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Summary

The coastal and marine ecosystems of peninsular India have been surveyed in detail to identify and prioritize the 'Important Coastal and Marine Biodiversity Areas (ICMBA)' for their better management, in addition to the existing Marine Protected Areas. This study followed the standardized global, national and regional level approaches to develop a criteria with several indicators which were later used to identify ICMBA sites in India. A state-wise site matrix was prepared and prioritized based on these indicators considering the ecological, cultural and socio-economic values of respective sites. A total of 350 potential sites were surveyed all along coasts of peninsular India, of these, 106 sites were identified and prioritized as ICMBA. Along the west coast of India, a total of 62 ICMBAs were identified, and 44 ICMBAs along the east coast. Of these 106 ICMBA, 22 ICMBAs have been prioritized for immediate conservation actions. These sites are proposed for consideration of Protected Areas under various categories largely as Conservation or Communities Reserves.

Introduction

Mainland India has a vast coastline of about 5423 km length spanning 13 maritime mainland states and union territories, with diverse coastal and marine ecosystems, supporting nationally and globally significant biodiversity. The coastline also supports almost 30% of its human population who are dependent on the rich exploitable coastal and marine resources. The coastline of the Bay of Bengal and Arabian Sea continues to be a rich fishing ground in the South Asian region, and India is one of the world's largest marine product exporting nations. Marine ecosystems such as estuaries, coral reefs, marshes, lagoons, sandy and rocky beaches, mangrove forests and sea grass beds are all known for their high biological productivity, and they provide a wide range of habitats for many aquatic plants and animals. They also provide important food resources and innumerable ecological services to human beings. Therefore, sustainability of these fragile ecosystems needs to be our primary concern. So far, we have largely looked at the marine biodiversity as a source of commercial products instead of appreciating their ecological values and services, which has resulted in overexploitation, and several coastal and marine species are now on the verge of extinction.

The coastal environment of India hosts a tremendous diversity of life. The east and west coastlines of India are dotted with estuaries, having a strong influence on the coastal and marine flora and fauna. These freshwater–seawater confluence environments are often sites of human settlements and are targets for expanding urban development, tourism, aquaculture and related activities. Moreover, human activities such as destructive fishing, shipping, coastal development and discharge of untreated effluent from industries have caused considerable damage and pose a severe threat to coastal and marine biodiversity. In addition to these, global warming due to climate change also poses a major challenge to the marine biodiversity of India.

Environmental and Ecological Signature

The length of the west coast is approximately 2877 km. It stretches along five states (Gujarat, Maharashtra, Goa, Karnataka, Kerala) and one union territory (Diu & Daman). There are diverse habitats along this

coast, such as rocky outcrops, mudflats, lateritic shorelines, narrow funnel-shaped estuaries and backwater areas. In general, the climate is arid in the north and humid in the south. The rainfall is high from the central portion to the south. The shelf is steep, with narrow beaