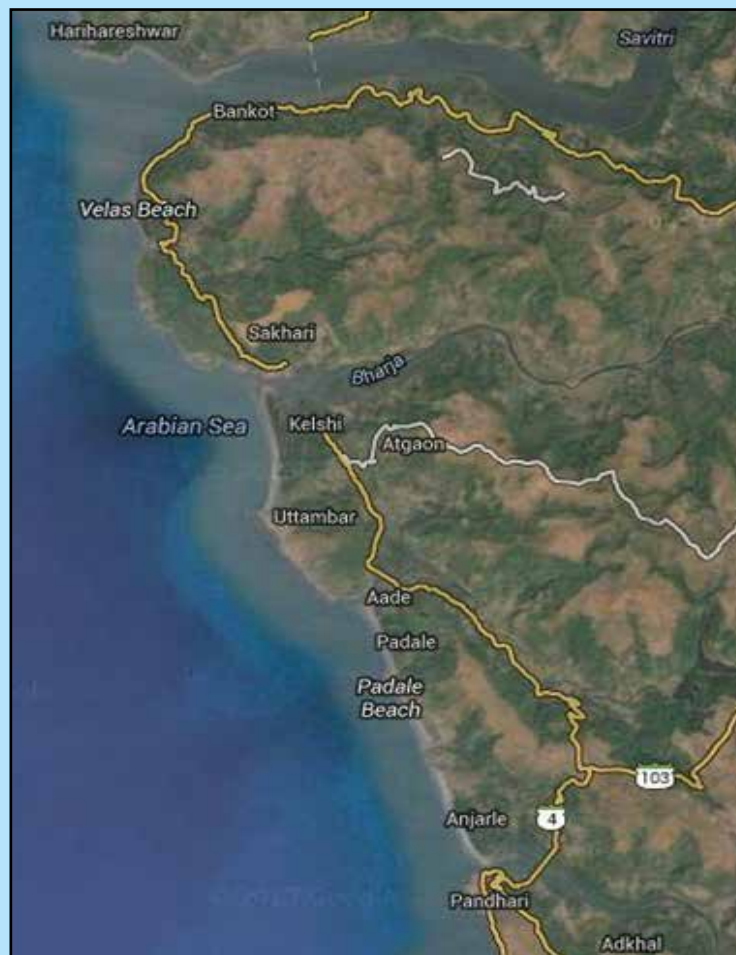
Maharashtra has the longest coastline in India which is approximately 720 km in length extending from 15°43'N and 20°10'N latitude and longitude between 72°39'E and 73°30'E. The six coastal districts of Maharashtra are Thane, Greater Mumbai, Navi Mumbai, Raigad, Ratnagiri and Sindhudurg (Thane district has been recently split into Palghar and Thane districts). The coast is indented with a number of beaches, 15 rivers, 5 major estuaries and over 30 backwater regions (Jagtap et al, as cited by Prabhu, 2014). According to Khire, 1996 (as cited by Prabhu, 2014), the total area of all the coastal districts is 30645.5 km<sup>2</sup> comprising of various classes as depicted below:

**Figure 3**  
**Land Use for Coastal Maharashtra**



Source: Khire, 1996

**Figure 4**  
**Location of Study Area**



The coastal belt of Maharashtra is very rich in terms of the number of creeks it has. There are about 58 such important creeks of different sizes present along the coast. The mouth of these rivers/creeks is funnel shaped. Kundalika, Savitri, Vashisthi, Sashtri are some of the rivers and few creeks like Vaitarana, Thane, Vasai, Panvel, Karanja, Dharamtar, Mhaisa, Kajvi, Purangad, Rajapur, Vagothan, Devgarh, Ajara, Kalivali harbor mangroves.

The study area in focus, the Velas-Dabhol coastal stretch located in the Ratnagiri district, has an approximate length of 60 km. The project will primarily focus on the areas around Velas, Kelshi and Anjarle villages. Ratnagiri district comprises of nine talukas of which five viz. Ratnagiri, Rajapur, Mandhangad, Dapoli and Guhagar are coastal talukas that are located along the 180 km stretch.

According to the forest classification by Champion and Seth (1968), the vegetation of

Konkan comprises of -

- a) Intertidal swampy forests on the tidal saline sediments along the estuaries and creeks
- b) Plateau vegetation at lower elevations or plains representing moist to dry deciduous forests
- c) Semi evergreen forests interspersed with patches of subtropical evergreen forests and west coast semi-evergreen forests along the ghats.

Some of the coastal areas are also endowed with small grasslands and scrublands, especially in Thane and Raigad districts.

Beaches along study area coast have gained popularity due to sea turtle nesting sites. Habitats in the region include sandy beaches, rocky shores, mangroves, estuaries, coastal plateaus and moist deciduous forests on hillsides.



## Chapter 2

# Legal/Institutional Framework for CMPA

A legal framework forms a very important part for protection of natural resources. India is member to many international conventions and accordingly, some rules and regulations have been conceived by the Government of India or has pledged its commitment. These rules do help in restricting destructive activities and in conservation efforts.

Following are the international conventions/treaties related to CMPAs and conservation of marine biodiversity:

### **Convention on Biological Diversity (CBD) and the Jakarta Mandate on Marine and Coastal Biological Diversity, 1992**

Lays out measures to be taken by Parties for conservation and sustainable use of biodiversity, including the establishment of a system of protected areas, or areas where special measures need to be taken to conserve biodiversity. The Jakarta Mandate, an associated instrument, lays out specific requirements for marine biodiversity conservation and identifies five key areas: integrated marine and coastal

area management; sustainable use of living resources; Marine and Coastal Protected Areas; and mariculture and alien species. COP7 of the CBD adopted the target of developing networks of MCPAs by the year 2012. The CBD is supported by a number of different funding mechanisms, including the Global Environment Facility (GEF) and National Environment Fund.

### **The Ramsar Convention on Wetlands, 1971**

Addresses conservation and wise use of wetlands, and covers freshwater and marine wetlands (up to 6m depth at low tide). Allows for designation of sites of 'international importance' that meet criteria covering representative, rare, unique wetland types or those especially important for conserving biodiversity. Sites must be managed but may be subject to 'wise' use and do not require formal protected area legal status. The Ramsar Convention is not a regulatory regime and has no punitive sanctions for violations of or defaulting upon treaty commitments – nevertheless, its terms do constitute a solemn treaty and are binding in international law in

that sense. The Ramsar Small Grants Fund provides resources for projects that contribute to the implementation of the Convention's Strategic Plan.

### **World Heritage Convention, 1972**

Provides for the protection of outstanding examples of the world's cultural and natural heritage. Parties may nominate protected areas that have outstanding values and that meet the specified criteria as World Heritage Sites. Funding under the International Assistance facility can be accessed under the Convention.

### **Convention on International Trade in Endangered Species of Wild Flora and Fauna**

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.

### **United Nations Convention on the Law of the Sea (UNCLOS)**

Gives coastal states jurisdiction over their inland waters, territorial seas (out to 12 nm from the coast) and Exclusive Economic Zone (EEZ) (200 nm or 370 km from the coast) provided they do not infringe the right of innocent passage by foreign ships. UNCLOS has a number of funding opportunities as well as a fellowship programme for government employees and academics involved in ocean law or maritime affairs.

### **International Convention for the Prevention of Marine Pollution from Ships**

MARPOL covers pollution of the marine environment by ships from operational or accidental causes (e.g. oil spills, ballast water discharge, sewage, solid waste). Allows for the establishment of Particularly Sensitive Sea Areas (PSSAs) in which shipping is regulated.

### **Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO)**

Mandated to enhance cooperation among member countries, other countries and organisations in the region and provide technical and management advisory services for sustainable coastal fisheries development and management in the Bay of Bengal region. The BOBP-IGO agreement has been formally signed by the governments of Bangladesh, India, Maldives and Sri Lanka.

### **South Asian Association for Regional Cooperation (SAARC)**

Provides a platform for the peoples of South Asia to work together in a spirit of friendship, trust and understanding. It aims to accelerate the process of economic and social development in Member States. The SAARC Coastal Zone Management Centre (SCZMC) seeks to promote cooperation in planning, management and sustainable development of the coastal zones.

### **Trade Related Aspects of Intellectual Property Rights (TRIPS)**

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) is an international agreement administered by the World Trade Organization (WTO) that sets down minimum standards for many forms of Intellectual Property (IP) regulation as applied to nationals of other WTO Members. The TRIPS agreement introduced intellectual property law into the international trading system for the first time and remains the most comprehensive international agreement on intellectual property to date. The WTO's TRIPS Agreement is an attempt to narrow the gaps in the way these

rights are protected around the world, and to bring them under common international rules. It establishes minimum levels of protection that each government has to give to the intellectual property of fellow WTO members. In doing so, it strikes a balance between the long term benefits and possible short term costs to society. Society benefits in the long term when intellectual property protection encourages creation and invention, especially when the period of protection expires and the creations and inventions enter the public domain.

### **Policies at National level**

As a mandate to follow the international conventions, India has constructed some acts and regulations which are legally binding for all Indian citizens. These legislative measures have restricted developmental activities to some extent, though there are instances of non-compliance. Gaps in the existing laws can be rectified by making necessary amendments as and when required. Some acts pertaining to coastal and marine areas are listed below.

#### **The Indian Fisheries Act, 1897**

This act gave the erstwhile Provinces (States) the responsibility of conservation and development of fisheries in the inland and the territorial waters of the respective States. It also gives liberty to the states to formulate their own rules and regulations for protection and safeguarding of their fisheries.

#### **The Indian Forest Act, 1927**

This Act is in continuation of the previous Acts of the British which was amended in June 1951. This Act consolidates and reserves the areas having forest cover, or significant wildlife, to regulate movement and transit of forest produce, and duty leviable on timber and other forest produce. It also defines the procedure to be followed for declaring an area as a Reserved Forest, a Protected Forest or a Village Forest. It defines a forest offence, the acts prohibited inside a Reserved Forest, and penalties leviable on violation of the provisions of the Act.

#### **Wildlife (Protection) Act, 1972**

This Act provides protection to wild animals, birds and plants species. It was amended in 2002 for the inclusion of fish in the protection measures. This Act establishes a schedule for protected plant and animal species and abandons the act of hunting or killing of any animals in these schedules. It has six schedules with varying levels of protection. Enforcement authorities have the power to compound offences under this Schedule (i.e. impose fines on offenders).

#### **Water (Prevention and Control of Pollution) Act, 1974**

The Water Act is enacted with the objective of prevention and control of pollution in India and aims at maintaining or restoring the wholesome nature of water for the establishment of Boards, and to vest them with such powers so as to enable them to carry out the purposes of the Act. The Water Act is followed by the Water (Prevention & Control of Pollution) Rules, 1975 and the Water (Prevention & Control of Pollution (Procedure for Transaction of Business) Rules, 1975. The provisions of the Act shall have effect notwithstanding anything contained to the contrary in any other enactment.

#### **Territorial Water, Continental shelf, Exclusive Economic Zone and other Marine Zones Act, 1976**

This Act restricts any person (including a foreign Government) to explore the continental shelf or exploit its resources or carry out any search or excavation or conduct any research within the continental shelf or drill therein or construct, maintain or operate any artificial island, off-shore terminal, installation or other structure or device therein for any purpose, unless otherwise stated.

#### **Marine Fishing Regulation Act, 1979**

The Act is based on a model piece of legislation prepared in 1979 by the Ministry of Agriculture, Government of India, in response to demand from non-motorised fishersto protect their fishing vessels, to safeguard their fishing space

and equipment from bottom trawlers. Some of the important management measures adopted under the MFRA are prohibitions on certain fishing gear, regulations on mesh size, establishment of closed seasons and areas, demarcation of the zones for no-trawling, besides other measures such as use of turtle excluder devices, and designation of non-fishing areas.

### **Maritime Zone of India (Regulation and fishing by foreign vessels) Acts, 1980**

This Act was enacted to provide regulation of fishing by foreign vessels in certain maritime zones of India and for matters connected therewith.

### **Environmental (Protection) Act, 1986**

The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment of 1972, in so far as they relate to the protection and improvement of the human environment and the prevention of hazards to human beings, other living creatures, plants and property. The Act is an 'umbrella' legislation designed to provide a framework for central government coordination of the activities of various central and state authorities established under previous laws, such as the Water Act and the Air Act.

### **Coastal Zone Regulation Notification, 1991**

The CRZ Notification 1991 was issued under certain provisions of the Environment (Protection) Act (EPA), 1986. It is a zoning law classifying coastal areas into four categories – CRZ 1, 2, 3 and 4. The notification in 2011 also included the Andaman and Nicobar Islands as well as Lakshadweep islands. The CZR 2011 also includes a section for areas requiring special consideration – Greater Mumbai, Goa and Kerala, as well as a provision for setting up Critically Vulnerable Coastal Areas. This notification includes the rules and regulations for coastal development.

### **National Conservation Strategy and Policy Statement on Environment and Development, 1992**

The conservation strategy is to serve as a management guide for integrating environmental concerns with developmental imperatives. The primary purpose of the strategy and the policy statement is to include and reinforce traditional ethos and to nurture a society living in harmony with nature, and making frugal and efficient use of resources guided by the best available scientific knowledge.

### **National Policy and Macro level Action Strategy on Biodiversity, 1999**

The National Biodiversity Action Plan draws from the principle in the National Environment Policy that human beings are at the centre of concerns for sustainable development and they are entitled to a healthy and productive life in harmony with nature. This Action Plan identifies threats and constraints in biodiversity conservation taking into cognizance the existing legislations, implementation mechanisms, strategies, plans and programmes, based on which action points have been designed.

### **Biological Diversity Act, 2002**

This act was enacted for the preservation of biological diversity in India and provides mechanism for equitable sharing of benefits arising out of use of traditional biological resources and knowledge. The Act was enacted to meet the obligations under Convention on Biological Diversity (CBD), to which India is a party. This Act lays the regulations for forming the Biodiversity Management Committees which would be responsible for documenting the locale-specific biodiversity and make people's biodiversity registers. Village level BMCs should be chiefly responsible for carrying out this activity.

### **Indian Ports Bill, 2011**

The Indian Ports Bill was proposed in 2011 in order to amend the existing Indian Ports Act of 1908. This amendment was suggested taking

#### Box 1

##### Gaps and Recommendations on Rules and Regulations, Conventions Related to CMPA

1. Exact physical boundary of CMPA, legal status of CMPA and role and responsibility of stakeholders based on the applicable laws in its management should be clearly articulated and communicated to the stakeholders.
2. A comprehensive study on link between these conventions, rules and regulations and CMPA may be conducted to understand which of these must be considered while planning and implementing CMPA.
3. Many international conventions offer funds, training and other guidance, case studies for conservation of ecosystems and species. The above suggested study may consider identifying such opportunities to strengthen the CMPA.
4. Some Acts offer excellent scope of stakeholder participation in biodiversity management. For example, constitution of village level Biodiversity Management Committees and documentation of Public Biodiversity Register. Such avenues must be explored for better management of CMPA.

into consideration the changed activities on the port and its usage.

In wake of the above mentioned Acts, it should be stated that people are still not aware of

them. For instance, there have been incidents of violation of the Maritime Fishing Regulation Act of 1979. The Biodiversity Management Committees are not yet formed at the village level at many places in India.

## Chapter 3

# Management of CMPA

12

Select key aspects related to the management of geographical area, stakeholders and assets (natural, socio-economic, cultural) of the proposed CMPA are mentioned below:

**Various Authors (2010): Coastal Issues and Concerns: Challenges for the Research Community. Consortium of Coastal Academic Institutions for the National Centre for Sustainable Coastal Management. Ministry of Environment, Forests and Climate Change, Government of India, June 2010**

This document was prepared by academic institutions working in the coastal regions of India and covers the salient features of the coastal ecosystem of respective states (which includes climate, biodiversity and the hotspots that need to be conserved) along with the major threats to them. The document features past research and proposes areas of required research.

**AID Environment, National Institute for Coastal and Marine Management/ Rijksinstituut voor Kust en Zee (RIKZ),**

**Coastal Zone Management Centre, the Netherlands(2004). Integrated Marine and Coastal Area Management (IMCAM), approaches for implementing the Convention on Biological Diversity, Montreal, Canada: Secretariat of the Convention on Biological Diversity (CBD Technical Series no. 14).**

This document aimed at Integrated Marine and Coastal Area Management (IMCAM) was developed for managers and policy makers working at all scales (regional to global). It provides a practical guide to conservation and sustainable use of marine and coastal biodiversity within IMCAM Programmes. It promotes implementation of the following four approaches:

### **The Ecosystem Approach (EA):**

EA is a strategy for integrating the management of land, water and living resources and promoting conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organization, which



encompass the essential structure, processes, functions and interactions among organisms and their environment. The EA also recognizes that humans and their cultural diversity are an integral component of any ecosystem.

The 12 principles of Ecosystem Approach are based on the understanding that the management system should be decentralized, based on the overall understanding of the ecosystem in its economic context. The ecosystem structure and functions should have a balance between sustainable use and conservation. All these conservation efforts should involve relevant sectors of society and scientific disciplines. An adaptive management system should be adopted for understanding, monitoring and managing these ecosystems.

Generation of integrated knowledge through Ecosystem Approach and development of successful governance are the two pillars of IMCAM. Taking an ecosystem perspective is a necessary first step towards planning for its management as it provides for a better understanding of how coastal ecosystems function, the flow of economic and environmental resources each system can generate, the environmental processes it creates and how to maintain their functional integrity specially under the influence of human activities. A balance must be struck between the physical and biological features of ecosystems and human factors.

Most UN-Biodiversity related processes, including Rio (Agenda 21), the Convention on Biological Diversity (CBD) and the Code of Conduct on Responsible Fisheries, have adopted a precautionary approach in order to manage the marine and coastal ecosystems at appropriate spatial and temporal scale with the best available scientific knowledge and other social information. This approach also takes into consideration the knowledge gaps.

### Indicators:

CBD states that indicators are an information tool for summarizing data on complex

environmental issues. Indicators are important for monitoring the status and trends of biological diversity, sustainable use and equitable sharing. They are required for improving the effectiveness of biodiversity management via IMCAM programmes, and providing inputs to organizational learning systems. Indicators also signal key issues to be addressed through policy interventions and other actions (including early warning systems).

These can be ecological indicators that depict the state of the ecosystem, or certain economic indicators which can help in understanding the social and economic status of the local people. These indicators should be reliable and can aid in the decision making process and form an integral part of an adaptive management system. There may be some other indicators which may be required to suit the policy, programme or project objectives. These indicators can be qualitative as well as quantitative and can be developed and monitored by select stakeholders. Various criteria have been mentioned for selecting and developing indicators.

### Restoration of Habitats

It has been widely accepted that over a brief ecological period, increased species richness (biodiversity) increases the efficiency and stability of some ecosystem functions and improves their resilience. However, within the timescale of the past generation, human population growth and migration, particularly in coastal zones, has increased at unprecedented rates and have been the most significant factors behind the current levels of environmental degradation and deterioration, which has undermined the resilience of ecosystems. Three categories of habitat deterioration have been identified:

**a. Habitat degradation:** It involves loss of environmental quality and the ability to support biological communities. Its adverse effects can be immediate or cumulative.

**b. Habitat loss:** is the outright destruction of a habitat. Its impact on biological

communities are immediate and catastrophic.

**c. Habitat fragmentation:** It is a result of habitat loss and is the disassembly of habitats into discontinuous, often isolated, patches. Its adverse effects are cumulative and not immediately noticeable.

Restoration and rehabilitation are the two main management interventions to remedy the impacts of habitat deterioration. Guiding approaches and principles for restoration programmes are:

- Monitoring of successional processes, timescales and sensitivity of species
- Multi-level management, with a particular focus on community management
- Multi-sectoral approaches to ecosystem restoration that recognise the multiple functions of resources
- Strive for complete and integrated scientific knowledge of marine biodiversity

Understanding the past functional state and the past path of succession is crucial to initiate restoration activities. This requires a consensus of the local, secondary and key stakeholders after having a dialogue with them. This can provide key inputs for the adaptive management program.

### Incentives

Incentives can be defined as inducements, which are specifically intended to incite or motivate governments, local people and organisations to act in the desired manner. The basic aim of an incentive for biodiversity conservation should be to induce people to conserve or sustainably use, as opposed to degrading or depleting, biodiversity in the course of their activities. Incentives are usually seen in terms of five broad types: economic, legal or regulatory, communication, social and cultural, and institutional. It is essential

that these incentives are used in combination, in order to address different types of biodiversity threats as well as to respond to the different motivations that influence people's behaviour. The main focus of all these incentives should be economic incentives since they are a key tool in achieving the objectives of the CBD, as economic factors lie at the heart of biodiversity loss in the coastal zone. These economic incentives can be in the form of property rights, providing markets and charge systems, fiscal instruments, livelihood support systems etc. Various economic incentives can be provided to different target groups in order to achieve the conservation goals.

### State of Environment Report: Maharashtra. Maharashtra Pollution Control Board, Ministry of Environment, Forests and Climate Change, 2007

The objective of this report was to assess the status of various natural resources and environmental sectors in the State so that future strategies could be planned which ensure sustainable growth with minimal damage to ecology and environment. The major areas identified for an in-depth study in this report were socio-economic profile, water resources and sanitation, air and noise pollution, solid waste management, land degradation, forests and biodiversity, disaster management, relevant global and other Issues.

The ESR report has a specific mention of the coastal area of Ratnagiri which can be summarized as follows:

The Institute of Ocean Management has identified Malwan, Ratnagiri on the Konkan coast, as ecologically important areas with a focus on coral reef and mangrove ecosystem. Data collected through the Coastal Ocean Monitoring and Prediction System (COMAPS) is used to assess and monitor the health of our seas and marine environment, and to formulate remedial measures to protect it. In Maharashtra, monitoring is done at Trombay, Bassein, Mahim, Thane, Bombay Harbour, Versova, Ulhas creek,



Murud, Ratnagiri and Redi. Thane, Ratnagiri and Raigad generate maximum solid hazardous waste in Maharashtra.

In the Tenth Development Plan, which allocates considerable funds for Forestry and Agriculture sectors, emphasis has been on improving the ecology of the Western Ghats Area of Maharashtra. This area comprises 62 talukas in 11 districts, of which Thane, Raigad, Ratnagiri, Sindhudurg, Nashik, Dhule, Ahmednagar, Pune, Satara, Sangli and Kolhapur have been covered in this project. The Ministry of Home Affairs (MHA), GoI and United Nations Development Programme (UNDP) are implementing the project entitled 'Disaster Risk Management Programme (DRMP)' in consultation with The Relief and Rehabilitation Department as the State Nodal Agency of the GoM.

The deluge in July 2005 which flooded many parts of Maharashtra such as Mumbai, Kalyan, Raigad, Chiplun Ratnagiri etc., and similar occurrences of extreme weather in other parts of India, are indicators of the dangers of climate change due to GHGs emissions from various anthropogenic activities. Increased seawater percolation may reduce freshwater supplies.

### **3.1.5 Anna University (2005): Ecologically Important Areas of Maharashtra**

This study was undertaken to identify the ecologically important areas along the Indian coastline using the following criteria:

- Occurrence of specialized ecosystems or habitats such as mangroves, coral reefs, seagrass, seaweed beds, salt marsh etc.
- Occurrence of breeding or nesting sites of marine animals such as turtles.

- Occurrence of uninhabited and unexplored islands.

- Occurrence of endemic or endangered marine fauna or flora.

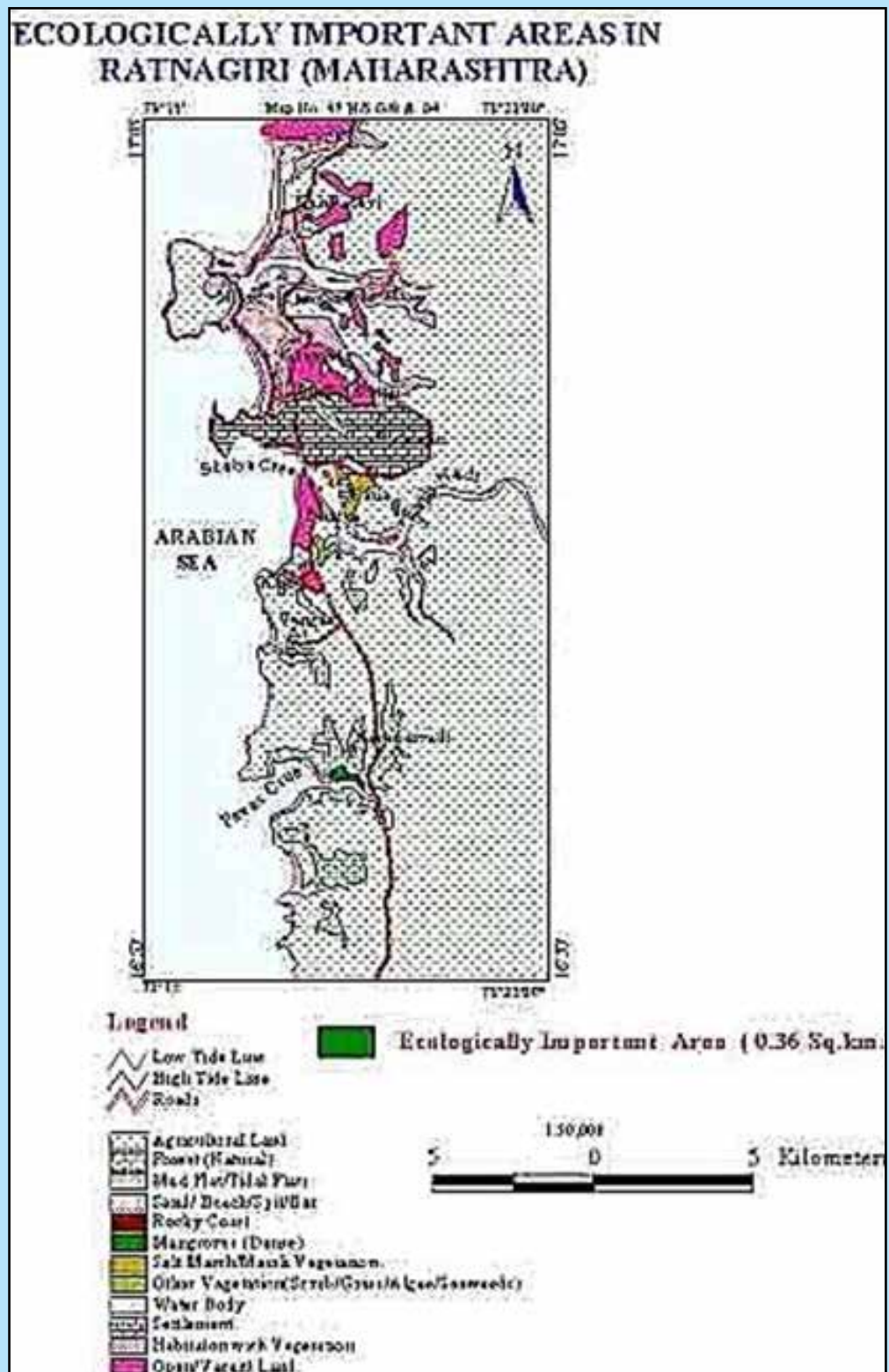
The main objectives of the project were:

- To assess the habitat types and identify areas to be designated as Ecologically Important Areas.
- To estimate the real extent of each ecologically important area and delineate the boundaries on the satellite imagery on 1:12,500 scale.
- To prepare a report on the EIAs including their importance and need for conservation.

To achieve these objectives, Coastal Land Use/ Land Cover maps and Coastal Regulation Zone maps on 1:25,000 scale derived from satellite data were collected from State Coastal Zone Management Authorities. The geo-referenced maps were digitized in ARC-INFO GIS. Digitized maps were edited, labeled and layouts were prepared. The area statistics of different Ecologically Important Areas were generated and represented in the maps.

This study identified Malvan and Ratnagiri as ecologically important areas. Ratnagiri has presence of patchy reef beaches with absence of coral mining or saltpans. Ratnagiri and Malvan are important areas in terms of their diverse marine and coastal flora and fauna. The maps of the Ecologically Important Areas for Ratnagiri and Malvan are given below:

Figure 5  
Ecologically Important Areas in Ratnagiri



Source: Anna University, 2005

Shindikar's undated document mentions that the Ministry of Environment, Forests and Climate Change (MoEFCC) has suggested 35 coastal areas exclusively for the conservation of mangroves in India, of which the following 10 sites were identified in Maharashtra under the coordination of the State Forest Department.

1. Achra-Ratnagiri
2. Devgad-Vijaydurg
3. Veldur
4. Kundalika-Revdanda
5. Mumbra-Diva
6. Vikroli
7. Shrivardhan
8. Vaitarna
9. Vasasi-Manori
10. Malvan

**Gole P. (1997): Conservation of Biodiversity of the West Coast between Mumbai and Goa. Ecological Society, Pune.**

A study was conducted by Prakash Gole from 1996 to 1998 with the objective of assessing the status of coastal habitat and biodiversity on the coastline between Mumbai and Goa and to identify the biodiversity hotspots in the area. The study also investigates the degree of dependence of the local communities on the biodiversity for their living and accordingly recommends a plan for conservation of biodiversity and its suitable utilization for the benefit of the local population and traditional communities.

**Methodology**

- Total 92 beaches on the coastline between Mumbai and Goa were surveyed from October 1996 to February 1998.
- The parameters that were identified to evaluate the quality of beaches were length and breadth of beaches, dune and protective vegetation, the variety and extent of the intertidal flora and fauna and the variety and number of nesting and wintering avifauna.
- The quality of mangroves was assessed on the

basis of length and breadth of the patch, floral diversity, density of cover and height of trees.

- Biodiversity hotspots were identified based on parameters like the extent and variety of dune vegetation, the extent and variety of algal cover, the presence of a nest of the White-bellied Sea Eagle, the evidence of nesting of marine turtles (endangered animals) and the variety and abundance of marine animals of the inter-tidal zone. Scores were allotted to beaches on the basis of the status of these parameters.
- A survey was carried out among the fishermen residing along the coast in the stretch between Bankot and Malvan. The investigation included their methods of harvesting natural resources around them, the way they meet their basic demands, their practices and traditions for protection and conservation of biodiversity.
- A proposal was prepared for biodiversity conservation taking participation of local people into account.

**Observations**

- Biodiversity – 50 varieties of algae, 27 species of mangroves and their associates, about 30 types of marine animals were recorded on the sandy and rocky beaches separately 80 species of birds were noted on this stretch of coastline. Over 35 nests of the White-bellied Sea Eagle were seen. Over 25 beaches were noted where evidence of nesting of marine turtles was found.
- Biodiversity hotspots: The beach of Murud scored first and those of Guhagar and Ratnagiri in Ratnagiri district scored second among sandy beaches. The beaches of Ladghar-Burondi, Sandkhol and Bhudhal in Ratnagiri district scored highest and the beaches Murud-Janjira in Raigad district and that of Kolewadi in Sindhudurg district scored second highest among rocky beaches. Additional parameters like nearness of source of freshwater stream, nearness of mangroves and forest, exposure and shelter from direct wave action were considered. On the basis of these, the Achra and Deogad beaches in

Sindhudurg district scored highest among sandy beaches followed by Ladghar-Burondi from Ratnagiri district.

- Local communities – Among the fishermen, though the main occupation was fishing, buying and selling of fish, coconut and other produce, cattle herding and unskilled labor provided additional sources of income. Most were dependent on the surrounding forest for fuelwood while some used kerosene as fuel. Earlier, wood required for boat construction was obtained from the forest, but due to scarcity of these tree species, wood had to be sourced from outside. Traditions and customs like using only traditional gear for fishing, no fishing during the spawning season, closure of fishing and no consumption of fish during festivals, protection of sacred groves and fine and punishment to those who break the tradition etc. help conserve marine life.

### Discussion

- A plan was proposed to create 5 biosphere reserves and 12 areas of special scientific interest for biodiversity conservation. Each reserve was to be demarcated carefully with separate zones with core, restricted use and multiple use areas. A management plan was to be designed in consultation with the local people and local NGOs.

- Habitats that sustain biodiversity were to be identified as they are dependent on ecological processes supported by marine, estuarine and terrestrial factors. The transport of sediment and nutrients by streams from mountains to sea being a continuous process, it was suggested that conservation of coastal biodiversity should start from the restoration of streams and forests on the mountains followed by rejuvenation of creeks and estuaries and then the actual coastline.

R.V. Salm, John Clark, and Erkki Siirila (2000). *Marine and Coastal Protected Areas: A guide for planners and managers*. IUCN. Washington DC.

This piece of work was inspired from the Workshop on Managing Coastal and Marine Protected Areas, held in October 1982 during the World Congress on National Parks in Bali, Indonesia. The principal goal of all MPAs is conservation of resources so they yield the greatest benefit to present generations without losing their potential to meet the needs and ambitions of future generations.

The intrinsic link between marine, terrestrial and coastal ecosystems should be recognized, which precludes the effective management of a marine area independent of managing adjacent land habitats. It should also be understood that coastal ecosystems include both land and water components and that they should be managed together. Specific small areas like seabird colonies should be protected but their management should be integrated with the larger multiple use areas and regional initiatives whenever possible.

Marine and coastal habitats may be protected individually or through national or regional systems of marine protected areas (MPAs). The success of either depends on the existence of appropriate legal frameworks, acceptance by coastal communities, an effective and well supported management system, and the delineation of areas so their boundaries are clear and they can be treated as self-contained units.

There is an increasing need to justify protected areas in measurable and convincing terms to satisfy social, commercial, development, and planning interests. Solely ethical arguments (spiritual values) are convincing only in a few privileged nations, and then not always. For these reasons conservation agencies and protected area planners need to have a well defined policy and a clear idea of the purpose of each protected site, stressing the practical (material) aspects. MPAs should be designed to simultaneously achieve multiple conservation objectives such as:

1. Limiting the exploitation of coastal and marine waters and resources or other linked areas.

**Table 3**  
**Salient Features of the Recommended Marine Areas**

Sr. No.	Name of the site	Ecosystem	Merits of the site
1	Vengurla rocks	Islands	Subtidal flora and fauna
2	Malvan	Benthic	
3	Achra	Mangrove, sand dune	<ul style="list-style-type: none"> <li>Well preserved Mangrove Forests</li> <li>Nursery for mangrove plantation already exists</li> <li>Mangrove forest provides sanctuary for various terrestrial and avifaunal species</li> <li>Sand dune vegetation</li> </ul>
4	Deogad	Mangrove	<ul style="list-style-type: none"> <li>Well preserved mangrove forests which provide sanctuary for various terrestrial and avifaunal species</li> </ul>
5	Vijaydurg	Mangrove	<ul style="list-style-type: none"> <li>Well preserved mangrove forests which provide sanctuary for various terrestrial and avifaunal species</li> </ul>
6	Ratnagiri (along with Shirgaon Creek)	Benthic and Mangrove	<ul style="list-style-type: none"> <li>56 species of marine algae</li> <li>Diversified fauna</li> <li>Well preserved mangrove forests which provides sanctuary for various terrestrial and avifaunal species</li> <li>About 121 birds species are present around the mangrove area</li> </ul>
7	Vikroli **	Mangroves	<ul style="list-style-type: none"> <li>Well preserved mangrove forest which provides sanctuary for various terrestrial and avifaunal species</li> <li>Privately owned and conserved</li> <li>Interpretation centre established</li> <li>A nursery for afforestation program</li> </ul>
8	Mumbra-Diva	Mangrove	<ul style="list-style-type: none"> <li>Well preserved mangrove forest of Sonneratia apetala</li> <li>Mangrove forest provides sanctuary for various terrestrial and avifaunal species</li> </ul>
9	Colaba	Benthic	<ul style="list-style-type: none"> <li>Despite being in Mega city area, highly diversified flora and fauna</li> <li>59 marine algal species recorded along with some rare species</li> <li>Rich in biomass estimation and fauna</li> <li>Presence of corals in the intertidal zone</li> </ul>

2. Protecting the critical habitats like coral reefs and mangroves.
3. Restoration of habitats which have been affected because of pollution or physical damage.
4. Enhancing certain economically productive activities like tourism and fisheries.
5. Defining sustainable levels of use and appropriate management structures and implementing activities to monitor and control these.

6. Obtaining and transferring information (for example, through research, education, and interpretive programmes)

**Untawale A. G. and Dhargalkar N. K. (2002): Marine and conservation strategies for Maharashtra Coast In: Advance in Marine and Antarctic Science, Edited by Dinabandhu Sahu and Premchanda Pande**



This study was carried out in 37 sites along the coastline of Maharashtra to assess biodiversity. After initial surveys, 10 sites were selected for detailed observation, but in the final phase only 6 sites were recommended to be declared as Marine Protected Areas. Detailed observations for flora and fauna were carried out at each of the sites. Information about the local industries was obtained and changes in biodiversity over the last 10 years were studied in estuarine and intertidal zones. Sediment sampling was also performed.

The open sea coast of Maharashtra harbours sea turtles, porpoises and dolphins, with occasional sightings of drifted whales. Reptiles, otters and other terrestrial animals like fox, wild boar and 121 bird species have been recorded on the coast.

This paper also mentions that the island ecosystem of Vengurla Rocks should be given special attention. These 9 sites mentioned in the above table had been recommended on priority basis for consideration of Marine Protected Areas. It recommended to ban mangrove deforestation at Mumbra-Diva.

The paper concludes with the following recommendations:

1. Participation of the stakeholders is necessary from the planning stage.
2. Final plan for conservation and management of these areas should be prepared.
3. More awareness activities at various levels are essential for conservation.
4. Regular monitoring of the health of the ecosystems is necessary.
5. Depending on the genetic diversity at the site, resource exploitation should be regulated or stopped.
6. Plans should be developed to manage key species of economic and ecological importance of sustainable utilization
7. A separate Marine Wing should be established within the present Forest Department for proper and effective

management of the Marine Parks (Malvan). The staff should be properly recruited and well trained in marine wildlife conservation.

8. An advisory committee representing State Government Departments, NGOs, Scientific Institutes and local stakeholders may be formed for effective policy decisions.
9. Research and educational institutes should be inter-linked.

**Untawale A. G., Dhargalkar V. K., Deshmukhe G. V., (2000): Prioritization of potential sites for marine and biodiversity conservation in India. In setting biodiversity conservation priorities for India: Summary of the findings and conclusions of the biodiversity conservation prioritization project, eds Singh S, Sastry A. R. K, Mehta R, Uppal V**

Coastal regions of Maharashtra which are rich in marine flora and fauna need to be preserved taking into consideration the ecological, biological and other environmental factors. The study states that Maharashtra has 17 species of mangroves and 17 associated plant species. Good mangrove patches were observed in Achra, Deogad, Vijaydurg (Sindhudurg district), Purangadh, Ratnagiri (Ratnagiri district), Kundalika (Raigad district) and Mumbra-Diva.

91 marine algal species were found along the coast: Malvan had 73 algal species followed by Colaba, Mumbai (64) and Ratnagiri (56). The sandy coasts also serve as an excellent habitat for many molluscs, crustaceans. Vengurla rock islands, Malvan, Ratnagiri and Mumbai harbour ecologically important fauna namely corals.

There have not been many avifaunal studies conducted along the coastline but 121 bird species have been recorded. The coasts also serves as a habitat for turtles, porpoises and dolphins.

This study recommends 5 sites to be declared

as Marine Protected Areas. They are Malvan, Achra - Deogad – Vijaydurg, Colaba, Vikroli and Mumbra-Diva.

Other hotspots mentioned which need to be protected on the West Coast are Pirotan Island in the Gulf of Kutch, while Gulf of Mannar, Sundarbans and Bhitarkanika are on the Eastern Coast.

The paper concludes with the following recommendations:

1. Since coastal habitats are more diverse than open oceans and subjected to more developmental and exploitation pressures, their ecological benefits need to be economically evaluated as they provide many direct and indirect benefits.
2. Deep sea benthic communities are known to be genetically diverse. There is a need to study diversity in these areas.
3. In order to sustain genetic exchange and to ensure that the varieties of breeding populations are maintained, population of various communities should be maintained at an optimum level.
4. In most of the developing countries the focus is on food production and on economic growth rather than on the conservation of biodiversity. Therefore, there is a need to explore the economic value and other practical benefits of conservation of biodiversity, so that policy decisions are made keeping in view the benefits that biodiversity conservation offers.
5. Public participation is essential for conservation of biodiversity. Awareness activities amongst coastal inhabitants about sustainable use of the biodiversity resources should be carried out.

**Critical Habitat Information System for Malvan (2001): Department of Ocean Development, Integrated Coastal and Marine Area Management Project Directorate, Chennai, Government of India.**

The major objective of this study was to create information on the resources of this region using Geographical Information System (GIS), incorporating its components of remote sensing and an external database. This was to help decision makers in effective monitoring and management of the biological wealth of this area.

Marine flora and fauna of the rocky, sandy and muddy shores of Malvan comprises 367 species, belonging to 173 genera (97 families, 16 classes and 9 phyla). 40 major animal groups, including corals and pearl oysters, were identified and 73 species of seaweed and 18 species of mangroves were recorded between 1971 and 1991. To monitor the health of Malvan Marine Sanctuary, data sets collected by various organizations on the biodiversity of the region along with the land use data and geomorphology were integrated to develop Resource Information System for Malvan (RISMA). The data was built using Image Processing of Remote Sensing Images, GIS and RDBMS.

1. RISMA incorporates the following information:
2. Current status of distribution of phytoplanktons, zooplanktons, benthos and corals.
3. Spatial distribution of corals in intertidal and subtidal zones.
4. Information on the previous work done in this area, to assess changes in biodiversity.

This system also provides information on hydrological features like surface water temperature, pH and salinity, dissolved oxygen, suspended particulate matter etc.

Intensive trawling activities along the coast, traditional fishing activities in the core area, over exploitation of undersized species and Illegitimate felling of mangrove trees were identified as threats in this area.

Following are the suggestions for Resource Management in this area:

1. Core and buffer zone should be demarcated for uses and regulations.
2. Marine Fishing Regulation Act and its provisions which restrict/specify the use of certain gears, net size etc. should be strictly implemented to minimize damage to the breeding population and juveniles.
3. Trawlers should operate only in specified zones in order to protect the interests of the traditional fishermen. It suggests formation of uniform fishing zones for traditional and the mechanized fishermen.
4. Focus on awareness and capacity building through training among the coastal communities for achieving sustainable utilization of the marine resources.

The study concludes that fishing activities and increased human activities can be identified as the primary causes of habitat destruction and decrease in the number of species along the coast. The Information System developed using a hybrid approach is effective in monitoring the health of the ecosystem as well as resource management of these areas.

**Biswas Nilanjana (2009): The Gulf of Kutch Marine National Park and Sanctuary: A case study. International Collective in Support of Fishworkers, Chennai.**

The Gulf of Kutch Marine National Park and Sanctuary (GKMNPS), which was established primarily to conserve marine resources, has an old management plan that has been ineffective in protecting this area from industrialization. Absence of clear physical boundaries and overlapping jurisdictions of various government bodies are the main reasons for habitat degradation. With increase in large, mechanised fishing vessels, traditional fishermen have been considerably impacted. Once rich in corals, mangroves and other marine fauna, this area is under tremendous pressure due to various developmental activities. Heavy siltation which occurs due to coral dredging has considerably damaged the reefs. Polluted soil and groundwater have also destroyed

the agricultural activities in this area. The exclusionary approach in governing the area and absence of government intervention to involve local communities in planning, regulation and developmental activities were the main reasons for the failure of the management plan. Lessons from the shortcomings of GKMNPS management plan can be noted while considering a plan for proposed CMPAs.

**Points To be considered for effective management of CMPAs (Learnings from the case study)**

1. Demarcation of boundaries: For effective management of CMPAs, demarcation of boundaries should be done after a considerable biodiversity study has been carried out. Remote Sensing Technology can be used to identify and delineate these areas. According to the Wildlife Protection Act, once an area is declared as protected, the legal settlement of boundaries and the rights of local communities must be completed within a two-year time frame as their concerns are of equal importance for defining the boundaries of CMPA.
2. Multiple stakeholders and legal regimes: Any port building and development activity to be carried out only after the consent of the park authorities and the local people. Port building activities should neither affect the livelihoods or the communities nor the biodiversity of CMPAs. They should also not affect the overlapping activities of Fisheries Department, Lighthouse department and the Indian Navy. The declared CMPAs should not be under pressure due to any religious activity. These areas once declared as protected, should not be de-notified for commercial and pollution causing activities.
3. Tourism: Tourism can be encouraged in some areas of the CMPAs since this can provide additional income to the local communities. However, tourism activities can be restricted to certain parts of CMPAs. Ecologically fragile and sensitive areas should be excluded by demarcating tourist and non-tourist zones.



## Box 2

### Recommendations for Management of CMPA

#### Short-term Recommendations:

1. Proper demarcation of CMPA boundary and communicating that to the stakeholders.
2. Comparative analysis of various conservation approaches (Ecosystem Vs. Indicator Species Vs. Habitat Restoration Vs. Incentives to Stakeholders) to identify single or combination of approaches most suitable to the CMPA.
3. Increased number of tourists is liability of CMPA management. A disaster management plan based on risks identification and mitigation measures to be in place.
4. The ecological benefits need to be economically evaluated since coastal regions provide many direct and indirect benefits to coastal communities. This will strengthen the case of proposed CMPA.

#### Long-term Recommendations:

1. Activities beyond delineated CMPA boundaries, like mining, industrial and domestic sewage etc. are bound to affect habitat, ecosystem and species in CMPA. Thus, CMPA is not to be treated in isolation and a plan to engage key stakeholders beyond CMPA boundaries should be prepared and implemented.
2. A dialogue among various Government agencies that have jurisdiction over CMPA site (ex. Forest Department, Fisheries Department, Maritime Board, Transportation Department, MTDC etc.), to share and evolve a common vision and negotiate permissible activities that may positively or negatively affect CMPA.
3. The number of private vehicles entering per day can be restricted in order to keep pollution levels in check. Entrance fees/Parking fees can be collected and utilized for mitigation and conservation activities. Car-free zones to be identified. All the three villages have narrow lanes with houses and shops, hence traffic regulation should be given priority to reduce air and noise pollution and to avoid subsequent problems.
4. Management of protected areas for the purpose of tourism entails huge opportunity costs. If the benefits are not distributed fairly among stakeholders, it would result in huge welfare loss to the society. Fees should be charged to tourists to cover maintenance costs with a bare minimum profit initially. Other such practices may be initiated.
4. Sale of branded packaged food should be discouraged, instead locals can sell local delicacies. This can facilitate a good cultural exchange and cultural conservation as well as reduce littering with plastic wrappers and other such waste.

#### Source: Katha Kokan Kinaryachi

The management of coastal land resources and marine resources should be done parallelly in such a way that not only is the economic condition of the people improved but the health of the natural ecosystems in the coastal areas is also restored and safeguarded.

Current uses of the marine resources as well as the possible future uses and the consequences should also be taken into consideration while designing the plan. Local people should be informed about the effects of any activity to be undertaken as their consent is a must for marking any strategy for the use and management of their resources.

In order to conduct these activities, a system

should be established at local, regional and state level with representation of the local population at every level.

To conserve marine resources:

1. Traditional knowledge and traditional practices should be followed.
2. Necessary steps to be taken for restoration of the habitats of marine resources.
3. The rare, endangered and threatened marine species should be protected and necessary activities for increasing their numbers should be carried out.
4. Rare and fragile ecosystems, habitats and environmentally sensitive areas should be protected.

## Chapter 4

# Biodiversity in CMPAs

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Biodiversity, or biological diversity, refers to the range of biological organisms within the living world. The term is commonly recognised as a description of the number, variety and variability of living organisms. Biodiversity, is also defined as 'the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems' (Anon-WCMCa, 2001).

### Mangrove Ecosystems of Maharashtra

Mangrove forests are intertidal wetlands which cover more than 100,000 Km<sup>2</sup> of tropical coastlines worldwide. India has a mangrove cover of about 6749 km<sup>2</sup> (Naskar and Mandal 1999 as cited by Singh et al, 2012). These ecosystems are unique in their structure and characterized by a variety of plants, animals and microorganisms, which have adapted to the dynamic environmental conditions. Mangroves are important in the following aspects:

- Mangrove litter serves as food for planktons, small fishes, crabs etc. and

provides nutrients for the flora.

- Mangroves are utilized for their wood for construction, fuel, fodder, barks for tannin extraction, fruits and young shoots are used as vegetable, medicine etc.
- Mangroves also serve as a buffer zone between the ocean and the shore by attenuating the waves and protecting land from natural calamities such as tsunamis.
- Mangroves act as a carbon sink and maintain climatic balance.

Clearing the mangrove forests makes a shoreline vulnerable to the erosive effects of the sea and significantly hinders the lifecycles of all the associated flora and fauna which depend upon the mangroves for their survival. There have also been reports which state that the Khar Land Development bunds are adversely affecting the mangrove cover (BNHS Report, 2013). Khar bunds are earthen dykes, primarily constructed to protect agricultural land from ingress of salt water and make them cultivable. Presently, there are many institutions working at various levels for the conservation of these unique ecosystems.

**Table 4**  
**Mangrove Cover Assessment for 2013**

Sr. No.	State/UT	Very dense mangrove(km2)	Moderately dense Mangrove (km2)	Moderately dense Mangrove (km2)	Total
1	Andhra Pradesh	0	126	126	352
2	Goa	0	20	20	22
3	Gujarat	0	175	175	
4	Karnataka	0	3	3	3
5	Kerala	0	3	3	6
6	Maharashtra	0	69	69	186
7	Odisha	82	88	88	213
8	Tamil Nadu	0	16	16	39
9	West Bengal	993	699	699	
10	Andaman & Nicobar Islands	276	258	258	604
11	Daman & Diu	0	0	0	1
12	Puducherry	0	0.14	0.14	
	<b>Total</b>	<b>1351</b>	<b>1457.14</b>	<b>1457.14</b>	

**Table 5**  
**Mangrove Distribution for Maharashtra**

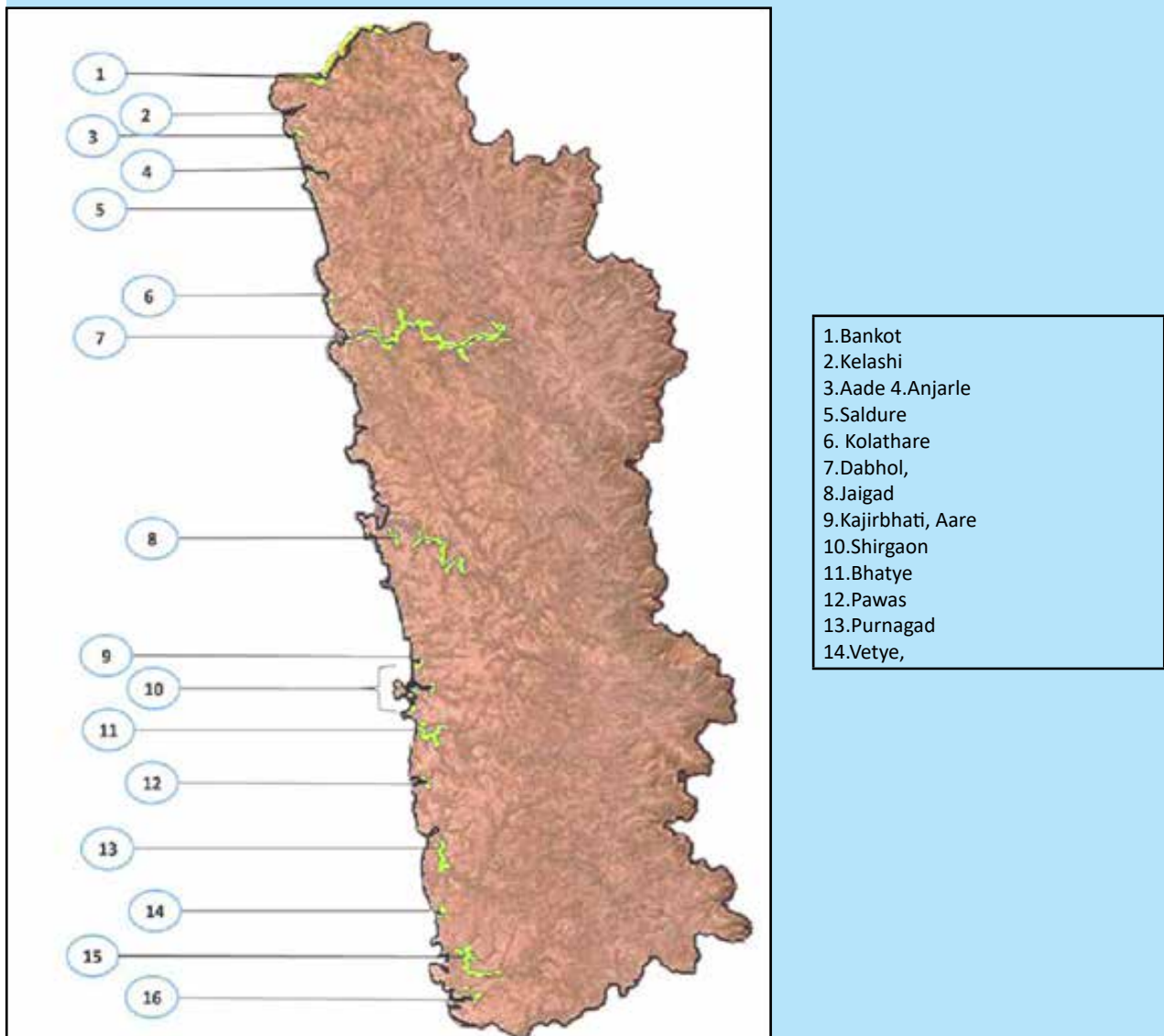
District	Very dense mangrove	Moderately dense mangrove	Open mangrove	Total
Mumbai City	0	0	2	2
Mumbai Suburb	0	23	20	43
Raigad	0	10	52	62
Ratnagiri	0	12	11	23
Sindhudurg	0	2	1	3
Thane	0	22	31	53
<b>Total</b>	<b>0</b>	<b>69</b>	<b>117</b>	<b>186</b>

‘Mangroves for the Future’ (MFF) is a partnership based program developed by IUCN for promoting investments in coastal ecosystems that support sustainable development. MFF has adopted mangroves as its flagship ecosystem in recognition of the important role that mangrove forests played in reducing the impact of the 2004 Indian Ocean tsunami, and the severe effect on coastal livelihoods caused by the loss and degradation of mangroves. However MFF embraces all coastal ecosystems, including coral reefs, estuaries, lagoons, wetlands, beaches and seagrass beds.

An independent mangrove cell has been established by the Maharashtra State Forest Department in January 2012 for the state’s mangrove protection, conservation and management. It has also been bestowed with the responsibility of conservation of coastal biodiversity.

BNHS and Oil and Natural Gas Corporation Limited initiated ‘Project Mangrove’ in 2007 in Gujarat and Maharashtra. This project works for Mangrove Conservation and has a mobile education unit. These efforts have helped

Fig 6  
Creeks and Mangroves of Ratnagiri



in developing a coastal green belt and creating employment opportunities in Denva, Valipur, Mangrol, Gandhar and Kalak.

A special case that should be mentioned for Mangrove conservation is that of Soonabai Pirojsha Godrej Marine Ecology Centre at Vikroli. This area can be considered as one of the last quality mangrove forest in the city of Mumbai, and is under private ownership and management.

### Report of the Forest Survey of India (2014): Chapter on Mangroves Cover

Forest Survey of India carries out the assessment of the forest cover throughout the country at 1:50,000 scale using remote sensing. The distribution of different types of mangroves (area in sq.km) along the Indian Coast is depicted in Table 4 and does not include tidal creeks and water bodies within the mangrove forests. The mangrove cover has been categorized into 3 types: Very dense mangroves (canopy density of 70% or more), Moderately dense mangroves (canopy density of 40% or more but less than 70%), and Open mangroves (canopy density of 10% or more but less than 40%).

Table 6  
Area under Mangrove Forests for Sakharatar Estuary for Four Time Periods

Year	Area covered by Mangroves (ha)
1989	109.13
1999	188.62
2004	203.45
2009	297.36

**Ongoing Project – Prabhu Swapna (2014): Ecological Assessment and Education for Conservation of Mangrove Community in Ratnagiri District of Maharashtra. Final Report of the MFF Small Grant Project, Bombay Natural History Society. March 2014.**

This project is an effort to reduce ignorance about mangroves in Maharashtra, amongst scientific circles as well as local communities. It is a short term activity to make a visible difference towards conservation, to empower people to value the importance of mangroves and to reduce incidental destruction. It is aimed towards detailed documentation of the present ecological status as well as potential threats to the mangrove community of Ratnagiri district. It also attempts empowerment of the local people through awareness generation and education programs for conservation of the mangroves.

To document the current ecological status, surveys were conducted at selected sites to analyze species richness, community structure and species distribution pattern across biotic and abiotic factors. Maps were to be produced based on this data. For generating awareness, specific activities were conducted for specific target groups. In order to share experiences and problems encountered in mangrove conservation, meetings with stakeholders and village governing bodies were conducted.

The project's aim was to develop a demonstration plot with people's participation for mangrove

restoration. About 10,000 saplings would be raised in the nursery. At least 4 acres of the suitable land would be restored with mangrove plantation.

The educational material developed by BNHS was distributed in form of handouts printed in Marathi. This project is ongoing and further reports would be released subsequently.

**BNHS (2013): Khar Land Development bunds affecting mangrove cover: case studies from Ratnagiri**

This document looks at the developmental activities that have affected the mangrove ecosystem and consequently impacted the lives of the local communities.

The first case that has been mentioned is that of Lagvan – Kasaari mangrove patch along the Jaigad creek. The mangrove area, which was about 108 ha in 1989, has declined to just 35 ha in 2013. Research shows that the area under mangroves declined subsequently after the bund construction was over. It has been reported the industries in this vicinity intend to store fresh water within the enclosed area. However, these activities have adversely affected the fresh water reserves of the villages.

The Shipole – Vesawi bund along the Bankot Creek passes through an old mangrove patch spread over approximately 48 ha. This bund has led to fragmentation of this patch. Ongoing construction activities may divert the flood water to existing and upcoming aquaculture units and

may lead to the desiccation of the mangrove patch.

The Sakhartar Creek near Shirgaon has a bund of approximately 2.5 km encircling about 75 ha of mangrove patch. Erection of bund has led to severe mortality of mangroves at some places. But recently, this bund had been destroyed at some places leading to mangrove restoration. However this patch which was dominated by *Sonneratia alba* is now dominated by *Rhizophora mucronata*.

**Nakhawa Ajay D., Markad Sandip S., Vichare Priyanka S. and Shirdhankar Mangesh M. (2012): Mapping and change detection of mangrove forest in Sakhartar estuary of Ratnagiri district, Maharashtra. International Multidisciplinary Research Journal**

The study describes the mangrove mapping and change detection for the Sakhartar estuary in Ratnagiri district of Maharashtra. Unsupervised classification technique was used and maps were prepared for the years 1989, 1999, 2004 and 2009. Satellite imageries from Landsat-TM, Landsat-ETM, ASTER, IRS-P6 (LISS-III) were used for the respective years. Baseline information about the estuary was gathered by conducting extensive field surveys in boats and by walking around the estuary.

Eight species of mangroves such as *Sonneratia alba*, *Avicennia* spp., *Rhizophora mucronata*, *Acanthus ilicifolius*, *Ceriops tagal*, *Lumnitzera racemosa*, *Excoecaria agallocha* and *Aegiceras corniculatum* were observed along the Sakhartar estuary. These species make it one of the most diverse estuaries in Maharashtra.

It concludes that there has been a net increase of 188.24 ha in the area under mangroves. Widening of the mangroves on the mudflats has been stated as the possible reason for this increase.

**Pawar Prabhakar R. (2012): Molluscan Diversity in Mangrove Ecosystem of Uran**

**(Raigad), Navi Mumbai, Maharashtra, West Coast of India. Bulletin of Environment, Pharmacology and Life Sciences, Volume 1 [6] May 2012**

Many mangrove associated species of molluscs act as indicator species for mangroves. This study assesses the species diversity of molluscs from mangroves of Uran. In all 55 species of molluscs representing 13 orders, 30 families and 39 genera were recorded from the study area. Of these species, 69.09% species were gastropods, 23.64% were pelecypods and 7.27% were cephalopods. 38 species of gastropods representing 6 orders, 18 families and 25 genera, 13 species of pelecypods representing 4 orders, 8 families and 10 genera and 4 species of cephalopods representing 3 orders, 4 families and 4 genera were recorded. Species like *Telescopium telescopium*, *Thais carinifera*, *Bursa tuberculata*, *Arca granosa*, *Placenta placenta*, *Meretrix meretrix*, *Katelysia opima*, *Octopus herdmania* and *Sepia officinalis* were common whereas *Chlamys singaporina*, *Loligo vulgaris* and *Amphitretus pelagicus* were rare. At present, ecological conditions in mangroves of Uran support high density of molluscs but due to intense industrialization and urbanization, pollution of Uran coast cannot be ignored. Therefore, data presented in this paper can be taken as a base line data.

**Singh A. K., Ansari Abubakar, Kumar Dinesh, Sarkar U. K. (2012): Status, Biodiversity and Distribution of Mangroves in India: An overview In Uttar Pradesh State Biodiversity Board.**

The mangrove habitats of the Indian Coasts can be subdivided into three zones: East Coastal Zone facing Bay of Bengal, West Coastal Zone facing Arabian Sea, and the Island Territories. The area under mangroves in Gujarat is the second largest along the Indian coast, after the Sunderbans. Mangroves in India account for about 3% of the global mangroves and 8% of Asian mangroves (SFR, 2009; FAO, 2007). Of the total mangrove cover, 27% of the total mangroves occurs along the Western Coast of India. As many as 55 mangrove species belonging to 22 genera and 18



families have been recorded in the Indian Ocean region.

The Indian mangroves comprise approximately 59 species in 41 genera and 29 families. Of these, 34 species belonging to 25 genera and 21 families are present along west coast. There are eight species of mangroves like *Sonneratia caseolaris*, *Suaeda fruticosa*, *Urochondra setulose* etc. which have been reported only from the west coast. There are approximately 16 mangrove species reported from the Gujarat coast, while Maharashtra has about 20 species, Goa 14 species and Karnataka 10. There are hardly three to four species of mangrove which are rarely found along the Kerala coast. The associated mangrove flora is quite common to both the coasts, with minor variations in distribution.

Human settlements, expansion of agricultural or salt-making lands, development of industries and ports, and expansion of coastal aquaculture, have been identified as the critical factors that have resulted in depletion and degeneration of mangrove resources. Main factor for consideration to developing a management strategy for mangroves is to create buffer zones, limiting anthropogenic activities around the demarcated corridor of the wetland which could revive its natural functioning (Castelle et al., 1994). It is important to identify the functional values, magnitude and source of disturbance, adjacent land use and to project the possible long term impact of such stresses. A buffer zone might consist of diverse vegetation along the perimeter of water body, preferably an indigenous one serving as trap for sediments, nutrients, metals and other pollutants, reducing human impacts by limiting easy access and acting as a barrier to invasion of weeds and other stress inducing activities (Stockdale, 1991).

#### **Mangrove Cell, Mahesh Shindikar, undated document**

Mangroves of Maharashtra were studied for more than a century and explored for botanical interests and environmental studies. With respect to habitat, the mangroves can be broadly

categorized into 5 types as:

1. River dominated estuarine mangroves
2. Mangroves along the tidal estuaries and creeks
3. Backwaters, bays or very small tidal inlets
4. Mangroves on rocky/ sandy substratum
5. Island vegetation

Majority of the mangrove forests of Maharashtra have vanished due to anthropogenic pressures in the recent years. During the last 25 years, about 40% reduction in the mangrove cover of Maharashtra has been due to human interference and State Kharland Development Board.

Along the Maharashtra coast, the major issues identified are problem of effluent treatment, indiscriminate solid waste disposal, inappropriate hazardous waste management and demand on land for an increasing population. Habitat conversion and wood felling are the two major threats observed for the mangroves of Maharashtra. The estuary/creek ecosystems in general and the mangroves in particular are under tremendous pressure due to urbanization and industrialization.

The coastal areas are also severely subjected to developmental projects like damming the rivers of the Western Ghats for water storage and power generation. The information on the mangroves of Maharashtra, though significant, is difficult to synthesize and interpret because of varying conditions of data collection. It also requires a multidisciplinary and integrated approach to sort out the realistic and representative information for optimal management. The mangroves of Konkan are also being viewed for their conservation. Protection and rehabilitation of mangroves through the State Forest Department and other institutional efforts for the research and conservation are under stages of implementation. The sustainable use of the mangrove ecosystem can be achieved by a) knowing the exact mangrove resource b) knowing the traditional ways of their utilization, c) providing infrastructural support for its protection, conservation and maintenance and

d) enhancing local participation in conservation. In view of this, an attempt has been made to identify and assess various threats from the study area.

The diversity and distribution of mangroves along the Konkan coast indicates the sensitivity of mangroves to various environmental changes. On the same lines, biotic threats to this fragile ecosystem along the coast were identified and analyzed. The increasing anthropogenic pressures, in the form of conversion of habitats or pollution, are responsible for the decline in species level diversity of mangroves along the coast, as in the case of industrial expansion in the Thane district. At some places, few species have become locally extinct.

The representative threats in the Mumbai metropolis mentioned in this document can be broadly categorized into biotic and anthropogenic threats.

Biotic threats include infestation by *Hyblaea puera* and barnacles, and grazing by cattle. Clearing of mangrove forests for wood, slash and burn technique of agriculture, dumping of non-biodegradable solid waste, pollution due to industrial and sewage discharge have been major anthropogenic threats. The other major anthropogenic threats are conversion of mangrove forests to salt pans, aquaculture plants or to agricultural plots/residential plots/industrial plots and other land filling activities.

It must be specially mentioned that large quantities (few kgs) of various kinds of non-biodegradable solid waste was recorded along the sampling sites. This waste included polythene bags, milk and oil bags, plastic bags, thermocol, rubber in form of footwear and tyres and tubes, glass in form of bottles and bulbs etc. Pollutants like Lead, Zinc, Chromium, mercury etc. that have been reported to be present in the discharged water, take a heavy toll on the biota of this region.

The document also suggests many

recommendations for sustaining the biodiversity in these areas.

### Ongoing Research by the Mangrove Cell of Maharashtra Forest Dept.:

The Mangrove Cell launched a joint initiative with Shivaji University, Kolhapur to conserve some rare and ecologically important species in Maharashtra. Some of the potential mangrove species for the conservation initiative include *Cynometra iripa* Kostel., *Rhizophora apiculata* Lamk., *Kandelia candel* L. Druce, *Heritiera littoralis*, *Xylocarpus granatum* etc. The idea of this research initiative is to conserve endangered mangrove species by collecting seedlings of each potential mangrove species. This initiative attempts to conserve the seedlings in a 'mangrove conservatory' and distribute them for plantation at the habitat site. Brief outline of the research project is:

1. Survey and collection of seedlings: Germplasm will be maintained and established in actual habitat of mangrove species as well as in the Department of Botany, Shivaji University, Kolhapur.
2. Nursery techniques: Seedlings development and seed germination experiments will be carried out.
3. Nursery development: Seedlings of various mangrove species found in Maharashtra will be maintained.
4. Standardization of methodology: Nursery techniques for various endangered species will be standardized.
5. Field Experiments like developing a nursery, raising propagules etc.
6. Transfer of knowledge to the staff of Forest Department.

### Coastal and marine biodiversity

Different types of beaches prevail in Maharashtra which serve as important habitat for sea turtles, molluscs, crustaceans as well as the plant community. Many beaches in Maharashtra have *Casuarina equisetifolia* and *Pandanus* Plantations. *Pandanus* plantations along with mangrove forests which can help protect the



local communities from natural disasters like Tsunamis, cyclones etc. However, many beaches in Maharashtra today are experiencing an increase in high tide line.

**Awale Dipa and Phillot Andrea D. (2014): A review of the adverse effects of Casuarina spp. on coastal ecosystems and sea turtle nesting beaches. Indian Ocean Turtle Newsletter No. 19, January 2014,**

This paper summarizes how Casuarina plantations adversely affect the coastal ecosystems and the sea turtle nesting beaches. Casuarina plantations hinder the nesting activities of the marine turtles sometimes leading to the abandonment of nesting attempts. Presence of Casuarina plantations lowers the beach temperature thus affecting the sexes of the hatchlings. It is suggested that removal of Casuarina plantations should be taken at high priority at sites which have low nesting and hatching success. Physical removal of these plants may be better than use of chemical or biological methods of removal as that has minimal effect on the environment and the sea turtle nests. Instead, native tree species can be planted on the beaches in order to reduce erosion.

**Priya Parkar (2014): Conservation of Olive Ridley Turtles through community participation: A Case Study of Velas, Ratnagiri District; Online International Interdisciplinary Research Journal, ISSN2249-9598, Volume-IV, Issue-I, Jan-Feb 2014**

The current paper elaborates on the turtle festival held in Velas, Ratnagiri district under the stewardship of NGO Sahyadri Nisarga Mitra (SNM). The main aim of the festival is to foster active participation of the local community in turtle conservation and simultaneously increase their income. The paper concludes that it is necessary to perform the valuation of economic damage due to loss of biodiversity to the region. It can also be computed by assessing the economic value of maintaining biodiversity through conservation policies and other

means. The next suggested stage is to perform a meticulous review of cost-effectiveness of various alternatives in biodiversity conservation policies and instruments. Once the planning and related execution has been performed, the overall economic impact (gained income, jobs) due to implementation of policies must be studied to assess effectiveness and course correction.

**Apte, D., Bhawe, V., Pitale, R., Nagale, P. and A. Prasade (2012). A Preliminary Report on Diversity of Coastal Ecosystems of Maharashtra Part 3: Ecologically Sensitive Coastal Areas of Ratnagiri, Rajapur and Vijaydurg. Bombay Natural History Society, Mumbai.**

The primary objective of this study was to evaluate coastal habitats of Maharashtra with respect to diversity and to prioritize sites as biodiversity hotspots for conservation. The major habitats identified for the study were rocky shores, sandy shores, sand dunes, mangroves, mud flats, open ocean and salt pans. The study focused only on intertidal region and rocky, sandy and muddy shores including mangroves. Data on a few oceanic and nearshore species based on sightings by locals, fishermen and records from various literature sources have also been included.

Systematic biodiversity assessment was carried out at selected sites for three seasons in two consecutive years. For rocky shores, random quadrats were laid within different zones of intertidal area. Flora and fauna from the rocks as well as undersides of the loose rocks were noted and photo documented. The side walls of pools, pebbles and cobbles at the base of rock pools were also surveyed and collection was carried out for a systematic study. Opisthobranchs of Phylum Mollusca were used as one of the indices to describe rocky shore ecologically sensitive coastal areas.

Sandy shore habitat and biodiversity were studied using transects perpendicular to shore

line. 3 transects per km were laid and 3 samples were collected per transect. Topographical factors including shore profile, wave action which directly reflect on the fauna of sandy shore, were also taken into consideration. To study sand characteristics like particle size, color and texture, samples were collected along the transects. Seasonal changes in both, the faunal diversity and shore profile were also studied.

Epibiotic and arboreal faunal assemblages from muddy shores and mangroves were studied from 11 sites of mudflats and mangroves along the banks of major creek systems (Jaigad, Ansure, Nate, Bhatye and Vijaydurg). Site specific checklists have been attached in the annexures.

### Research on Sea turtles:

#### **Annie Kurian (2013): Marine Turtles along the Indian Coast: Distribution, Status, Threats and Management Implications. WWF Report**

The current distribution, status and threats to Marine turtles along the Indian coastline have been studied in this report. It is observed that the Eastern Coast serves as a mass-nesting site for sea turtles while nesting is sporadic along the Western Coast. State-wise information on turtle habitats and their nesting sites has been provided. It covers the coastal states of India, but due to limitation of resources, excludes the islands of Andaman and Nicobar and Lakshadweep. Distribution of marine turtles, their status and threats have been reported for Maharashtra by Mr. Bhau Katdare of Sahayadri Nisarg Mitra (SNM).

The Olive ridley turtles nest quite frequently along coastal Maharashtra from November to April. While beaches of Velas, Kelshi and Anjarle have been mostly used as nesting sites by Olive ridley turtles, other beaches such as Kolthare, Dabhol and Guhagar (Ratnagiri district), Maral, Harihareshwar, Velas, Diveagar and Srivardhan in Raigad district and Tambaldeg and Vayangani in Sindhudurg district are also used. These beaches have reported the nesting as well as monitoring

of nests by village volunteers for past three to ten years. A questionnaire was developed to collect secondary data on turtle nestings linked to social and physical factors from 160 villages.

Sahayadri Nisarga Mitra (SNM) has been monitoring 39 village beaches since 2002 and nests of Olive ridley turtles have been reported since then. However, nesting of the Green, Hawksbill and Leatherback turtle has not been reported across the 118 beaches surveyed. This survey shows that beaches from Raigad and Ratnagiri districts and few places in Sindhudurg district are potential nesting sites. Ratnagiri district had the highest nesting density for 2011-2012 with an average of 4 nests per km of the coastal stretch and also recorded the highest number of eggs and hatchlings released to the sea.

Green turtle nesting has not been reported in Maharashtra. However, local fishermen have reported the presence of adult and juvenile Green turtles near the coast. Records of dead Green turtles were found on some of the beaches.

No recent authentic record is available for Leatherback turtle. Hawksbill turtle has been reported from Nivti in Sindhudurg district, Ratnagiri and Velas in Ratnagiri district no nests have been found.

91% of the coastal villages have reported an annual increase in high tide line. This has led to submergence of the nesting sites at many places. Illegal sand mining is rampant on Srivardhan, Diveagar and Anjarle beaches which may have adversely affected turtle nesting.

The Maharashtra State Forest Department has now stopped Casuarina plantations on the beach since it hinders the nest building activities of the turtles.

Most fishermen who unintentionally catch turtles, release them back into the sea. But some fishermen do capture the turtles for their

Table 7  
Marine Turtle Nesting Statistics from 2002-2003 to 2013-2014

Year	No. of Nests Protected	No. of hatchlings released
2002-2003	50	2734
2003-2004	35	1687
2004-2005	31	1565
2005-2006	36	1624
2006-2007	62	1890
2007-2008	167	5517
2008-2009	155	7884
2009-2010	71	2851
2010-2011	81	3482
2011-2012	68	3555
2012-2013	83	3661
2013-2014	45	1795**

**\*\*Data excluding Dive-Agar**

*Data for 2011-2012 onwards is unpublished data (Source: SNM Library)*

meat and carapace. Often these turtles are sold illegally in local markets or within the community itself. Trade of carapaces occurs in some areas, where they are sold as show pieces.

Mechanized fishing activities have increased considerably over time. However, traditional fishing boats are also being used by many fishermen.

Poaching activities do occur in areas where there is no patrolling or protection. SNM has proposed to stop these activities by safeguarding non-protected beaches.

This report also highlights the ongoing destructive developmental activities on the coast. The threats to the turtles may intensify if the proposed 16 coal based power plants become operational. A huge seawall constructed at Dabhol has made it difficult for the turtles to find appropriate nesting sites. Similarly, seawalls constructed by the government near the high tide line to prevent erosion has also affected the turtle nesting activities. Increase in tourism over the years has also adversely impacted the nesting of the turtles.

### **Brad Nahill (2012): Best Practices for Sea Turtle Conservation Tourism. SWOT Report.**

This article reflects on how conservation tourism can benefit local communities as well as sea turtle programmes. It also highlights the adverse impacts of sea turtle tourism if not managed properly. These include habitat degradation, increase in solid waste on beaches, boat strikes and harassment of the nesting turtle females, thus affecting their behaviour. Other unintended effects of tourism have also been mentioned. A tourist program can be developed if different types of tourist markets are focused. Some other management practices have also been mentioned which can be followed easily.

### **Katdare Bhau (2012): An update on Olive Ridley Nesting along the West Coast of Maharashtra, India (2011-2012)**

This article provides the data for number of hatchlings released along the coasts of the villages monitored by SNM.

### **Various Reports of the Turtle Action Group/TAG:**

**Shenoy, S., T. Berlie, N. Namboothri and K. Shanker. 2010. Building a network for**

**conservation of marine turtles in India. Project report submitted to the USFWS. Ashoka Trust for Research in Ecology and the Environment, Bangalore. Tripathy, A. and K. Shanker. 2011. Building and Strengthening Network for Conservation of Marine Turtles in India. Project report submitted to the USFWS. Madras Crocodile Bank Trust and Dakshin Foundation, Bangalore.**

Tripathy A., N. Kale and K. Shanker. 2012. Strengthening the Network for Monitoring and Conservation of Sea Turtles in India. Project report submitted to the USFWS. Madras Crocodile Bank Trust and Dakshin Foundation, Bangalore.

The Turtle Action Group (TAG) is an association of over 25 NGOs and other organizations dedicated to sea turtle conservation and coastal protection in India which includes the mainland as well as the islands of Andaman and Nicobar and Lakshadweep. These groups initially came together on a common platform in January 2009 in order to share their knowledge and efforts on sea turtle conservation. TAG is represented by 10 coastal states, namely: Andhra Pradesh, Gujarat, Karnataka, Kerala, Lakshadweep Islands, Maharashtra, Odisha, Puducherry, Tamil Nadu, and Union Territory of Andaman and Nicobar Islands.

The primary aim of the project was to provide a platform for the exchange of information, knowledge and experiences amongst various groups and individuals working along the coast. In addition, the initiative sought to strengthen community based NGOs in the various coastal states through capacity building by providing grants, training and technical assistance. The project also sought effective engagement of network members with other stakeholder groups, research institutions and government agencies in order to better informed conservation actions. The overall objectives of the project are:

1. To support and expand the Turtle Action Group in India for improved and dynamic

approaches to sea turtle monitoring and conservation and ensure inclusion of all community based groups from around the country working on sea turtle conservation.

2. To establish appropriate channels of communication between partner organisations for effective sharing of information.
3. To build capacity and interest of local communities and students in coastal conservation through their involvement in monitoring programmes and training workshops.
4. To monitor the status of marine turtles at key sites along the Indian mainland coast and islands with the involvement of local communities.
5. To provide local context and synthesis that can support individual institutions in planning their own programmes.
6. To facilitate interaction of groups with a primary focus on sea turtle conservation with coastal communities, law enforcement agencies, academic institutions and the private sector.

As a part of this programme, a newsletter titled 'The Indian Ocean Turtle Newsletter' is being published. This journal is bi-annual and provides a forum for exchange of information on sea turtle biology and conservation, management and education and awareness activities in the Indian subcontinent, Indian Ocean region, and south/southeast Asia. The newsletter also intends to cover related aspects such as coastal zone management, fisheries and marine biology.

**Vishwas Katdare, Vijay Mahabal, Kapil Sahasrabuddhe, Rameshwar Fugare, Mahendra Todankar (2010): The Status of Marine Turtle Olive Ridley (*Lepidochelys olivacea*) populations on the Maharashtra coastline.**

This report provides the status of Olive Ridley turtles based on the information collected from fishermen, villagers, and concerned government employees working on the coastline

Table 8  
No. of Beaches Surveyed in Coastal Maharashtra by SNM (Excluding Mumbai and Greater Mumbai)

District	Number of beaches surveyed
Sindhudurg	44
Ratnagiri	61
Raigad	24
Thane	31
<b>Total</b>	<b>160</b>

Figure 7  
Various Beach types and their numbers for Maharashtra

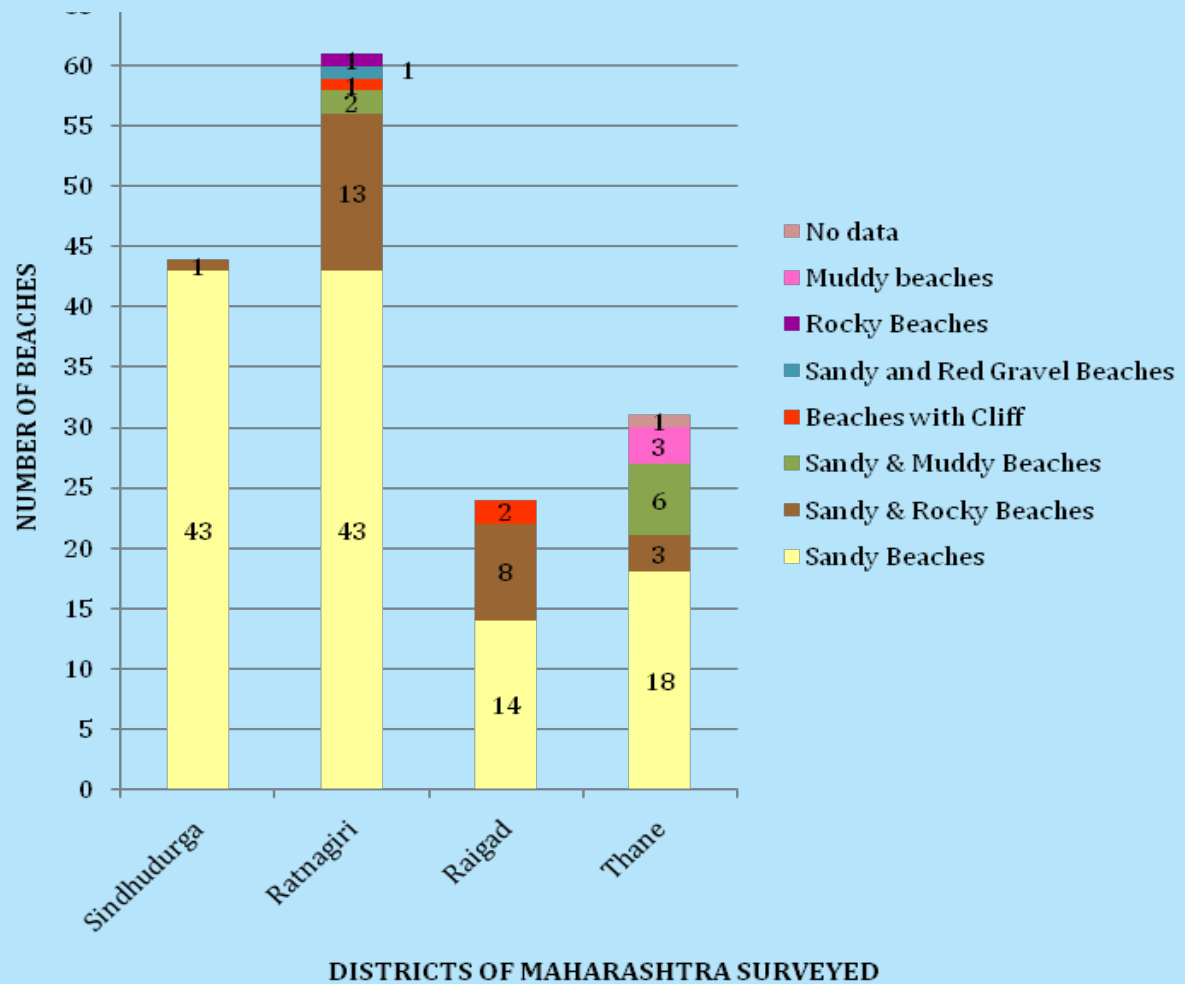
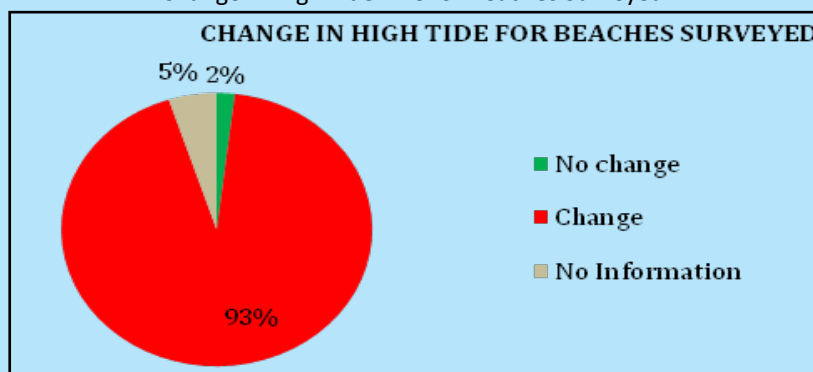


Figure 8  
Change in High Tide Line for Beaches Surveyed



of Maharashtra and turtle conservation work on west coast of Maharashtra.

Population surveys for Olive ridley turtles was attempted across almost all beaches of coastal Maharashtra in four districts: Thane, Raigad, Ratnagiri and Sindhudurg. 160 villages (including hamlets and padas) were systematically surveyed. The length of the beaches surveyed was more than 330950 m for all four districts. The number of beaches surveyed for each of the districts is given in the following table:

In addition, information like presence of Casuarina and Pandanus plantations, pollution along the coast, beaches affected by erosion, presence of erosion embankments etc. was also collected. It was observed that 35% of the beaches were devoid of Casuarina plantations while 61% beaches had plantations. No data was available for 4% of the beaches.

77% of the beaches surveyed had no Pandanus plantations along the coast while 19% beaches had them. 4% of the beaches had no data regarding Pandanus plantations.

Most beaches had a change in their high tide line across years. This has been depicted in Figure 8.

74% of the beaches recorded the presence of turtles while 24 % beaches had no turtles present. 2% of the beaches had no data. 61% of the nests were used for nest building by

the turtles whereas 33% of the beaches recorded no presence of turtle nests. No data was available for 6% nests.

Poaching turtles and their eggs is still prevalent at some beaches. This can be seen in the pie chart below.

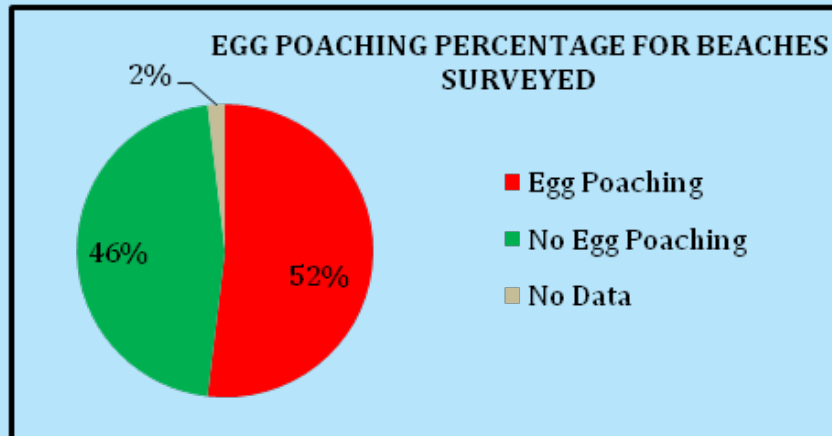
Many beaches along the Maharashtra coastline are getting eroded. 34% beaches come under this category while 65% beaches have no erosional activities. No data was available for 1% of the beaches.

In order to prevent beach erosion, few beaches have been modified with artificial embankment. 34% beaches have been embarked while there have been no embankment activities along the coast for 65% beaches. No data is available for 1% of the beaches.

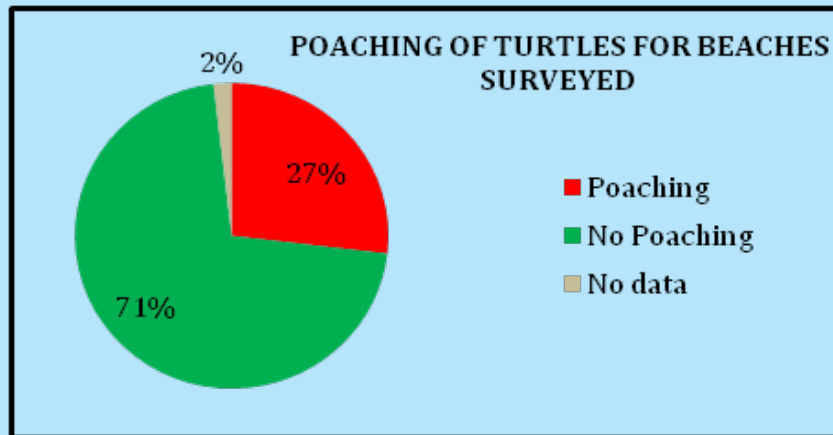
Ex-situ conservation is being carried out by creating nests in hatcheries. The eggs are protected from poaching and other predators and the hatchlings are released after they emerge from the eggs.

Villagers of Velas have initiated marine turtle conservation and established Kasav Mitra Mandal with SNM's assistance. They organise the annual turtle festival with the objective of conservation of sea turtles through community participation. Increasing the income of the locals through these activities is also one of the objectives.

**Figure 9**  
Percentage of Egg Poaching Activities



**Figure 10**  
Percentage of Turtle Poaching Activities



**Figure 11**  
Fishing Intensity Percentage along the Beaches Surveyed

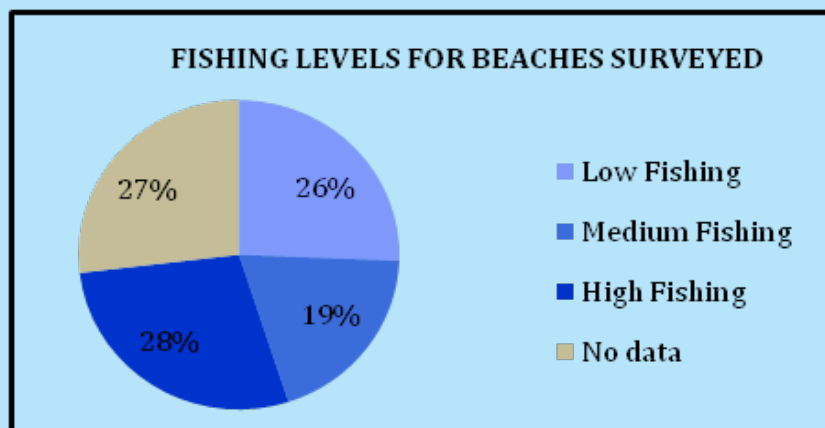
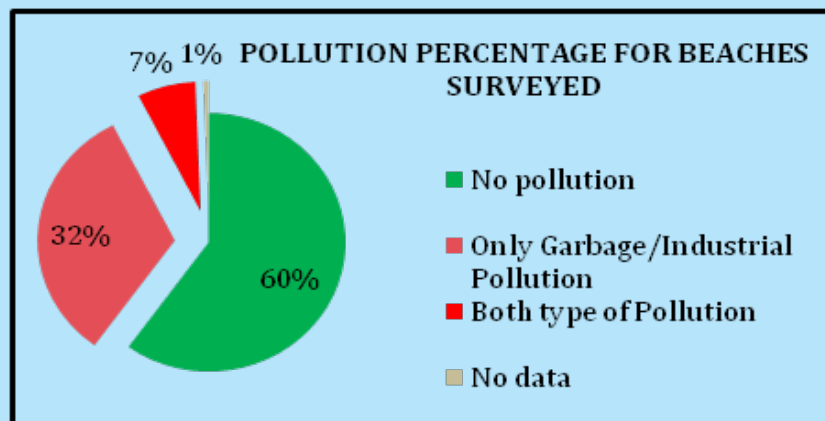




Figure 12  
Percentage of Pollution on Beaches



This study identifies absence of the incorporation of local stakeholders in decision making. Exploitation of eggs, directly taking of turtles and the lack of use of TEDs by trawling fleets are some of the other threats to Olive ridley turtles. However, SNM's effort in 30 villages has resulted to an increase in the number of protected nests of Olive ridley turtles. This study identified 30 potential nesting sites which need protection, which include Velas, Kelshi and Anjarle.

**Chaudhari, S., K. V. Devi Prasad and K. Shanker (2009): Impact of Casuarina Plantations on Olive Ridley Turtle Nesting along the Northern Tamil Nadu Coast, India. ATREE, Bangalore and MCBT, Mamallapuram, India.**

This study examines the possible impacts of Casuarina equisetifolia plantations on Olive ridley (*Lepidochelys olivacea*) turtle nesting beaches along the northern Tamil Nadu coast. The study was carried out across three habitats, namely open beaches, vegetated beaches and beaches with Casuarina plantations. All three sites lie along the northern Tamil Nadu coast, starting from the mouth of the Adyar estuary till Vadanemmeli, and are separated by an approximate distance of 40 km. Parameters such as beach slope, beach width and temperature of beach were measured to examine the effect of Casuarina on these beaches. Twelve quadrats of 4 X 4 m were laid to

examine the effect of Casuarina on native sand dune vegetation. Data on beach profiles and independent data on nesting was collected by patrolling these three types of beaches. Nesting data was collected for 45 days and a total of 47 nests were encountered. Nesting in beaches with Casuarina was significantly different from the other two types of beaches. Slope and beach width were also significantly different among the three types of beaches. The temperature at different distances from the high tide line showed a similar pattern across the beach types, but the mean temperature of beaches with Casuarina was significantly lower than in the other two beach types. This study suggests that Casuarina has potentially negative impacts on sea turtle nesting. Further, since it is an exotic, it may not be an appropriate specie for large scale plantation on the coasts of India. The study recommends that native species be planted, where appropriate, and that if Casuarina plantations exist, they should be at a minimum distance of 50 – 100 m from the High Tide Line.

**Berlie T., N. Namboothri, A. Mohan, and K. Shanker (2008): A Protocol for Ecological Monitoring of Sandy Beaches and Intertidal Fauna on the Indian Coast. UNDP/UNTRS, Chennai and ATREE, Bangalore, India.**

This manual was developed to provide a standard



protocol for monitoring sandy beaches by the beach managers. The recommendations are based on field tests and logistical and technical practicality of sampling over a large area. This protocol is designed for studies that cover a large area (more than 200 km/more than 10 sites). The manual is focussed on three major components that need to be monitored on a regular basis in order to characterise ecosystem health and understand nearshore processes: 1. Beach Profiling 2. Intertidal soft-bottom benthic fauna (macro and megafauna) 3. Biotic and abiotic parameters

**Shanker K., B. C. Choudhary and Chandrasekhar Kar (2007): Census technique for arribadas – Monitoring olive ridley sea turtles in Orissa.**

This manual was exclusively developed to count number of turtles during arribadas, which is the phenomenon of synchronous mass nesting as observed in Odisha, on the East Coast of India. Strip transect method along with the method for collecting data on egg laying females has been explained. This can be easily replicated where mass turtle nestings occur.

**Shanker, K., B. C. Choudhary and H. V. Andrews (2003): Sea Turtle Conservation: Beach management and hatchery programmes. A GOI-UNDP Project Manual Centre for Herpetology/Madras Crocodile Bank Trust, Mammallapuram, Tamil Nadu, India.**

This is the first manual in a series developed to educate Forest Officers, Conservationists, NGOs and wildlife enthusiasts for designing and carrying out sea turtle conservation activities. This guide provides information on setting up of a hatchery, collection and transportation of sea turtle eggs, management of a beach for ex-situ conservation methods, and methods of collecting data for successful monitoring of sea turtle nestings etc. Establishing a hatchery provides an excellent means for education and awareness amongst people. It also stresses that these conservation activities should be carried out and co-managed by the local community.

In addition to beach management regimes, an identification key, life-cycle of the turtles, and identification features of nesting tracks and nests has also been provided. List of field equipment required along with data sheets has been supplemented at the end of the manual.

**Shanker K., B. Pandav and H. V. Andrews (2003): Sea Turtle Conservation: Research and Management Techniques. A GOI-UNDP Project Manual Centre for Herpetology/Madras Crocodile Bank Trust, Mamallapuram, Tamil Nadu, India.**

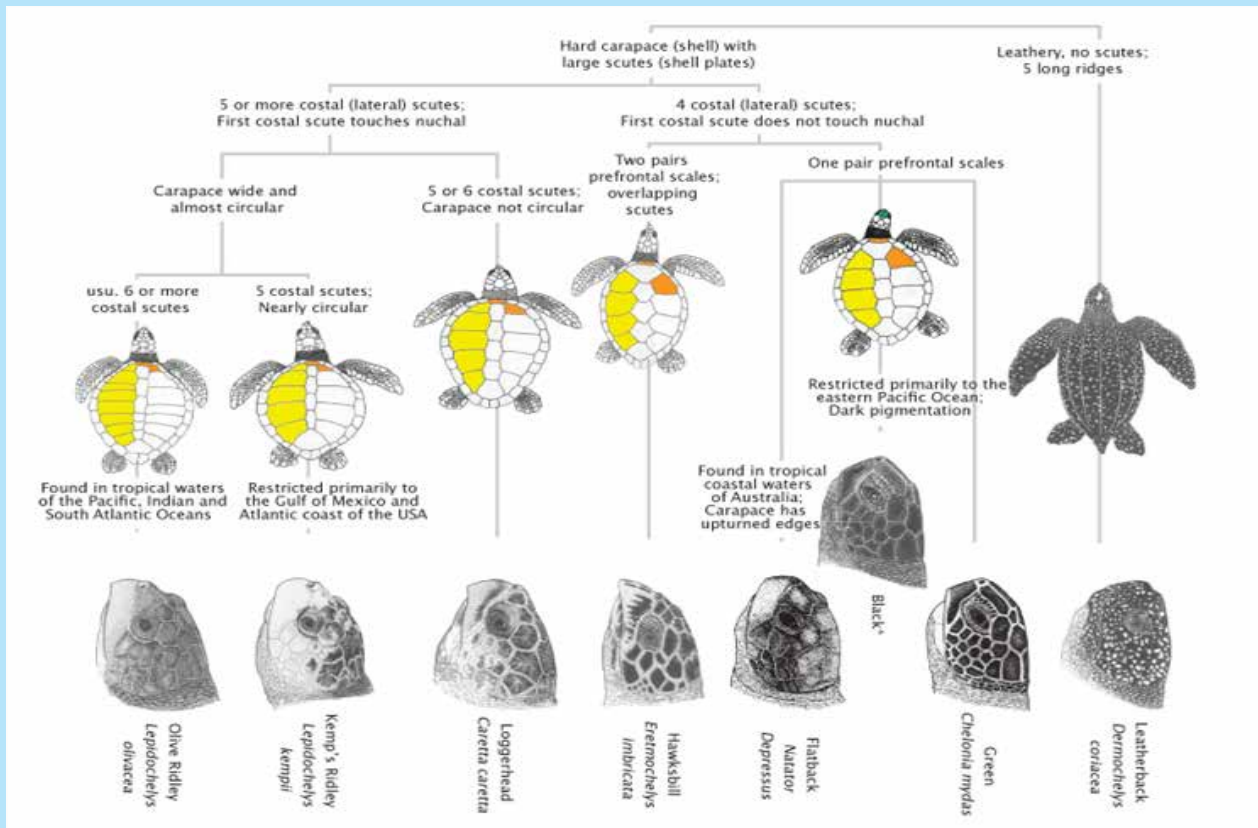
This is the second manual in the series which was designed to fill the gaps in conducting research activities for the purpose of sea turtle conservation. It acts as a guide for planning research activities, studying behavior and other areas where research needs to be conducted. It also has information on sea turtle conservation resources as well as information on sea turtle research programmes in India.

**Shanker K., B. Pandav and B. C. Choudhary (2003): Sea Turtle Conservation: Population Census and Monitoring. A GOI-UNDP Project Manual Centre for Herpetology/Madras Crocodile Bank Trust, Mamallapuram, Tamil Nadu, India.**

This is the third manual in the series which deals with the population census techniques, methods of estimating the size of the population as well as sources of error while collecting this data. It also provides information on conducting habitat surveys, methods of collecting secondary data and the methodology for conducting market surveys. It also supplements with quantification of the threats and presents information on data analysis.

**Choudhary B. C., B. Pandav, B. Tripathy and H. V. Andrews (2003): Sea Turtle Conservation: Eco (turtle) friendly coastal development. A GOI-UNDP Project Manual Centre for Herpetology/Madras Crocodile Bank Trust, Mamallapuram, Tamil Nadu, India.**

**Figure 13**  
**Identification Key for Sea Turtles Found along the Indian Coast**



The fourth manual in the series provides information on the different threats the beaches are experiencing and ways in which these can be addressed. Threats on the beach, in offshore waters, and threats due to aquaculture and tourism have been mentioned separately.

A revised edition of all these four manuals was released in 2011 which can be cited as: Sea turtles of India. 2011. A comprehensive field

guide to research, monitoring and conservation (Compilers. S. Shenoy, T. Berlie and K. Shanker). Dakshin Foundation, Bangalore and Madras Crocodile Bank Trust, Mamallapuram, India.

Dakshin Foundation has designed an identification key for all types of sea turtles encountered on the Indian Coast. This can be widely used for educating people about turtle conservation.

### Box 3

#### Gaps and Recommendations for Biodiversity Management in CMPA

##### Short-term Recommendations:

1. This desk review does not cover Bachelor's and Master's Dissertations on coastal and marine biodiversity and ecosystems by various students from the coastal districts and other neighbouring areas due to restrictions on time and resources. Hence, it is recommended to review them before any biodiversity related study is initiated. Based on the analysis of information available through this compilation, identification of threats to these areas is also necessary. These can be very crucial inputs for formulating the baseline of management strategy of these areas.
2. Identifying areas of research and collaboration with academic and research institutes to develop authentic database will be used for CMPA management.
3. A study on diversity and composition of floral and faunal species will be helpful in understanding the health of ecosystems, uniqueness of CMPA and sustainable economic use by the surrounding community.
4. Mapping of habitats like sandy and rocky shores, mud flats, areas preferred by turtles for nesting, Casuarina plantations, and listing disturbances in these habitats, if any, may help in evolving conservation strategy for species, ecosystems and habitats of the proposed CMPA. Based on analysis, mid-term and long-term conservation plan can be prepared through a participatory process.
5. Research on mangrove ecosystem for classification based on zonation and canopy density, along with disturbances, may help for its better management.
6. The mangrove ecosystem owned by various Government agencies to be handed over to the Forest Department. A communication campaign to be conducted for private landowners on legislations applicable to mangrove conservation.
7. The current conservation activities for sea turtles should be continued and expanded if all necessary resources are available. A study on efficiency of TEDs followed by plan to manufacture and use TEDs. Local fisher folks may be trained and incentivized for the use of TEDs.
8. A training module and Marathi booklet to be developed for training of volunteers involved in protection of turtle nests and management of hatcheries.
9. Buffer zone may be created in CMPA to limit anthropogenic activities. This would restore the breeding grounds of the fishes.

##### Long-term Recommendations:

1. Habitat mapping and beach profiling studies to be conducted to assess effects of Casuarina plantations on turtle nesting. Based on the analysis of such studies, an initiative to control/reduce Casuarina cover may be undertaken by the Forest Department.
2. CMPA management to establish formal and informal partnerships with national and international networks, NGOs, CMPAs to enhance knowledge of CMPA management. Some suggested networks/institutions are Turtle Action Group, Mangroves for Future, Ramsar Wetlands Group.
3. The community conservation approach of turtle conservation should be encouraged and scaled up to other villages of Kelshi and Anjarle.

## Chapter 5

# Ecotourism

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The Konkan region boasts of several places of geographical, cultural and architectural interest and the coastline is well endowed with beautiful beaches. Though tourism is mostly restricted to religious places such as Shrivardhan-Hareshwar, Hedvi-Velneshwar, Ganpatipule, Pawas and Kunkeshwar, the sandy beaches and forts of north Konkan are also beginning to attract visitors. Palghar, Dahanu, Tarapur, Vasai, Alibag, Ratnagiri, Malvan and Vengurla are some of the major towns along the coast. With increase in coastal tourism, a number of resorts have sprung up in the Konkan region, though many such facilities are in violation of the Coastal Regulation Zone (CRZ) Notification.

The annual 'Turtle Festival' at Velas is receiving increasing popularity and attracts a large number of tourists who flock here to witness turtle hatchlings make their way to the sea. The festival is hailed as a fine example of combining conservation with livelihoods. At the same time, as IUCN (1992) lists tourism as the second major threat to environmentally fragile areas, there is a need to develop a practice of 'Ecotourism'. The

World Conservation Union (IUCN) and Ecotourism Society defines ecotourism as "responsible travel to natural areas that conserves the environment and sustains the well-being of the local people". Maharashtra Tourism Development Corporation (MTDC) was established under the Companies Act, 1956 for systematic development of tourism on commercial lines. MTDC is fully owned by the Government of Maharashtra. In order to initiate ecotourism activities in these areas, MTDC along with Gram Panchayats, Forest Department and other stakeholders can run participatory activities.

Research papers obtained on this topic also suggest ecotourism as a solution to resolving conflict between conservation and community needs in the Konkan area.

**Patil Sardar (2012): Sustainable Tourism Development in Konkan: A need of Time. Electronic International Interdisciplinary Research Journal, Vol. I, Issue III, May/June 2012.**

This study was undertaken to review tourism

development in the Konkan region of Maharashtra and to do its SWOT analysis. Accordingly, recommendations for sustainable tourism development were suggested.

Field investigations and observations for primary data collection and informal personal interactions for verification of the data, was the methodology adopted for this study. Secondary data was collected from government offices, Survey of India toposheets and maps, books, journals, newspapers and several websites.

The paper highlights the fact that the geography and the history of this region has contributed to the development of tourism in this region. The length of the coastline is dotted with many scenic and attractive beaches, temples, forts, hot springs and waterfalls. Authentic Konkani cuisine along with the hospitable nature of the local communities, has further made the region attractive for visitors. Connectivity through Konkan railway and proximity to Mumbai International Airport have made the area more accessible.

A few popular places along with the lesser known tourist destinations have been mentioned in the study. Kelshi is listed as one among the popular beaches that attracts domestic as well as foreign tourists. Bankot Fort near Velas is also a popular tourist destination along with the Ganesh temple (Kadyavarcha Ganpati) at Anjarle.

The weaknesses mentioned are attitude of local population and visitors, migration of people to big cities for better jobs, undulating physiography which hinders the development of transport network, lack of entrepreneurship among local people, lack of innovations in the locality, lack of cooperation from the natives of the region, lack of analytical data and lack of quality human resources.

Environmental degradation due to conventional tourism, damage to the natural features and cultural monuments due to various developmental activities, possibility of terrorist

attacks from the sea and competition with other neighbouring coastal states are the threats faced by this area.

The study underlines the opportunities for developing ecotourism in this area and suggests the following measures:

1. NGOs, private owners and local government bodies should collaborate to invest in these areas to enhance the potentiality of the tourism industry.
2. Training in local language as well as foreign languages should be imparted to local people so they may guide the tourists about the area's natural and socio cultural heritage and the need to conserve it.
3. Native food and food products of Konkan can be marketed among tourists to help maintain food diversity. These food items include Dink laddoo, Kulthache pithale, Dalimb bhat, coconut water, Kokam sharbat and Kokam soda, Bangda fry, fish fry, mango juice etc. Seasonal fruits can also be sold.
4. A Tourism Information System should be initiated as part of planning and development of tourism industry.
5. Social media should be used to publicise tourist destinations.
6. Visitors and the locals should be encouraged to use eco-friendly products to reduce damage to the environment.
7. The hospitality standard of the local people (hosts) should be enhanced through training.
8. MTDC licenses to be given to only those who provide quality service to tourists.
9. Interdisciplinary and applied research should be regularly undertaken in order to initiate new practices for enhancing ecotourism.

**Lad Devdatta (2013): Ecotourism development in the Konkan region of Maharashtra: A Review. Scholars Academic Journal of Biosciences (SAJB)**

The paper identifies places in the Konkan area which can be developed into ecotourism spots. It concludes that ecotourism can generate job opportunities for the youth in their own villages which would help reduce migration to nearby

cities for jobs. Ecotourism can also improve the socio-economic condition of the people residing in Konkani and can ultimately help to earn foreign exchange for the country.

**Sawkar Kalidas, Noronha Ligia, Mascarenhas Antonio and Chauhan O. S. (undated): Issues of concern in the Coastal Zone of Goa**

This paper highlights the issues and implications of tourism on the coastal, marine and socio-economic environment of Goa. Ever since tourism was adopted in 1961 as a key component for the development of Goa, beach tourism has been and is being encouraged by policy makers and concerned parties.

Following impacts have been observed:

1. There has been a very rapid and uncontrolled growth of tourism in Goa.
2. The seasonal nature of tourism has led to swings in employment and income, most markedly related to small scale industries and to unskilled workers.
3. The locals were not involved in policy and decision making process, as a result, the policies introduced did not take into consideration the needs of the local communities.
4. Overcrowding of beaches, unsustainable development along the coastal strip, violation of regulations by the hotel lobby etc. have put a tremendous pressure on the natural resources. This has also led to a decline in area under agriculture.
5. It poses major changes in land use, shortages of natural resources, such as land and water, and damage to coastal aquifers, the sand dune system, and mangrove vegetation.
6. Tourism related anthropogenic activities have destroyed the spawning and breeding grounds of the fishes and other marine fauna. This has led to a decline in traditional fishing activities.
7. There has been habitat degradation along the coasts; highlighting that the sustainability and conservation related norms have been ignored.

The paper suggests some actions to be taken:

1. A study on sustainability of tourism and its impact on Goa should be undertaken. The environmental impacts of tourism and its valuation should be integrated in the decision making process. Factors that make the Goan coast a preferred destination should be studied too.
2. Recognition that tourism should not permanently change the face of the sea coast in the long run.
3. A monitoring and regulatory system that ensures an effective implementation of coastal regulations needs to be introduced. This can keep in check all illicit activities and also effectively monitor the ecosystem, social and economic changes along the coast.
4. The integration of the principles of coastal environment and ecology into the planning stage of any coastal activity, as a preventative rather than a remedial measure should be followed.
5. An Environmental Impact Assessment study of estuaries, backwaters and all coastal stretches needs to be undertaken.
6. Policies which recognize the type/s of interconnections between tourism, local communities and the environment need to be introduced, to ensure that tourism contributes to a sustainable development agenda.

In order to balance nature and anthropogenic activities, the government should promote environmentally sustainable livelihood options as well as carry out environmental education and outreach activities. Villages can be developed into ecotourism model sites. Following steps can be followed for establishing ecotourism:

Short-term Recommendations:

1. Home-stay model to be strengthened and continued at all the potential ecotourism sites. The MTDC should communicate the model and its guidelines to the villagers. Interested villagers to be trained for ecotourism.
2. The tourists should be provided with the



information about the CMPA covering particularly- (i) what to see; (ii) how to see; and (iii) how to behave.

3. Guided tours should be provided so that visitors stay on specified routes and do not trample vegetation or disturb animals, and that noise and the use of light at night (e.g. during visits to turtle nesting beaches) is minimized. Local population to be trained for guided tours.
4. Compost generated (output of the wet waste) can be sold to tourists or to nearby market places. This can provide additional revenue.
5. This area harbours a mangrove ecosystem which needs to be conserved and can act as a very important aspect from environmental education point of view. Efforts can be taken to make these areas as one of the most special sites to be visited.
6. Take away products can be designed as souvenir for the tourists. These mementos can help to reach and sensitize more people.
7. A guest book should be provided to visitors for noting their suggestions.
8. A rating system should be developed for home-stay providers depending on the quality and quantity of services they provide. This will help tourists to select appropriate home-stay type and minimize conflicts.
9. Based on Turtle Festival experience and standard international guidelines, SNM and MTDC may develop a guiding manual for effective eco-tourism in Konkan area.

A holistic eco-tourism plan covering all stakeholders and management aspects may be developed and implemented in a phase wise manner.

10. If ecotourism grows beyond a certain limit, several environmental problems, cultural and social changes, disruption of traditional economic activities may occur. Even the local population may not be willing to accommodate and host tourists beyond a certain limit. This problem may be mitigated by finding the carrying capacity of the region. The carrying capacity can be physical, social or economic. The Delphi technique can be used for the identification and assessment of the impacts of the tourism. Till this study is undertaken, tourism can be developed on above guidelines.

#### Long-term Recommendations:

1. Restrict/regulate the number of tourists coming at a time to reduce the pressure on infrastructure and ecology of these areas. Pre-registration of tourists can be made mandatory. The local people can form a system to streamline this process. This would restrict new construction activities like setting up of new hotels with private rooms.
2. In long term, the respective gram panchayats should give due consideration to turtle tourism and set up local committee to monitor and regulate turtle tourism for sustainability.

## Chapter 6

# Livelihoods Options for the Locals in CMPA

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Livelihoods of people are often dependent on the natural resources available in the area where they reside. Based on the interaction with Mr. Mohan Upadhye, Secretary of Kasav Mitra Mandal, Velas, some insights were obtained about livelihoods in the Konkan area.

Agriculture and fishing are the two main occupations of the people in this region. While agricultural activities are chiefly carried out in low-lying plains, fishing is predominantly in coastal and estuarine areas. The main food crops are rice, ragi, vari and cereals like green and black gram. Considerable area is occupied by orchards of coconut, mango, areca nut, cashew, condiment and spices. Other minor occupations include livestock, forestry, mining, household industry, trade and commerce. Salt pans are also present at a few places in the Konkan region.

Paddy cultivation is carried out during the monsoons and about 60% of the total population of Velas (582 people according to Census 2011) is engaged in it. Ratna (hybrid variety from Agricultural College, Dapoli) and

Suvarna (traditional variety) are the two main types of paddy cultivated. The total yield is more than sufficient for all households in the village. However, these days, many farmers have stopped cultivating traditional rice varieties and switched to hybrid rice.

About 50% of the total population is dependent on coconut and areca nut plantations while 60% have their own mango orchards. Some who don't have their own orchards, rent other villagers' orchards and share expenses and profits. Some are also involved in rabi farming and Paavta (*Phaseolus lunatus*) is the crop cultivated. However, due to an increase in salinity of the soil, many people have stopped cultivating it.

Household industries include processing of cashew nuts, in which freshly harvested cashew nuts are dried using a dryer and packed as whole, half or as chopped flakes. This activity is carried out in almost all households in Velas. Some families are also involved in the year round business of making maadi (a fermented drink made out of coconut leaves).



Table 9  
List of Tree Species Commonly Used for Boat Construction

Sr.	Local name of the tree species (Marathi)	Scientific name of the tree species
1	Saag	<i>Tectona grandis</i>
2	Hirda	<i>Terminalia chebula</i>
3	Ain	<i>Terminalia alata</i>
4	Shivan	<i>Gmelina arborea</i>
5	Aamba	<i>Mangifera indica</i>
6	Bivla	<i>Pterocarpus marsupium</i>
7	Undi	<i>Calophyllum inophyllum</i>
8	Bhend	<i>Thespesia populnea</i>

Two of the households are involved in occasional fishing along the coast. However, they restrict their fishing activities from October to May. Providing lodging and boarding facilities to tourists is a seasonal livelihood option for these fishers. There are 19 households which provide home-stay facilities, while 2 households provide only meals for the tourists in Velas. Some people are also hired as full time drivers for vehicles. The same scenario exists in Kelshi and Anjarle.

There are 9 SHGs (Self Help Groups) in Velas village of which almost 7 are involved in the making and selling of incense sticks. One SHG is involved in the making of paper and cloth bags and the other in cleanliness related activities.

Mariculture is also being practiced in Raigad district. Prawn species are cultivated in an area ranging from 2 to 25 ha by converting mangrove swamps into aquaculture plots. However, these activities increase the salinity of that plot, rendering it unsuitable for later use. Presently

many privately owned lands in Ratnagiri and Sindhudurg districts have been abandoned due to absence of potential commercial market.

#### Source: Katha Kokan Kinaryachi

Construction of boats and ships is one of the occupations on the coastline. Boat building is done using the wood of 16 indigenous tree species which are generally found in the forests. Of these, the following 8 tree species are most widely used for boat-building:

The above mentioned tree species have ceased to exist in the Konkan area due to large scale cutting of forests. These tree species grow very slowly and obtaining revenue from them is a time-consuming process. Recognising the need to undertake plantation of these tree species, local villagers have suggested the use of their land by the forest department or the land which comes under Joint Forest Management. Forests having these tree species should be protected from any kind of destructive activities.

## Box 5

### Recommendations for Livelihood Options

#### Short-term Recommendations

1. A study of livelihoods directly and indirectly dependent on fishing and allied industries may give an idea of dependence of local population on CMPA area. Based on the results and analysis, a sustainable livelihoods plan may be prepared.
2. Mapping of CMPA management activities and scope to involve local population in skilled and unskilled activities may generate support to CMPA among local stakeholders. For ex. local SHGs may be involved in waste management of CMPA.
3. Aquaculture activities, if necessary, should be regulated and carried out only at places where the mangrove ecosystem is degraded.
4. New livelihoods based on biodiversity, such as eco-tourism, home stays, boat rides, making and marketing of plates and bowls from leaf matter, making and selling of local food products may be encouraged.

#### Long-term Recommendations

1. Fishing activities should be carried out as per the restrictions laid down by the traditional/State/Country level regulations and laws. All rules and regulations should be communicated to the local population and visitors of the area.
2. It is recommended to plant native tree species on the land under JFM. The wood can be used for sustainable harvesting for boat construction. This would also help in maintaining the ecological balance and reduce exploitation of mangroves for wood.
3. Many success stories of processing agricultural produce of Konkan have been published in the local agricultural paper 'Agrowon'. These may be referred to for making sharbats from the fruits of Garcinia, Carrisa etc. Tourists visiting the CMPA will be the main target for selling these food products.

## Chapter 7

# Traditional Knowledge, Practices and Socio-Cultural Aspects on Managing Natural Resources

Indigenous knowledge is developed by a community based on its' experience of the local environment and culture. This knowledge has been developed over time and continues to evolve. Local people's knowledge about ecology and ecological processes has been developed due to their close association with nature and that is the reason they have a better understanding of their environment. These aspects of traditional knowledge cannot be overlooked while managing CMPAs.

Festivals which bring together all people for celebration also use natural resources for various activities. Understanding how these resources have been used over time, changes in the usage of these resources and the necessity for intervening should be understood to conserve and protect these areas.

### Agriculture

Rice has been cultivated in Velas, Kelshi and Anjarle for many years while plantations of mango and cashew have come up only recently, after

Ratnagiri district was declared a horticultural belt in 2003. Government of Maharashtra's subsidies brought large areas under mango and cashew plantations for which there were no pre-existing traditional practices, particularly in these three villages. Whereas, traditional farming practices have been followed for rice cultivation in these villages.

Raab is an age-old practice followed in the Konkan region in which farmers burn the piece of land where a rice nursery is to be raised. This consists of burning cow-dung cakes, lopping tree branches, dry leaves, grass, byre waste etc. by making layers on the paddy seed-bed area. There is a variation in the material used for Raab due to ecological reasons, vegetation, availability of material and location of the fields. Rabbing is a sort of partial sterilization of the soil. It improves the physical structure of the soil and increases availability of nutrients in the soil. The practice is, therefore beneficial in raising vigorous seedlings but it involves wastage of valuable organic matter, which can preferably be used for making compost.

## Fishing:

Some community members from Konkan have been engaged in fishing for many generations. The traditional fishermen of Raigad district belong to various castes and creed such as Bhoi, Gaabit, Khaarvi and Koli. Of these, Gaabits, Khaarvis and Kolis also reside in the Ratnagiri and Sindhudurg districts (Gole, 1997).

These fishermen build their own fishing boats which can measure 3 to 6 meters in length and 2 to 9m in width. They weigh anywhere between 4 to 9.5 tonnes. The fishermen knit different kinds of nets for different seasons. 'Raapni' is a traditional method of fishing in which many fishermen come together to catch fish in a defined area. They use traditional fishing boats and catch a limited number of fish. Once they return to the shore, the catch is sorted and unwanted fish is thrown back into the sea to serve as food for avifauna and other animals. The unwanted fish is sometimes kept aside for making bio-fertilizers. If water snakes get caught in the fishing nets, they too are released back in the sea. The good catch is shared equally amongst the fishermen participating in 'Raapni'.

At times, fishermen from neighbouring villages come together and demarcate areas in the sea for fishing activities by each of the villages. This system helps establish an amicable environment for carrying out fishing activities by the concerned villages.

Traditional fishermen in the Konkan area cease all fishing activities during the monsoons as that is the breeding season for many fish species. As the newly emerged hatchlings grow and develop, they provide a huge benefit to fishermen when they resume work post monsoon. However, now large mechanized boats carry on with their fishing activities in the deep sea, irrespective of the season, which reduces the total fish catch for the next season.

Listed below are some of the other practices followed by traditional fishermen to conserve marine fauna:

### 1. Appropriate time to start fishing activities:

They normally start after Narali Purnima or after Krishna Janmashtami at some places, while others start from September. Fishing activities resume only after performing religious rituals.

### 2. Seasonal and spatial ban on fishing activities:

A total ban on fishing activities from May to Narali Purnima (which is the breeding season of the fishes) is imposed at most of the places. No fishing is carried out during annual festivals. Most fisher folk also restrict fishing for 20 days during Holi. There are also some no-take zones identified.

### 3. Diet Practices:

Consumption of fish is avoided on fasting days and abandoned during monsoons. At some places, fish meals are avoided at least once a week.

### 4. Fishing practices:

Fishing activities start only after performing puja of the traditional fishing boat and gear.

### 5. Conservation approaches:

Fishermen consider sea turtles sacred and an incarnation of god and therefore, do not kill them. Timber that is used for building boats is not extracted from the sacred groves. People who do not follow these traditional practices are abandoned from the community.

Increase in mechanized fishing has definitely grown the total production but has also introduced new threats. With more boats entering the sea, the breeding process of the fishes has been disturbed, thus not allowing for replenishment of the fish stocks. Many new large nets with very small pores have been introduced which do not allow hatchlings to escape. This impacts the catch for the next season. With mechanized boats, there is also an increase in the frequency of fishing in shallow waters which is a breeding ground and habitat of hatchlings.

Dr. Gole's report states that many fishermen were aware of the situation and suggested that

the breeding grounds of the fishes should be protected. Rocks immersed in the sea, roots of the mangroves and places where sea-grass grows are important habitats where fishes breed and their hatchlings grow. Hence, in their opinion, these micro-habitats should be conserved.

**Nirmale Vivek H., Sontakki Bharat S., Biradar R. S. and Metar Santosh Y (2004): Assessment of indigenous knowledge of coastal fisherfolk of Greater Mumbai and Sindhudurg districts of Maharashtra. Indian Journal of Traditional Knowledge, Vol. 3(1), January 2004, Nirmale Vivek H., Sontakki Bharat S., Biradar R. S., Metar Santosh Y and Charatkar S. L. (2007)**

Use of indigenous knowledge by coastal fisherfolk of Mumbai district in Maharashtra. Indian Journal of Traditional Knowledge, Vol. 6(2), April 2007, These studies were conducted to gain access to the traditional knowledge of the fishermen and validate it scientifically. Data was collected with the help of semi-structured interviews in ten randomly selected fishing villages. Non-participant observation was also carried out. Seven criteria were used for validity assessment. It concluded that the indigenous knowledge of coastal fishermen on various fisheries management aspects like

choice of materials, methods of fishing and fish processing, their perceptions of the effect of the colour of water, wind direction, lunar cycles, tidal fluctuations was by and large based on scientific rationale and efficient use of natural resources. This knowledge can be correlated with existing scientific and technical advances for sustainable management of local resources.

**Sinha Kirti, Mishra N. P., Singh J and Khanuja S. P. S. (2004): Tinospora cordifolia (Gududchi), a reservoir plant for therapeutic applications: A review. Indian Journal of Traditional Knowledge. Vol. 3 (3), July 2004**

This paper documents the medicinal uses of *Tinospora cordifolia* which is found along the Konkan coastline. It is known by the name of Gulwel in Maharashtra and has been used by tribals and fishermen to treat leprosy, asthma, fever and anorexia. It is also used in the treatment of jaundice, gout, skin infections, piles, diabetes, chronic diarrhea and dysentery. Gulwel has also been used for promoting longevity and for curing itching.

There are many such medicinal plants which can be found in the kitchens of Maharashtra but traditional knowledge hasn't been exclusively documented in the Konkan region.

#### Box 6

##### Gaps and Recommendations in Traditional Knowledge and Socio-cultural Aspects

###### Short-term Recommendations

1. Traditional knowledge of the people residing in these villages has not been documented exclusively. A study can be conducted which can be utilized for making the management plan.
2. Traditional fishing practices and customs should be encouraged. A study on impact of mechanized trawlers on marine fauna with a focus on turtle migration to be conducted. A plan to regulate fishing in shallow waters, especially during the breeding season, to be prepared through consultation with local fisherfolk.
3. The tradition of not fishing during monsoon allows replenishment of fish stock through breeding. Such practices should be encouraged.

###### Long-term Recommendations:

1. Ganesh idols made up of traditional clay (Shadu) were used during Ganesh Festivals. These idols do not cause any damage to the environment when immersed in sea/lake/river water. However, these days, idols made of plaster of paris are used for worshipping. These idols, when immersed into the water release gypsum, phosphorus and other metals like mercury, lead etc. These adversely affect the marine life. Hence, sale and purchase of idols made of plaster of paris should be discouraged/banned in these areas. If these idols are used, they should not be immersed in the sea water. Instead, artificial tanks should be constructed and utilized for this purpose.

## Chapter 8

# Industries and Pollution in and around CMPA

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Bauxite deposits found in Dapoli & Mandangad have attracted many mining industries. In Dapoli, deposits are found in Anjarle, Chikalgaon, Kavdoli and a few other places. Deposits of ilmenite, limonite, silica and clay are found in Ratnagiri District. Clay is mostly used for making bricks, tiles and cheap red glazed wares.

Bauxite mining was prevalent for 8-10 years in Velas Sakhri, till it was stopped in 2011 based on Western Ghats Ecology Experts Panel's recommendations. At Kelshi and Umbershet, mining is still evident as the mining company is not following mandates laid down by the government.

There are seven industrial areas in Ratnagiri district with various renowned medium and large scale companies operating in the area. Their details were obtained from a report on micro, small and medium enterprises submitted by MSME Development Institute Mumbai and the website of Maharashtra Industrial Development Corporation, Ratnagiri.

The major industrial centers in this area are Ratnagiri – Mirjole, Dapoli (Mini) and Devrukh (Sadavali). Many industries are located along the banks of rivers or along the coastal area. Some of them have been depicted in Figure 14.

The table in Annexure 8a. shows the large scale industries present in these seven industrial estates. Many of the industries are either chemical or industries affiliated to the engineering sector. Locals had opposed the establishment of many of these industries in their areas as they would pollute drinking water sources and hinder with their livelihood activities. Ratnagiri Gas & Power Project Ltd. was started after the closure of the Enron Power Plant. The activities of three other companies viz. J S W Energy, Finolex and Bharati Shipyard Ltd. have affected the livelihoods of the locals in a big way. Fishing communities staying in the vicinity of these areas have had to discontinue their traditional fishing activities due to destruction of the mangrove ecosystem for constructing private jetties. Dredging activities for creating pathways/channels for the private ships of these companies have destroyed marine



**Figure 14**  
**Industrial Areas in Ratnagiri District**



biodiversity. Instances of fishing licenses taken away forcibly from the fishermen have also been reported.

Similarly, farmers have lost productive agricultural lands for the purpose of construction of infrastructure of companies and are now left with no other livelihood option. Local communities are even deprived of basic necessities like potable drinking water, since industries have polluted ground water resources. As there are no reliable numbers/official statistics, this information was obtained from some books in Marathi that talk about the current scenario of developmental activities happening/proposed in Konkan area.

### **Adverse Impacts of the Industries on the livelihoods of people:**

**Source: Kokan Jaltana, Sachin Rohekar**

Ratnagiri district was declared the star horticultural district of the state in the year

2003 by the Maharashtra Government. A large area was brought under cultivation of mango and cashew after the state government declared almost 100% subsidy for these two crops. The famous Alphonso mango also found its place in the international markets for its quality and taste. However, the upcoming thermal power generation projects are located in the same belt which gives the highest yield of alphonso mango. Other crops like cashew nut, coconut, kokum (*Garcinia* sp.) and some spices and condiments are also grown in this area. About 0.45 million people are dependent on horticulture for their livelihoods. A study conducted by the Industrial Toxicology Research Centre, Lucknow, revealed that the quality and yield of mango declines due to the sulphur dioxide released by the thermal power plants. Acid rain may prevail during winters in the area of 15-20 km surrounding the power plant. This is detrimental to the growth of mango flowers which bloom during winter.

**Box 7**  
**Recommendations for Management of Impacts of Existing Industries**

**Short-term Recommendations:**

1. A holistic regional environment impact assessment study can be conducted to understand whether and how industries of Ratnagiri and adjoining districts pollute the coastal and marine environment.

**Long-term Recommendations:**

1. Based on findings of the study, impact prevention and mitigation plan to be developed and implemented through partnership of Government agencies and industrial conglomerations.
2. Develop means to involve industrial sector in management of CMPA through employee engagement initiatives, sponsorships, technical cooperations etc.



## Chapter 9

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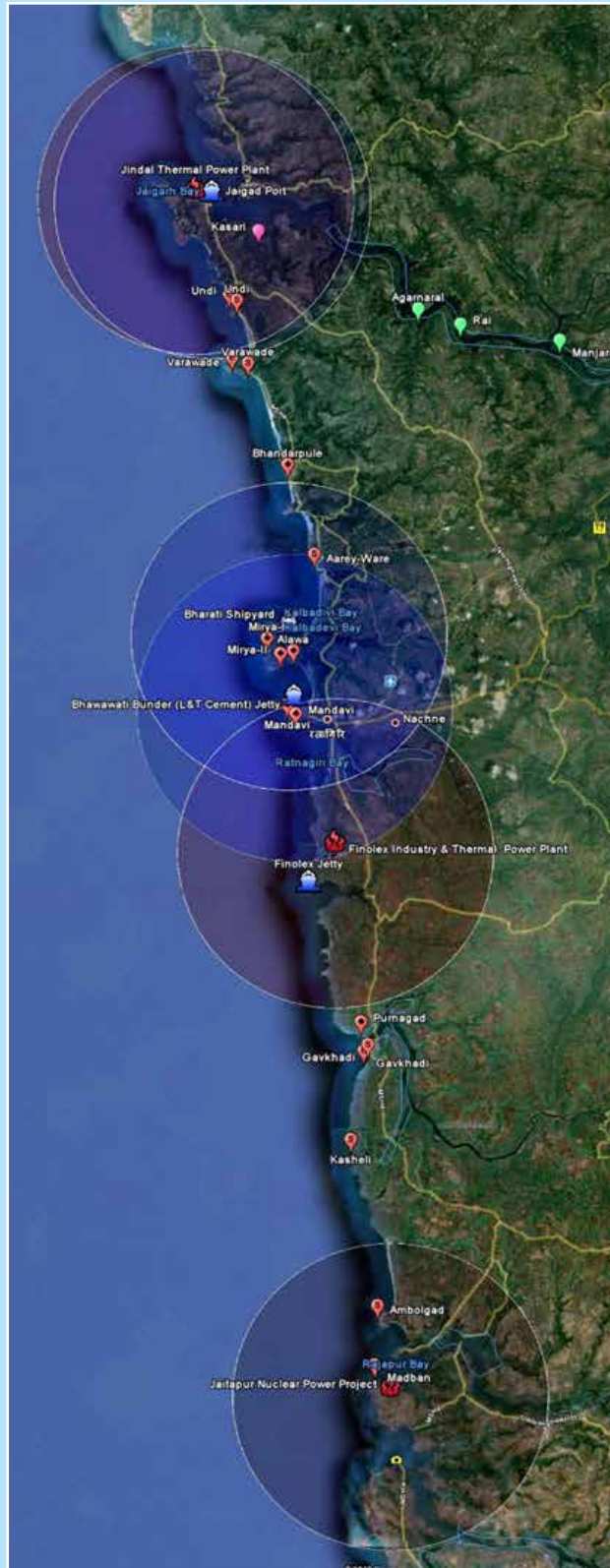
# Proposed Developmental Activities in Konkan

**Source: Newspaper Kokan Jaltana, article by Dr. Deepak Apte**

Under the many developmental activities that have been proposed for the entire Konkan area, 25 power plants have been suggested to be built on a narrow strip of coastal land which is 50-90 km wide and 200 km long. Since power plants prefer their own captive ports for transport of raw material, a number of minor ports too are proposed to come up in this area. Besides, work is ongoing for developing four shipyards. Needless to say that ancillary development will take place which may not have necessarily been envisaged in the proposed project impacts.

Besides power plants, minor ports and jetties, the Konkan coastal area is dotted with numerous aquaculture farms, which have emerged at the cost of mangroves, and probably without legal clearances. Unfortunately, a vast area with mangroves in Konkan is privately owned, and thus, easily available for unplanned development. Coastal tourism too is catching up fast in the region and a number of resorts have come up, of which, some are in total violation of the Coastal Regulation Zone (CRZ). The proposed developmental projects have been depicted in Figure 15 while the area-wise list is given in Tables 10 and 11.

**Figure 15**  
**Proposed Developmental Projects along the Konkan Coast**



Source: Deepak Apte, 2012

**Table 10**  
**List of Proposed Developmental Projects in Konkan Area**

Sr.No	Proposed Site	Company	Capacity (MW)
<b>RAIGAD DISTRICT</b>			
<b>Coal based</b>			
1	Shahapur, Alibag	Reliance Energy Ltd.	4000
2	Shahapur-Dherand, Alibag	Tata Power Ltd.	1600
3	Alibag	Ispat Energy Ltd.	1000
4	Medhekhar, Alibag	Patni Power Ltd.	1500
<b>Gas based</b>			
5	Uran	Mahagenco	1220
6	Dronagiri, Uran (Navi Mumbai, SEZ)	Urban Energy Generation Pvt. Ltd.	2000
7	Wangani-Taarfe, Taloja	Urban Energy Generation Pvt. Ltd.	2100
8	Kodgao, Roha	Urban Energy Generation Pvt. Ltd.	2100
9	Khalapur	Poyna Power Ltd.	1300
10	Nagothane	Reliance Industries Ltd.	1200
11	Safaale (Thane)	Reliance Industries Ltd.	495
<b>Captive Power Plant</b>			
12	Kolad, Roha	M/S. Hi-Tech Carbon	25
<b>RATNAGIRI DISTRICT</b>			
<b>Coal based</b>			
13	Anjarle, Dapoli	Tiyana Power Projects Pvt. Ltd.	1500
14	Anjanvel, Guhagar (Expansion Project)	Ratnagiri Gas and Power (NTPC)	1200
15	Dhopawe, Guhagar	NTPC-Mahagenco	1600
16	Nandiwade-Jaigad (Phase-1)	JSW Energy	1200
17	Nandiwade-Jaigad (Phase-2)	JSW Energy	3200
18	Ranpar-Pavas, Tal.Ratnagiri (Phase-2)	Finolex Industries	1200
19	Merve-Purnagad, Tal.Ratnagiri	Larsen and Toubro Ltd.	2000
<b>Gas based</b>			
20	Dabhol, Dapoli	Tiyana Power Projects Pvt. Ltd.	2000
<b>Nuclear Power based</b>			
21	Gudghe-Umbarghar-Bhopan, Dapoli	GMR Energy	1980
22	Madban-Mithgavane, Rajapur (Jaitapur Atomic Power Project)	Nuclear Power Corporation of India	9900
<b>Captive Power Plant</b>			
23	Ranpar-Pavas, Tal.Ratnagiri (Phase-1)	Finolex Industries	43
<b>SINDHUDURG DISTRICT</b>			
24	Munge, Devgad Ultra Mega Power Project (UMPP)	NTPC (Central Govt.)	4000
25	Dhakore-Aajgao, Sawantwadi	Ind Bharat Power Konkan Ltd.	1500

Table 11  
List of Proposed Shipyards in the Area

Sr. No.	Shipyard Company	Proposed Site
1	Rajapur Shipyards Pvt. Ltd.	Vetye
2	Vijaydurg Shipyards Pvt. Ltd.	Vijaydurg
3	Chowgule's Jaigad Port	Jaigad

Box 8  
Gaps and Recommendations on Proposed Developmental Activities in Ratnagiri

1. A comprehensive study on impacts of these proposed industrial activities on CMPA is needed.
2. Majority of the developmental activities may have been planned taking just short-term benefits into consideration.
3. However, long-term impacts of these activities should not be neglected while planning any developmental activities.
4. Developmental activities which are suitable to the local conditions and which would have minimal harm to local biodiversity should be encouraged. Destructive developmental activities should be strictly avoided in this region.

## Chapter 10

# Waste Management in CMPA

Increased flow of tourists and industrial growth in the Konkan region has further added to the issues and threats faced by the marine ecology of the area. Land, water and air pollution along with solid waste have seen a drastic rise over the past few years. In order to manage solid waste, the Government of India enacted the Municipal Solid Waste Management (Management and Handling) Rules, 2000 which is applicable to every municipal authority responsible for collection, segregation, storage, transportation, processing and disposal of municipal solid waste. According to this act, the municipal authority is also to conduct awareness activities amongst the citizens for waste segregation and promote recycling and reuse of segregated materials. Biodegradable waste is to be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. Incineration activities under some constraints can be carried out. Land-filling activities should be carried out strictly for non-biodegradable, inert and other waste not suitable for recycling. Norms have also been laid down for deciding the landfill sites and

the environmental parameters to be monitored at the landfill sites.

Segregation of waste into wet and dry is to be done at source itself at the household level in CMPA areas. The wet waste generated is to be utilized for generating compost or vermicompost which can be used by the villages for enhancing their horticultural production, or can be sold to tourists. Wet waste can also be converted to biogas. This can help reduce the usage of LPG, as in the case of Velas.

Dumping of non-biodegradable waste like plastic and thermocol poses a massive problem in the CMPAs. A lot of dry waste is deposited from Harihareshwar, Baghmandala and Valmikinagar villages nearby CMPA villages. There have been initiatives taken at the village level in places such as Mandhangad and Dapoli to ban the usage of plastic bags. Yet, many articles like plastic bottles and straws are discarded haphazardly and are an eyesore in this area. In addition, slippers, plastic bags and plastic bottles are also washed ashore. Sometimes the waste is burnt in a corner

of the village. Non-biodegradable but recyclable articles can be sold to scrap dealers for recycling but villagers experience difficulties in finding them. The waste items can also be used for building roads as demonstrated by the cities of Jamshedpur and Bengaluru.

Recently a number of NGOs and private companies have initiated the activity of producing plates and cups, mainly from Areca

leaves. This activity is particularly flourishing in South Indian states of Tamil Nadu, Kerala and Karnataka. The Konkan region with its dense plantations of coconut, areca and other similar palm species, may be an ideal habitat to start plate and cup making activities. This will ensure utilization of excess biomass. A feasibility study may be conducted to assess the scope of this endeavor.

#### Box 9 Gaps and Recommendations on Waste Management

##### Short-term Recommendations:

1. Research on composition and quantity of waste, its current disposal system and role of stakeholders in waste management would provide insights to address growing waste in CMPA.
2. Plastic waste should not be burnt. Instead it can be utilized to build village roads.
3. Finding scrap dealer/recycling agency that can give appropriate returns to the waste collected has been a problem. It needs to be resolved in collaboration with nearby villages to make waste management financially viable.
4. There is a need to study the impact of the industrial waste on these areas.
5. Regular cleaning of turtle nesting habitats to be taken up by Gram Panchayats.

##### Long-term Recommendations:

1. The compost generated can be sold in nearby town areas or to the tourists. Retailers who can provide good returns to the villagers need to be identified through a market study.
2. The wet waste can also be used to generate biogas to substitute LPG. This can make the village self-sufficient in terms of domestic fuel.
3. In general, there is no organized, effective and participatory waste management system in CMPA which needs to be constituted through participation of stakeholders.
4. A check needs to be implemented on the garbage which comes to Velas coast from Mandhangad, Bankot and Valmikinagar. The ban on plastic in Mandhangad should be effectively implemented. The strategy used for dry waste management in these villages can be employed in the neighbouring villages so that no waste accumulates on these beaches and the nesting probability by sea turtle is enhanced.

## Chapter 11

# Current Status of Environmental Education and Outreach Activities

Environmental education and outreach activities form an inseparable part of conservation. It has been observed that conservation cannot be successful unless local communities, policy makers and decision makers are proactive participants in it. In light of the current proposed developmental activities in the Konkan region, it is necessary to educate all stakeholders about the rich biodiversity the region harbors and the possible threats it may face. They also need to be made aware in order to mitigate the problems that may arise in the current climate change scenario. Moreover, any activities which adversely affect the local flora and fauna, can be prevented and mitigated through these outreach activities and thus add to the conservation efforts, making earth habitable for a few more species.

**Rupika S. Rajakaruna, E. M. Lalith Ekanayake, Thusan Kapurusinghe and K. B. Ranawana (2013): Sea Turtle Hatcheries in Sri Lanka: Their activities and potential contribution to Sea Turtle Conservation. Indian Ocean Turtle**

**Newsletter, Issue No.17, January 2013.**

This paper explores how hatcheries can serve as a very effective tool in conservation and education with regards to nesting sea turtles. Initially these hatcheries were developed with a mere intention of earning profits. None of the hatcheries were involved in any collaborative research or provided visitor education contributing to sea turtle conservation. But their operations soon became an attraction for tourists and provided financial opportunities for the local community. Now they are used as a communication media for sensitizing tourists.

**Ongoing project: Mainstreaming coastal and marine biodiversity conservation into production sectors in Sindhudurg Coast, Maharashtra. GOI-GEF-UNDP Project**

The Sindhudurg Coastal and Marine Ecosystem (SCME) is considered to be rich in biodiversity. However, unsustainable fishing, expanding tourism sector and pollution from fishing vessels and maritime traffic are identified factors responsible for ecosystem degradation.



The UNDP-GEF intervention aims to give stimulus to coastal and marine biodiversity conservation measures, while improving livelihoods of coastal communities through appropriate interventions. Sustainable fishing, agriculture and horticulture, small scale aquaculture, value addition to low-value fishes, eco-tourism, dolphin watch, underwater observations of marine life etc., are some of the activities proposed under the Project. It will also support conservation of mangroves, marine turtles, corals, marine mammals etc. Capacity building of people and institutions in different sectors, training and awareness generation are all integral components of this project.

**Completed Work:** Angria Bank was studied for biodiversity. Angria is a bank and a shallow sunken atoll, on the continental shelf off the west coast of India. It is located 105 km (65 mi) west of Vijaydurg, Maharashtra. The bank is at a depth of 20.1 metres and its dimensions are 40 km (25 mi) from north to south and 15 km (9 mi) from east to west. It is a coral habitat. The bottom is composed of sand, shells, and coral. The bank is steep on all sides, with great depths surrounding it.

Underwater diving revealed the presence of hard and soft corals. The coral types encountered were favites corals, brain corals, cup corals, *Acropora* sp. *Ambipora* sp. and many soft corals. Fishes associated with coral reefs like wrasse, surgeonfish, glass fish, bait fish, butterfly fish, sweeper fish, big eye fish, triggerfish, angel fish, parrot fish and damsel fish were observed. Various algae (red, brown and green), cushion starfishes, sea urchins, sponges, eunicid worms, spider crabs and mosaic crabs were also observed. Stingrays and dolphins are also present.

**Marine Turtle Conservation and education** was carried out by SNM in the Konkan region. 36 nests were protected and 1884 hatchlings released in 2013 through nest protection and hatchery. A number of awareness activities for schools and colleges, Forest Department and community are conducted through screening

of films, presentations and poster exhibitions. Volunteers involved in turtle nest monitoring are trained for nest protection, translocation of eggs to hatchery and hatchery management.

**Mangrove restoration and mapping:** Mangrove nurseries have been established at Achra in Malvan Taluk and Mithbav in Deogad taluk. A project for mapping mangroves in Sindhudurg district using high resolution satellite data is being carried out by the Maharashtra Remote Sensing Application Centre (MRSAC), Nagpur. Mapping the diversity and density of mangrove patches along with potential areas identified for restoration would be an output of this exercise.

**Population Assessment** of dolphins and finless porpoises along with causes of mortality would be studied. An inventory of the biodiversity of coral areas covering species of corals, associated invertebrates and fishes would be prepared. Suitable strategies for conservation and management of marine faunal resources can be built only after their comprehensive assessment.

**Avifauna** of the coastal region would be studied to identify important nesting sites to address specific conservation needs.

**Coral restoration and rehabilitation** by live coral transplantation would be carried out for Sindhudurg District.

#### **Other proposed activities:**

Fisheries and tourism are the economic backbones of the Sindhudurg district. Hence, this project proposes to prepare an **Ecosystem Approach Based Biodiversity Inclusive Fisheries Sector Plan**. This plan would be based on key relevant guidelines (global, national, local) available on this matter. Traditional and indigenous knowledge of the local fisher folk on management aspect of the fisheries would also be taken into consideration. This plan may be replicated in other coastal states.

A study has been undertaken using Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD)

so that the juvenile fish and shrimp species and other non-targeted species are excluded from the catch during trawling. The study implies that the device has the potential advantage of retaining larger fishes of higher market value and reducing sorting time and increasing productive fishing time.

Sustainable Marine Fishing (Capacity Building) aims to sensitize local fishers in matters related to sustainable fishing, fisheries resource conservation as well as implementation of 'Code of Conduct for Responsible Fishing', 'Ecosystem Approach to Fisheries' and various fisheries regulations. In order to achieve the same, capacity building programs for the local fishers have been commissioned to the College of Fisheries, Ratnagiri.

Considering the natural availability of species of oyster and mussel species, it is proposed to identify suitable sites for undertaking the farming activities for this untapped resource in Sindhudurg district of Konkan.

For augmenting mariculture based livelihood of the people living in the coastal region of the district, a project has been awarded to College of Fisheries, Ratnagiri for survey of the mussel and oyster culture potentials of Sindhudurg.

The project also aims to prepare a low impact, sustainable and community driven tourism plan with the intent to reduce the pressure on biological resources, boost local economy and to help develop a strong constituency for marine and coastal biodiversity conservation. The Plan would also aim at establishing appropriate norms and standards for development of robust biodiversity inclusive tourism activities.

A solid waste management plan at landscape level has also been proposed in this project. Present solid waste disposal practices and ways of waste generation would be evaluated and solutions would be provided to tackle issues related to solid waste. The project has been working at a policy level along with the Zilla Parishad

and elected institutions to prepare a concrete solid waste management plan that provides solutions to tackle issues of biodegradable, non-biodegradable, recyclable and non-recyclable waste and also takes into account community related issues. The idea is to motivate local communities to take up the issue of waste management and deal with it at a personal level. Under this banner, a clean fort campaign and clean beach program was initiated.

Suitable anchorage points were decided in the sea for the boats ferrying tourists to the coral sites in Malvan so that there is no damage to the coral beds. These points were prepared in consultation with expert scuba divers, RFO of Malvan, socio-economists and conservation biologists of the UNDP Project.

**A workshop** was conducted to generate awareness amongst the 'Homestay groups' registered with MTDC.

Projects for the stock enhancement of mangrove crabs as well as for promoting mussel culture and oyster farming have been initiated. Studies on mortality of marine mammals are being planned with support from Central Marine Fisheries Research Institute, Kochi.

**Dharini Supraja (2012): Capacity building for Trawl/Commercial Fishers to reduce bycatch mortality of sea turtles along the Chennai Coast, India. Indian Ocean Turtle Newsletter No.15, January 2012.**

This outcome was a joint effort by the TREE Foundation, Wildlife Wing of Forest Department, Fisheries Department, Chennai Trawl Mechanized Boat Fishermen Welfare Association and the Indian Coast Guard. Many adult sea turtles get entangled in the fishing/ trawl nets and get seriously injured or even die. This sensitive issue needs to be addressed by taking into consideration both, the livelihood of the fishermen as well as the conservation of sea turtles. This article directs measures for the safe release of Olive ridley turtles trapped in fishing nets along the coast of Chennai.

“Sea Turtle Fact Stickers” were prepared outlining the proper rescue and release methodology. These stickers were distributed amongst the fishermen and strategically stuck on each of the 3000 boats. The turtle factsheets and the stickers were responsible for a change in attitude among the trawl fishers. Talks by speakers explaining the ecological importance of the sea turtles were also responsible for this change in mindset.

### Conservation Education and Outreach by SNM

Stickers on turtle conservation have been designed and distributed by SNM in a few villages amongst school children, fisher folks, fishermen co-operative societies etc. SNM has also published books on conservation of marine turtles in Marathi and English.

The three villages have 11 schools which provide pre-primary, primary secondary as well as higher secondary education in Marathi, English and Urdu medium. The schools follow the Maharashtra State Board syllabus. These schools need to be involved in the proposed education and outreach activities.

There is little or no awareness about the National Biodiversity Act of 2002 in these villages. Gram Panchayats, open grounds, temple courtyards and halls in the vicinity of the villages can serve as venues for outreach activities on the Act and the Public Biodiversity Register (PBR).

Many villagers are aware of the need and importance of conservation of sea turtles. Also, school children are actively involved in tree plantation activities. A sea turtle information centre has been developed at Velas which is visited by many people during the annual Turtle Festival. The existing Centre may be upgraded in its content, design and activities. Similar centres on coastal and marine biodiversity may be developed at the other potential sites. The outreach material downloaded from [seaturtleconservation.org](http://seaturtleconservation.org) can be effectively translated to Marathi (with necessary permissions) in order to reach to a wider audience. New outreach material can also be developed.

#### Box 10

##### Gaps and Recommendations for Conservation Education and Outreach

1. The necessary steps for constituting Biodiversity Management Committee and preparing People's Biodiversity Registers should be taken at the earliest. School and college students should be involved in documentation of local biodiversity through the process of making these registers. Nature Clubs may be formed in schools for this purpose.
2. Three to five year participatory conservation education and outreach plan may be developed and implemented for effective management of CMPA and surrounding area.
3. Awareness activities for conservation of ecosystems like mangroves, mudflat, sandy shores and flagship species like marine turtle, white bellied sea eagle should be carried out. Educational material for improving knowledge about habitats, resources, relevant legislations, policies and conservation strategies should be developed in regional language.
4. Interpretation Centres should be developed in potential sites to provide information about the coastal and marine biodiversity, different ecosystems, the ecological benefits they provide and the need and advantages of protecting them. Local SHGs should be involved in Centre management and avenues provided to showcase local products to tourists. Information about sea turtles and other flagship species can be designed and distributed in form of pamphlets, brochures, stickers, etc. Material available in English can be translated to Marathi with necessary permissions. Screening documentaries, bird watching activities and conducting study tours can also be other ways in which environmental education and awareness can be carried out. The objective of these activities should be to strengthen participatory research and management of CMPA.

Annexure 1  
List of Marine Protected Areas in Peninsular India

Sr. No	Name of MPA	State	Category	Area	Year of Establishment
1	Coringa	Andhra Pradesh	Sanctuary	235.4	1978
2	Krishna	Andhra Pradesh	Sanctuary	194.81	1989
3	Pulicat Lake	Andhra Pradesh	Sanctuary	500	1980
4	Dadra & Nagar Haveli	Dadra & Nagar Haveli	Sanctuary	92.16	2000
5	Fudam	Daman & Diu	Sanctuary	2.18	1991
6	Chorao Island	Goa	Sanctuary	1.78	1988
7	Marine (Gulf of Kutch)	Gujarat	National Park	162.89	1995
8	Khijadia	Gujarat	Sanctuary	6.05	1981
9	Marine (Gulf of Kutch)	Gujarat	National Park	295.03	1980
10	Kadalundi Vallikkunnu Community Reserve	Kerala	Community Reserve	1.5	2007
11	Malvan Marine	Maharashtra	Sanctuary	29.12	1987
12	Bhitarkanika	Odisha	National Park	145	1998
13	Bhitarkanika	Odisha	Sanctuary	672	1975
14	Chilka (Nalaban)	Odisha	Sanctuary	15.53	1987
15	Gahirmatha	Odisha	Sanctuary	1435	1997
16	Balukhand Konark	Odisha	Sanctuary	71.72	1984
17	Gulf of Mannar	Tamil Nadu	National Park	6.23	1980
18	Point Calimere	Tamil Nadu	Sanctuary	172.6	1967
19	Pulicat Lake	Tamil Nadu	Sanctuary	153.67	1980
20	Sundarbans	West Bengal	National Park	1330.1	1984
21	Haliday Island	West Bengal	Sanctuary	5.95	1976
22	Sajnakhali	West Bengal	Sanctuary	2091.1	1976
23	Lothian Island	West Bengal	Sanctuary	38	1976

Source: ENVIS website

Annexure 2  
List of Marine Protected Islands of India

Sr. No.	Name of MPA	State	Category	Area	Year of Establishment
1	Arial Island	Andaman & Nicobar	Sanctuary	0.05	1977
2	Bamboo Island	Andaman & Nicobar	Sanctuary	0.05	1977
3	Barren Island	Andaman & Nicobar	Sanctuary	11.99	1977
4	Battimalv Island	Andaman & Nicobar	Sanctuary	5.03	1977
5	Belle Island	Andaman & Nicobar	Sanctuary	0.08	1977
6	Bennett Island	Andaman & Nicobar	Sanctuary	3.46	1977
7	Bingham Island	Andaman & Nicobar	Sanctuary	0.08	1977
8	Blister Island	Andaman & Nicobar	Sanctuary	0.26	1977
9	Bluff Island	Andaman & Nicobar	Sanctuary	1.14	1977
10	Bondoville Island	Andaman & Nicobar	Sanctuary	2.55	1977
11	Brush Island	Andaman & Nicobar	Sanctuary	0.23	1977
12	Buchanan Island	Andaman & Nicobar	Sanctuary	9.33	1977
13	Campbell	Andaman & Nicobar	National Park	426.23	1992
14	Chanel Island	Andaman & Nicobar	Sanctuary	0.13	1977
15	Cinque Islands	Andaman & Nicobar	Sanctuary	9.51	1977
16	Clyde Islands	Andaman & Nicobar	Sanctuary	0.54	1977
17	Cone Islands	Andaman & Nicobar	Sanctuary	0.65	1977
18	Curlew (B.P.) Island	Andaman & Nicobar	Sanctuary	0.16	1977
19	Curlew Island	Andaman & Nicobar	Sanctuary	0.03	1977
20	Defence Island	Andaman & Nicobar	Sanctuary	10.49	1977
21	Dot Island	Andaman & Nicobar	Sanctuary	0.13	1977
22	Dottrell Island	Andaman & Nicobar	Sanctuary	0.13	1977
23	Duncan Island	Andaman & Nicobar	Sanctuary	0.73	1977
21	East Island	Andaman & Nicobar	Sanctuary	6.11	1977
25	East of Inglis Island	Andaman & Nicobar	Sanctuary	3.55	1977
26	Egg Island	Andaman & Nicobar	Sanctuary	0.05	1977
27	Elat Island	Andaman & Nicobar	Sanctuary	9.36	1977
28	Entrance Island	Andaman & Nicobar	Sanctuary	0.96	1977
29	Galathea	Andaman & Nicobar	National Park	110	1992
30	Gander Island	Andaman & Nicobar	Sanctuary	0.05	1977
31	Girjan Island	Andaman & Nicobar	Sanctuary	0.16	1977
32	Goose Island	Andaman & Nicobar	Sanctuary	0.01	1977
33	Hump Island	Andaman & Nicobar	Sanctuary	0.47	1977
34	Interview Island	Andaman & Nicobar	Sanctuary	133.87	1977
35	James Island	Andaman & Nicobar	Sanctuary	2.1	1977
36	Jungle Island	Andaman & Nicobar	Sanctuary	0.52	1977
37	Kyd Island	Andaman & Nicobar	Sanctuary	8	1977

Annexure 2 (*Cntd...*)  
List of Marine Protected Islands of India

Sr. No.	Name of MPA	State	Category	Area	Year of Establishment
38	Landfall Island	Andaman & Nicobar	Sanctuary	29.48	1977
39	Latouche Island	Andaman & Nicobar	Sanctuary	0.96	1977
40	Lohabarrack	Andaman & Nicobar	Sanctuary	22.21	1977
41	Mahatma Gandhi Marine	Andaman & Nicobar	National Park	285.1	1983
42	Mangrove Island	Andaman & Nicobar	Sanctuary	0.39	1977
43	Mask Island	Andaman & Nicobar	Sanctuary	0.78	1977
44	Mayo Island	Andaman & Nicobar	Sanctuary	0.1	1977
45	Megapode Island	Andaman & Nicobar	Sanctuary	0.12	1977
46	Middle Button Island	Andaman & Nicobar	National Park	0.44	1987
47	Montgomery Island	Andaman & Nicobar	Sanctuary	0.21	1977
48	Mount Harriett	Andaman & Nicobar	National Park	46.62	1987
49	Narcondam Island	Andaman & Nicobar	Sanctuary	6.81	1977
50	North Brother Island	Andaman & Nicobar	Sanctuary	0.75	1977
51	North Button Island	Andaman & Nicobar	National Park	0.44	1987
52	North Island	Andaman & Nicobar	Sanctuary	0.49	1977
53	North Reef Island	Andaman & Nicobar	Sanctuary	3.48	1977
54	Oliver Island	Andaman & Nicobar	Sanctuary	0.16	1977
55	Orchid Island	Andaman & Nicobar	Sanctuary	0.1	1977
56	Ox Island	Andaman & Nicobar	Sanctuary	0.13	1977
57	Oyster Island-I	Andaman & Nicobar	Sanctuary	0.08	1977
58	Oyster Island-II	Andaman & Nicobar	Sanctuary	0.21	1977
59	Paget Island	Andaman & Nicobar	Sanctuary	7.36	1977
60	Parkinson Island	Andaman & Nicobar	Sanctuary	0.34	1977
61	Passage Island	Andaman & Nicobar	Sanctuary	0.62	1977
62	Patric Island	Andaman & Nicobar	Sanctuary	0.13	1977
63	Peacock Island	Andaman & Nicobar	Sanctuary	0.62	1977
64	Pitman Island	Andaman & Nicobar	Sanctuary	1.37	1977
65	Point Island	Andaman & Nicobar	Sanctuary	3.07	1977
66	Potanma Islands	Andaman & Nicobar	Sanctuary	0.16	1977
67	Ranger Island	Andaman & Nicobar	Sanctuary	4.26	1977
68	Rani Jhansi	Andaman & Nicobar	National Park	256.14	1996
69	Reef Island	Andaman & Nicobar	Sanctuary	1.74	1977
70	Roper Island	Andaman & Nicobar	Sanctuary	1.46	1977
71	Ross Island	Andaman & Nicobar	Sanctuary	1.01	1977
72	Rowe Island	Andaman & Nicobar	Sanctuary	0.01	1977
73	Saddle Peak	Andaman & Nicobar	National Park	32.54	1987
74	Sandy Island	Andaman & Nicobar	Sanctuary	1.58	1977
75	Sea Serpent Island	Andaman & Nicobar	Sanctuary	0.78	1977
76	Shark Island	Andaman & Nicobar	Sanctuary	0.6	1977

Annexure 2 (*Cntd...*)  
List of Marine Protected Islands of India

Sr. No.	Name of MPA	State	Category	Area	Year of Establishment
77	Shearme Island	Andaman & Nicobar	Sanctuary	7.85	1977
78	Sir Hugh Rose Island	Andaman & Nicobar	Sanctuary	1.06	1977
79	Sisters Island	Andaman & Nicobar	Sanctuary	0.36	1977
80	Snake Island-I	Andaman & Nicobar	Sanctuary	0.73	1977
81	Snake Island-II	Andaman & Nicobar	Sanctuary	0.03	1977
82	South Brother Island	Andaman & Nicobar	Sanctuary	1.24	1977
83	South Button Island	Andaman & Nicobar	National Park	0.03	1987
84	South Reef Island	Andaman & Nicobar		1.17	1977
85	South Sentinel Island	Andaman & Nicobar	Sanctuary	1.61	1977
86	Spike Island-I	Andaman & Nicobar	Sanctuary	0.42	1977
87	Spike Island-II	Andaman & Nicobar	Sanctuary	11.7	1977
88	Stoat Island	Andaman & Nicobar	Sanctuary	0.44	1977
89	Surat Island	Andaman & Nicobar	Sanctuary	0.31	1977
90	Swamp Island	Andaman & Nicobar	Sanctuary	4.09	1977
91	Table (Delgarno) Island	Andaman & Nicobar	Sanctuary	2.29	1977
92	Table (Excelsior) Island	Andaman & Nicobar	Sanctuary	1.69	1977
93	Talabaicha Island	Andaman & Nicobar	Sanctuary	3.21	1977
94	Temple Island	Andaman & Nicobar	Sanctuary	1.04	1977
95	Tillongchang Island	Andaman & Nicobar	Sanctuary	36.43	1977
96	Tree Island	Andaman & Nicobar	Sanctuary	0.03	1977
97	Trilby Island	Andaman & Nicobar	Sanctuary	0.96	1977
98	Tuft Island	Andaman & Nicobar	Sanctuary	0.29	1977
99	Turtle Islands	Andaman & Nicobar	Sanctuary	0.39	1977
100	Kwangtung Islands	Andaman & Nicobar	Sanctuary	0.57	1987
101	West Islands	Andaman & Nicobar	Sanctuary	6.4	1977
102	Wharf Island	Andaman & Nicobar	Sanctuary	0.11	1977
103	White Cliff Island	Andaman & Nicobar	Sanctuary	0.47	1977
104	Galathea Bay	Andaman & Nicobar	Sanctuary	11.44	1977
105	Cuthbert Bay	Andaman & Nicobar	Sanctuary	5.82	1977
106	Pitti	Lakshadweep	Sanctuary	0.01	2002

Source: ENVIS website



**Annexure 3**  
**Checklist of Faunal Species of Malvan by Parulekar, 1981**

Phylum	Group	Family	Name of the Species
Porifera	Desmosponges	Tetillidae	Tetilla dactyloides
		Tethyidae	Tethys lynarium
	Sea pen	Veretillidae	Cavernularia orientalis
		Virgulariidae	Virgularia rumphii
	Sea anemones	Edwardsiidae	Edwardsia tinetrix
		Haloclavidae	Metapeachia tropica
		Haliactiidae	Pelocoetes exul
			Phytocoetes giganticus
		Actiniidae	Anemonia indicus
			Bunodosoma granulifera
			Anthopleusa midori
			Anthopleusa asiatica
			Anthopleusa panikkarii
Coelenterata			Paracondylactis indicus
			Actinogeton sultana
			Cribrinopsis robertii
			Acontiophorum bombayensis
		Metridiidae	Metridium senile var. fimbriatum
			Neoaipiasia commensali
		Aiptasiomorphidae	Aiptasiomorpha luciae
	Tunicates	Didemnidae	Didumene schilleriana
	Zooanthid	Epizoantidae	Epizoanthus elongatum
		Siderastreidae	Siderastrea savigniana
	Corals		Coscianaera monile
		Poritidae	Porites lutia
			Porites lichen
		Faviidae	Favites halicora
			Goniastrea retiornis
			Cyphastrea sp.
		Mussidae	Cynaria lacrymalis
		Dendrophylliidae	Turbiniaria crater
Annelida	Scale worms	Aphroditidae	Lepidonotus carinulatus
			Gattyana deludens
			Hermothoe ampullifera
			Sthenelais boa
			Leanira japonica
			Poliodontes melanonotus

**Annexure 3 (Cntd...)**  
**Checklist of Faunal Species of Malvan by Parulekar, 1981**

Phylum	Group	Family	Name of the Species
			Panthalis oerstedii
	Segmented worms	Chrysopetalidae	Bhawania cryptocephala
	Fire worms	Amphinomidae	Eurythoe complanata
			Chloeia rosea
	Bristle worms	Hesionidae	Hasiona pantherina
			Leocrates claparedii
			Leocratides ehlersi
			Podarke angustifrons
		Syllidae	Syllis spongicola
			Syllis gracilis
			Syllis closterobranchia
			Syllis veriegata
			Nereis chingrighattensis
			Nereis chilkaensis
			Nereis costae
			Nereis mirabilis
			Perinereis vancaurica var. typica
			Perinereis vancaurica var. indica
			Perinereis cultrifera
			Perinereis aibuhitensis
			Perinereis negro-punctata
			Perinereis nuntia
		Eunicidae	Eunice tentaculata
			Eunice antennata
			Diopatra neapolitana
			Onuphis sp.
			Lumbriconereis heteropod
			Arabella iricolor
		Spionidae	Polydora coeca
			Cirriformia limnoricola
			Phylochaetopterus socialis
			Sabellaria sp.
		Terebellidae	Pista sp.
			Siprographis spallanzanii
			Dasychone cingulatus
			Dasychone serratibranchis
			Potamilla leptochaeta
		Serpulidae	Vermiliopsis glandigerus
Sipunculoidea		Dendrostomiidae	Dendrostoma signifer
Echiuroidea	Spoon worms	Echiuroidae	Ochetosoma bombayensis
		Serpulidae	Vermiliopsis glandigerus

**Annexure 3 (Cntd...)**  
**Checklist of Faunal Species of Malvan by Parulekar, 1981**

Phylum	Group	Family	Name of the Species
Arthropoda	Mantis shrimp	Squillidae	Squilla raphidea
			Squilla nepa
			Squilla scorpio
			Squilla interrupta
			Gonadactylus chiracra
	Isopods	Euridicidae	Cirolana sp.
			Limnoria bombayensis
		Sphaeromidae	Sphaeroma walkeri
		Idoteidae	Synidotea variegata
		Ligyidae	Ligia exotica
	Crabs	Calappidae	Matuta victor
			Matuta planipes
		Leucosiinae	Philyra globosa
		Dorippidae	Dorippe astuta
		Hymaenosomatidae	Elamena cristatipes
			Schizophrys aspera
		Portunidae	Portunus pelagicus
			Portunus sanguinolentus
			Charybdis annulata
			Thalamita arenata
		Xanthidae	Leptodius arassimanus
			Ozium rugulosus
		Pinnotheridae	Pinotheres sp.
		Ocypodidae	Uca annulipes
			Dotilla myctiroides
			Macrophthalmus sulcatus
			Ocypode ceratophthalma
			Emerita holthuisi
		Grapsidae	Metagrapsus messor
			Sesarma oceanica
	Hermit crabs	Paguridae	Clibanarius intraspinitus
			Clibanarius padavensis
			Diogenes sustus
			Diogenes miles
	Prawns	Sergestidae	Acetes indicus
			Penaeus japonicus
			Metapenaeus monoceros
			Parapeneopsis stylifera
	Cleaner shrimps	Hippolytidae	Hippolysmata ensiostris
	Barnacles	Iblidae	Ibla cumingi
			Lepas sp.
		Balanidae	Balanus tintinnabulum tintinnabulum

**Annexure 3 (Cntd...)**  
**Checklist of Faunal Species of Malvan by Parulekar, 1981**

Phylum	Group	Family	Name of the Species
			Balanus (Balanus) amphitrite var. communis
			Tetraclita (Tetraclitella) purpurascens
			Cthamalus withersi
	Water measurers	Hydrometridae	Halobates sp.
Mollusca		Ischnochitonidae	Ischnochiton computus
	Keyhole limpet	Fissurellidae	Diodora bombayana
			Scutus unguis
	Sea snails	Patellidae	Cellana radiata
	Top snails	Trochidae	Euchelus asper
			Euchelus tricarinatus
			Calliostoma scobinatum
			Gibbula swainsonii
			Clanculus depictus
			Trochus radiatus
			Umbonium vestiarum
	Turban snails	Turbinidae	Turbo intercostalis
			Astrea stellata
	Nerites	Neritidae	Nerita oryzarum
			Nerita polita
	Periwinkles	Littorinidae	Littorina subgranosa
			Littorina intermedia
			Littorina ventricosa
			Tectarius malaccanus
	Worm snails	Vermetidae	Vermetus sp.
	Planaxids	Planaxidae	Planaxis sulcatus
	Horn snails	Potamididae	Cerithidea fluviatilis
			Telescopium telescopium
	Cerithiids	Cerithiidae	Alaba rectangulata
			Cerithium morus
			Cerithium rubus
	Slipper snails	Calyptraeidae	Ergoea walshii
	True conchs	Strombidae	Tibia curta
	Moon snails	Naticidae	Natica lineata
			Natica muculosa
	Cowries	Cypraeidae	Cyprea pallida
	Frog snails	Bursidae	Bursa tuberculata
	Rock snails	Muricidae	Murex adustus
			Brupa kankanensis
			Thais carinifera
			Thais rudoplhi
			Thais tissoti
	Dove snails	Pyrenidae	Pyrene terpsichore
	True whelks	Buccinidae	Babylonia spirata

**Annexure 3 (Cntd...)**  
**Checklist of Faunal Species of Malvan by Parulekar, 1981**

Phylum	Group	Family	Name of the Species
		Nassidae	Bullia lineolata
			Nassarius arnatus
	Nassidae	Turridae	Urcula javana
	Sea hares	Aplysiidae	Aplysia cornifera
			Bursatella leachii
	Sea slugs	Onchidiidae	Onchidium verraculatum
	Ark clam	Arcidae	Arca bistrigata
			Arca symmetrica
			Anadara granosa
	Mussels	Mytilidae	Mytilus viridis
			Modiolus striatulus
			Brachyodontes karachiensis
	Scallops	Pectinidae	Chlamys tranquebaricus
	Bivalves	Limidae	Lima lima
	Clams	Anomiidae	Anomis achaeus
	True oysters	Ostreidae	Crassostrea cucullata
			Crassostrea bicolor
			Crassostrea lacerata
		Trapaziidae	Trapazium vellicatum
	Bivalve clams	Cardiidae	cardium asiaticum
	Venus clams	Veneridae	Gafrarium divaricatum
			Sunetta solandri
			Meretrix meretrix
			Meretrix casta
			Paphia textile
	Duck clams	Mactridae	Coecella transversalis
	Bean clams	Donacidae	Donax incarnatus
			Donax scortum
		Soleniidae	Solen truncatus
	Pearl oyster	Pteriidae	Pinctada chemnitzii
	Piddocks	Pholadidae	Martesia striata
Echinodermata	Sea stars	Asterinidae	Astropecten indica
	Brittle star	Ophiactidae	Ophiactis savignyii
	Sea urchins	Temnopleuridae	Temnopleurus torreumaticus
	See cucumbers	Phyllophoridae	Holothura scabra
			Synapta sp.
Chordata			
		Ophichthyidae	Pisodonophis boro
		Theraponidae	Therapon jarbua
		Blenniidae	Petroscirtes punctatus
			Callogobius sp.
		Gobiidae	Batrachus sp.

**Annexure 4**  
**Checklist of Identified Species (Other than Opisthobranchs) from Rocky Shores**

Sr. No.	Phylum	Name	IUCN status (IUCN 3.1)
1	Chlorophyta	Caulerpa macrophysa	NE
2		Caulerpa scalpelliformis	NE
3		Caulerpa sertuloides	NE
4		Caulerpa verticillata	NE
5		Caulerpa peltata	NE
6		Chaetomorpha antennina	NE
7		Chaetomorpha cf crassa	NE
8		Enteromorpha sp.	NE
9		Ulva sp.	NE
10		Chaetomorpha lineatum	NE
11		Cladophora sp.	NE
12		Chaetomorpha sp.	NE
13	Ochrophyta	Colpomenia sinuosa	NE
14		Dictyopteris sp.	NE
15		Dictyota dichotomata	NE
16		Dictyota sp. 1	NE
17		Padina cf gymnospora	NE
18		Padina tetrastrum	NE
19		Sargassum sp. 1	NE
20		Sargassum sp. 2	NE
21		Stoechospermum marginatum	NE
22	Rhodophyta	Acanthophora cf specifera	NE
23		Amphiroa anceps	NE
24		Amphiroa sp.	NE
25		Champia cf parvula	NE
26		Cheilosporum spectabile	NE
27		Chondria cf armata	NE
28		Gelidiopsis sp.	NE
29		Gelidium cf pusillum	NE
30		Gracilaria cf corticata	NE
31	Little Ringed Plover	Charadrius dubius	LC
32	Kentish Plover	Charadrius alexandrinus	LC
33	Lesser Sand Plover	Charadrius mongolus	LC
34	Red-wattled Lapwing	Vanellus indicus	LC
35	Whimbrel	Numenius phaeopus	LC
36	Eurasian Curlew	Numenius arquata	NT
37	Common Redshank	Tringa totanus	LC

#### Annexure 4 (Cntd...)

#### Checklist of Identified Species (Other than Opisthobranchs) from Rocky Shores

Sr. No.	Phylum	Name	IUCN status (IUCN 3.1)
38	Marsh Sandpiper	<i>Tringa stagnatilis</i>	LC
39	Common Greenshank	<i>Tringa nebularia</i>	LC
40	Wood Sandpiper	<i>Tringa glareola</i>	LC
41	Common Sandpiper	<i>Actitis hypoleucos</i>	LC
42	Little Stint	<i>Calidris minuta</i>	LC
43	Heuglin's Gull	<i>Larus heuglini</i>	LC
44	Yellow-legged Gull	<i>Larus cachinnans</i>	LC
45	Pallas's Gull	<i>Larus ichthyaetus</i>	LC
46	Brown-headed Gull	<i>Larus brunnicephalus</i>	LC
47	Black-headed Gull	<i>Larus ridibundus</i>	LC
48	Slender-billed Gull	<i>Larus genei</i>	LC
49	Lesser Crested Tern	<i>Sterna bengalensis</i>	LC
50	Large Crested Tern	<i>Sterna bergii</i>	LC
51	Little Tern	<i>Sterna albifrons</i>	LC
52	Whiskered Tern	<i>Chlidonias hybridus</i>	LC
53	Chlidonias hybridus	<i>Columba livia</i>	LC
54	Little Brown Dove	<i>Streptopelia senegalensis</i>	LC
	Spotted Dove	<i>Streptopelia chinensis</i>	LC
55	Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	LC
	Rose-ringed Parakeet	<i>Psittacula krameri</i>	LC
56	Brainfever Bird	<i>Hierococcyx varius</i>	LC
57	Asian Koel	<i>Eudynamys scolopacea</i>	LC
58	Greater Coucal	<i>Centropus sinensis</i>	LC
59	White-rumped Needletail Swift	<i>Zoonavena sylvatica</i>	LC
60	Asian Palm-Swift	<i>Cypsiurus balasiensis</i>	LC
61	Alpine Swift	<i>Tachymarptis melba</i>	LC
62	Small Blue Kingfisher	<i>Alcedo atthis</i>	LC
63	Stork-billed Kingfisher	<i>Halcyon capensis</i>	LC
64	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	LC
65	Lesser Pied Kingfisher	<i>Ceryle rudis</i>	LC
66	Small Bee-eater	<i>Merops orientalis</i>	LC
67	Lesser Golden-backed Woodpecker	<i>Dinopium benghalense</i>	LC
68	Common Swallow	<i>Hirundo rustica</i>	LC
69	Wire-tailed Swallow	<i>Hirundo smithii</i>	LC
70	Red-rumped Swallow	<i>Hirundo daurica</i>	LC
71	Large Pied Wagtail	<i>Motacilla maderaspatensis</i>	LC
72	Yellow Wagtail	<i>Motacilla flava</i>	LC
73	Paddyfield Pipit	<i>Anthus rufulus</i>	LC
74	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	LC
75	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC



**Annexure 4 (Cntd...)**  
**Checklist of Identified Species (Other than Opisthobranchs) from Rocky Shores**

Sr. No.	Phylum	Name	IUCN status (IUCN 3.1)
78	Oriental Magpie-Robin	Copsychus saularis	LC
79	Grey-breasted Prinia	Prinia hodgsonii	LC
80	Ashy Prinia	Prinia socialis	LC
81	Plain Prinia	Prinia inornata	LC
82	Blyth's Reed-Warbler	Acrocephalus dumetorum	LC
83	Common Tailorbird	Orthotomus sutorius	LC
84	Purple-rumped Sunbird	Nectarinia zeylonica	LC
85	Purple Sunbird	Nectarinia asiatica	LC
86	White-throated Munia	Lonchura malabarica	LC
87	White-rumped Munia	Lonchura striata	LC
88	Spotted Munia	Lonchura punctulata	LC
89	Black-headed Munia	Lonchura malacca	LC
90	House Sparrow	Passer domesticus	LC
91	Common Myna	Acridotheres tristis	LC
92	Eurasian Golden Oriole	Oriolus oriolus	LC
93	Black Drongo	Dicrurus macrocercus	LC
94	Ashy Drongo	Dicrurus leucophaeus	LC
95	House Crow	Corvus splendens	LC
96	Jungle Crow	Corvus macrorhynchos	LC
97	Mollusca	Modiolus sp.	NE
98		Brachidontes karachiensis	NE
99		Cardita variegata	NE
100		Astrea semicostata	NE
101		Astrea stellata	NE
102		Cantharus undosus	NE
103		Cellana radiata	NE
104		Cerethium collumella	NE
105		Clanculus ceylanicus	NE
106		Clypidina notata	NE
107		Cronia contracta	NE
108		Cronia subnodulosa	NE
109		Cypraea arabica	NE
110		Cypraea lentiginosa	NE
111		Cypraea ocellata	NE
112		Diodora singaporensis	NE
123		Drupa heptagonalis	NE
114		Echinolittorina malaccana	NE
115		Nodilittorina leucosticta	NE
116		Echinolittorina cf malaccana	NE
117		Engina zea	NE
118		Euchelus asper	NE
119		Euchelus tricarinata	NE
120		Gibulla swainsonii	NE

**Annexure 4 (Cntd...)**  
**Checklist of Identified Species (Other than Opisthobranchs) from Rocky Shores**

Sr. No.	Phylum	Name	IUCN status (IUCN 3.1)
121		Gyrineum natator	NE
122		Littoraria intermedia	NE
123		Mitra scutulata	NE
124		Mitra sp.	NE
125		Nerita albicilla	NE
126		Nerita chamaeleon	NE
127		Nerita oryzarum	NE
128		Planaxis sulcatus	NE
129		Purpurea panama	NE
130		Pyrene scripta	NE
131		Pyrene terpsichore	NE
132		Scutus unguis	NE
133		Supplanaxis niger	NE
134		Thais bufo	NE
135		Thais lacera	NE
136		Thais rugosa	NE
137		Thaisella tissoti	NE
138		Trochus radiatus	NE
139		Turbo bruneus	NE
140		Conus cumingii	NE
141		Morula uva	NE
142		Cerethium morus	NE
143		Turbinella pyrum	
144		Littoraria undulata	NE
145	Echinodermata	Stomopneustes variolaris	NE
146		Temnopleurus cf toreumaticus	NE
147		Heterocentrotus cf mammillatus	NE
148		Holothuria Mertensiothuria leucospilota	NE
149		Macrophiothrix aspidota	NE
150		Asterina lorioli	NE
151	Pisces	Abudefduf septemfasciatus	NE
152		Chaetodon sp.	NE
153		Istiblennius dussumieri	NE
154		Cephalopholis formosa	LC
155		Odonus niger	NE
156		Gymnothorax cf favagineus	NE
157		Gymnothorax sp. 2	NE
158		Echidna nebulosa	NE
159		Nebrius cf ferrugineus	VU
160		Myripristis murdjan	NE
161		Chaetodon collare	LC
162		Halichorers hortulanus	NE

**Annexure 4 (Cntd...)**  
**Checklist of Identified Species (Other than Opisthobranchs) from Rocky Shores**

Sr. No.	Phylum	Name	IUCN status (IUCN 3.1)
163		Pomacanthus annularis	LC
164		Labroides dimidiatus	LC
165		Diodon liturosus	NE
166	Mammals	Delphinus delphis	LC
167		Sousa chinensis	NT
168		Tursiops truncatus	LC
169		Neophocaena phocaenoides phocaenoides	NE
170		Physeter catodon	NE
171		Lutrogale perspicillata	VU

Source: Apte et al, 2012

**Annexure 5**  
**Checklist of Identified Species from Sandy Shore**

Sr.no.	Group	Name	Habitat	IUCN status
1	Algae	Centroceros sp.	Rocky patch	NE
2		Padina sp.	Washed off	NE
3		Sargassum sp.	Washed off	NE
4		Ulva sp.	Rocky patch	NE
5	Porifera	Mycale sp. (Orange-red)	Creeklet	NE
6	Cnidaria	Brown sea anemone (Bunodosoma sp.)	Rocky patch with sand	NE
7		Obelia geniculata	Rocky patch with sand	NE
8		Physalia physalis	Sand	NE
9		Porpita porpita	Sand	NE
10		Red sea Anemone (Bunodosoma cf goanensis)	Rocky patch with sand	NE
11	Arthropoda	Dottila sp.	Sand	NE
12		Matuta lunaris	Sand	NE
13	Gastropoda	Babylonia spirata	Sand	NE
14		Donax faba	Sand	NE
15		Dosinia sp.	Sand	NE
16		Dosinia sp.	Sand	NE
17		Janthina globosa	Sand	NE
18		Nassa ornatus	Sand	NE
19		Nassa pictus	Sand	NE
20		Nassarius distortus	Sand	NE
21		Nassarius pullus	Sand	NE
22		Nassarius stolatus	Sand	NE
23		Nerita sp.	Rocky patch	NE
24		Nodilittorina leucosticta	Rocky patch	NE
25		Oliva nebulosa	Sand	NE
26		Oliva oliva	Sand	NE
27		Paphia textile	Sand	NE
28		Siliqua radiata	Sand	NE
29		Solen sp.	Sand	NE
30		Sunetta donacina	Sand	NE
31		Thais bufo	Rocky patch	NE
32		Turritella duplicata	Sand	NE
33		Turris javana	Sand	NE
34		Umbonium vestiariium	Sand	NE
32	Opistho-branch	Phidiana militaris	Rocky patch	NE
36	Pelecypoda	Ostrea sp.	Rocky patch	NE
37	Echinoder-mata	Astropecten indicus	Sand	NE

Source: Apte et al, 2012

**Annexure 6**  
**Checklist of identified Species from Muddy Shores**

Sr. no.	Group	Name	IUCN status
1	Seagrass	Name	VU
2	Mangrove and Associates	Halophila cf. beccarii	LC
3		Acanthus ilicifolius	LC
4		Aegiceras corniculatum	LC
5		Avicennia marina	LC
6		Avicennia officinalis	NE
7		Bruguiera gymnorhiza	LC
8		Ceriops tagal	LC
9		Excoecaria agallocha	LC
10		kandelia candel	LC
11		Lumnitzera racemosa	LC
12		Rhizophora apiculata	LC
13		Rhizophora mucronata	LC
14		Sonneratia alba	LC
15		Sonneratia apetala	LC
16		Sesuvium portulacastrum	NE
17	Crustaceans	Clerodendron inermi	NE
18	Gastropoda	Uca sp.	NE
19		Cerithidia cingulata	NE
20		Ascemenia sp.	LC
21		Neritina violacea	LC
22		Telescopium telescopium	NE
23		Nassarius stolatus	NE
24		Nassarius olivacea	LC
25		Clithon oualaniensis	NE
26		Cassidula aurisfellis	NE
27		Elysia cf. Bengalensis	NE
28		Natica picta	NE
29		Heminoea sp.	NE
30		Platyvindex correous	NE
31		Platyvindex sp.	LC
32	Bivalvia	Littoraria undulata	NE
33		Perna viridis	NE
34		Marcia opima	NE
35		Arca granosa	NE
36		Gelonia sp.	NE
37	Reptiles	Crassostrea sp.	LC
38		Dog faced Snake (Cerberus rynchops)	LC
39		Black kite (Milvus migrans)	LC
40		Brahminy kite (Haliastur Indus)	LC
41	Aves	White-bellied Sea Eagle (Haliaeetus leucogaster)	NT

**Annexure 6 (Cntd...)**  
**Checklist of identified Species from Muddy Shores**

Sr. no.	Group	Name	IUCN status
42		White-breasted Kingfisher ( <i>Halcyon smyrnensis</i> )	LC
43		Little Egret ( <i>Egretta garzetta</i> )	LC
44		Little Egret ( <i>Egretta garzetta</i> )	LC
45		House crow ( <i>Corvus splendens</i> )	LC
46		Smooth coated otter	
47	Mammals	<i>Lutrogale perspicillata</i>	VU

Source: Apte et al, 2012

**Annexure 7**  
**Complete Checklist of Birds from Study**

Sr.no.	Common Name	Scientific Name	IUCN status
1	Little Grebe	Tachybaptus ruficollis	LC
2	Little Cormorant	Phalacrocorax niger	LC
3	Darter	Anhinga melanogaster	NT
4	Little Egret	Egretta garzetta	LC
5	Western Reef-Egret	Egretta gularis	LC
6	Grey Heron	Ardea cinerea	LC
7	Large Egret	Casmerodius albus	LC
8	Median Egret	Mesophoyx intermedia	LC
9	Cattle Egret	Bubulcus ibis	LC
10	Indian Pond-Heron	Ardeola grayii	LC
11	Little Green Heron	Butorides striatus	LC
12	Black-crowned Night-Heron	Nycticorax nycticorax	LC
13	Black Bittern	Dupetor flavicollis	LC
14	Asian Openbill-Stork	Anastomus oscitans	LC
15	White-necked Stork	Ciconia episcopus	LC
16	Oriental Honey-Buzzard	Pernis ptilorhynchus	LC
17	Black-shouldered Kite	Elanus caeruleus	LC
18	Black Kite	Milvus migrans	LC
19	Brahminy Kite	Haliastur indus	LC
20	White-bellied Sea-Eagle	Haliaeetus leucogaster	LC
21	Short-toed Snake-Eagle	Circaetus gallicus	LC
22	Crested Serpent-Eagle	Spilornis cheela	LC
23	Western Marsh-Harrier	Circus aeruginosus	LC
24	Pied Harrier	Circus melanoleucos	LC
25	Montagu's Harrier	Circus pygargus	LC
26	Shikra	Accipiter badius	LC
27	Booted Eagle	Hieraaetus pennatus	LC
28	Osprey	Pandion haliaetus	LC
29	Common Kestrel	Falco tinnunculus	LC
30	Peregrine Falcon	Falco peregrinus	LC
31	Little Ringed Plover	Charadrius dubius	LC
32	Kentish Plover	Charadrius alexandrinus	LC
33	Lesser Sand Plover	Charadrius mongolus	LC
34	Red-wattled Lapwing	Vanellus indicus	LC
35	Whimbrel	Numenius phaeopus	LC
36	Eurasian Curlew	Numenius arquata	NT
37	Common Redshank	Tringa totanus	LC
38	Marsh Sandpiper	Tringa stagnatilis	LC
39	Common Greenshank	Tringa nebularia	LC
40	Wood Sandpiper	Tringa glareola	LC
41	Common Sandpiper	Actitis hypoleucos	LC
42	Little Stint	Calidris minuta	LC



**Annexure 7 (cntd...)**  
**Complete Checklist of Birds from Study**

Sr.no.	Common Name	Scientific Name	IUCN status
43	Heuglin's Gull	Larus heuglini	LC
44	Yellow-legged Gull	Larus cachinnans	LC
45	Pallas's Gull	Larus ichthyaetus	LC
46	Brown-headed Gull	Larus brunnicephalus	LC
47	Black-headed Gull	Larus ridibundus	LC
48	Slender-billed Gull	Larus genei	LC
49	Lesser Crested Tern	Sterna bengalensis	LC
50	Large Crested Tern	Sterna bergii	LC
51	Little Tern	Sterna albifrons	LC
52	Whiskered Tern	Chlidonias hybridus	LC
53	Chlidonias hybridus	Columba livia	LC
54	Little Brown Dove	Streptopelia senegalensis	LC
55	Spotted Dove	Streptopelia chinensis	LC
56	Eurasian Collared-Dove	Streptopelia decaocto	LC
57	Rose-ringed Parakeet	Psittacula krameri	LC
58	Brainfever Bird	Hierococcyx varius	LC
59	Asian Koel	Eudynamys scolopacea	LC
60	Greater Coucal	Centropus sinensis	LC
61	White-rumped Needletail Swift	Zoonavena sylvatica	LC
62	Asian Palm-Swift	Cypsiurus balasiensis	LC
63	Alpine Swift	Tachymarpis melba	LC
64	Small Blue Kingfisher	Alcedo atthis	LC
65	Stork-billed Kingfisher	Halcyon capensis	LC
66	White-breasted Kingfisher	Halcyon smyrnensis	LC
67	Lesser Pied Kingfisher	Ceryle rudis	LC
68	Small Bee-eater	Merops orientalis	LC
69	Lesser Golden-backed Woodpecker	Dinopium benghalense	LC
70	Common Swallow	Hirundo rustica	LC
71	Wire-tailed Swallow	Hirundo smithii	LC
72	Red-rumped Swallow	Hirundo daurica	LC
73	Large Pied Wagtail	Motacilla maderaspatensis	LC
74	Yellow Wagtail	Motacilla flava	LC
75	Paddyfield Pipit	Anthus rufulus	LC
76	Red-whiskered Bulbul	Pycnonotus jocosus	LC
77	Red-vented Bulbul	Pycnonotus cafer	LC
78	White-browed Bulbul	Pycnonotus luteolus	LC
79	Common Iora	Aegithina tiphia	LC
80	Oriental Magpie-Robin	Copsychus saularis	LC
81	Grey-breasted Prinia	Prinia hodgsonii	LC
82	Ashy Prinia	Prinia socialis	LC
83	Plain Prinia	Prinia inornata	LC
84	Blyth's Reed-Warbler	Acrocephalus dumetorum	LC
85	Common Tailorbird	Orthotomus sutorius	LC
86	Purple-rumped Sunbird	Nectarinia zeylonica	LC

**Annexure 7 (cntd...)**  
**Complete Checklist of Birds from Study**

Sr.no.	Common Name	Scientific Name	IUCN status
87	Purple Sunbird	Nectarinia asiatica	LC
88	White-throated Munia	Lonchura malabarica	LC
89	White-rumped Munia	Lonchura striata	LC
90	Spotted Munia	Lonchura punctulata	LC
91	Black-headed Munia	Lonchura malacca	LC
92	House Sparrow	Passer domesticus	LC
93	Common Myna	Acridotheres tristis	LC
94	Eurasian Golden Oriole	Oriolus oriolus	LC
95	Black Drongo	Dicrurus macrocercus	LC
96	Ashy Drongo	Dicrurus leucophaeus	LC
97	House Crow	Corvus splendens	LC
98	Jungle Crow	Corvus macrorhynchos	LC

Source: Apte et al, 2012

**Annexure 8 A**  
**List of Large Scale Industries in Ratnagiri District**

Sr. No.	Name of the Industry	Address	Product
1	Gadre Marine Export Pvt. Ltd.	FP-1, MIDC, Mirjole, Dist. Ratnagiri	Fish & Fishery Products, Freezing of Marine Products, Fish Paste
2	Hindustan Unilever Ltd.	B-7, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Toilet Soap
3	Gharda Chemicals Ltd.	D-1/2, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Agrochemicals
4	Ratnagiri Gas & Power Project Ltd.	A/P. Anjanwel, Tal. Guhagar, Dist. Ratnagiri	Power Generation, Regasification of LNG
5	J S W Energy (Ratnagiri) Ltd.	Nandiwade, Jaigad, Tal. & Dist. Ratnagiri	Generation & Transmission of Electric Energy
6	Finolex Industries Ltd.	A/P. Ranpar-Golap, Tal. & Dist. Ratnagiri	PVC Resin & PVC Pipes
7	Bharati Shipyard Ltd.	Usgaon, Dabhol, Tal. Dapoli, Dist. Ratnagiri	Fishing Trawlers upto 45 m in length

Source: MSME Document, 2012

**Annexure 8 B**  
**List of Medium Scale Industries in Ratnagiri District**

Sr. No.	Name of the Industry	Address	Product
1	A.B. Mauri Pvt. Ltd.	D-7/2, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Compressed Yeast
2	Aimco Pesticides Ltd.	B-1/1, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Pesticides, Fungicides & Weedicides
3	Associated Cables Pvt. Ltd.	C-9, MIDC, Kherdi, Tal. Chiplun, Dist. Ratnagiri	Electrical Wires & Cables
4	Auchtel Products Ltd.	D-1, MIDC, Mirjole, Tal. & Dist. Ratnagiri	Iron Exchangers
5	Deepak Chemtex Ltd.	Awashi Adgul, Tal. Khed, Dist. Ratnagiri	Acid Dyes
6	Deepak Novochem Ltd.	D-27/3/1, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Cresols & Xylenols
7	Dow Agro Sciences	A-1, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Pesticides
8	Excel Industries Ltd.	D-9, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Phosphorous Trichloride
9	Exotic Fruits Pvt. Ltd.	G-20, MIDC, Mirjole, Tal. & Dist. Ratnagiri	Fruit Pulp, Puree & Juices
10	J.K. Talbot Ltd	C-1/2, MIDC, Gane Khadpoli, Tal. Chiplun, Dist. Ratnagiri	Engineering Files
11	Kansai Nerolac Ltd.	F-2/3, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Synthetic Resins
12	Pentokry Organy (India) Ltd.	D-1/1, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Acetic Acid & its Salts, Acetic Anhydride
13	Rallis India Ltd.	D-26, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Agrochemicals – Insecticides
14	J.K. Files India Ltd	A-1, MIDC, Mirjole, Tal. & Dist. Ratnagiri	Files, Rasps, Pilers, Pin-cers, Tweezers, Metal Cutting Shears
15	J.K. Files India Ltd	C-1/1, MIDC, Gane Khadpoli, Tal. Chiplun, Dist. Ratnagiri	Engineers Files, HSS Twist Drill
16	S.R. Drugs Pvt. Ltd.	B-3, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Diethyl Oxalate
17	SAF Yeast Co. Pvt. Ltd.	MIDC, Gane, Khadpoli, Tal. Chiplun, Dist. Ratnagiri	Baker's Yeast
18	Sandvik Asia Ltd.	D-27/1, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Machine Tools Material
19	Vanaz Engineers Ltd.	Sadavali-Deorukh, Tal. Sangameshwar, Dist. Ratnagiri	Gamma Acid – Amino-Alcohols their Ethers
20	SI Group India Ltd.	D-1/3, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Phenolic And Alkyl Phenolic Resins
21	Three M Paper Mfg. Co. Ltd.	F-1, MIDC, Kherdi, Tal. Chiplun, Dist. Ratnagiri	Paper & Paper Board
22	USV Ltd.	B-1/8, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Active Pharmaceutical Ingredients
23	Ultratech Cement Ltd.	MIDC, Zadgaon, Tal. & Dist. Ratnagiri	Cement Grinding Unit
24	Vinati Organics Ltd.	A-20, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Sodium salt of Methyl Allyl Suphonic Acid
25	India Oxalate Ltd.	B-2, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Oxalate Acid
26	Asahi India Glass Ltd.	A/P. Waked, Tal. Rajapur, Dist. Ratnagiri	Pesticides, Fungicides & Weedicides
27	Consolidated Cables Pvt. Ltd.	W-20/C, MIDC, Gane Khadpoli, Tal. Chiplun, Dist.	Electrical Cables
28	George Fischer Piping Systems Pvt. Ltd.	C-224, 225, 226, MIDC, Mirjole, Tal. & Dist. Ratnagiri	Piping Systems
29	Shree Pushkar Petro Products Pvt. Ltd.	B-103, MIDC, Lote Parshuram, Tal. Khed, Dist. Ratnagiri	Polyester Resins (Saturated)

### **The CMPA Project**

The Project “Conservation and Sustainable Management of Coastal and Marine Protected Areas” (CMPA) is a project of the Indo-German technical cooperation. It is funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) and implemented by the Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India, and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of BMUB.

Established to support the achievement of the Aichi targets of the Convention on Biological Diversity, the Project’s overall goal is to contribute to conservation and sustainable use of biodiversity in selected areas along the coast of India. Taking into consideration the economic importance of the coastal zone for large segments of the population, the Project’s approach is people-centered, thus ensuring the support for conservation by those depending on coastal ecosystems.

# Biodiversity Conservation: A Literature Review

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**giz** Deutsche Gesellschaft  
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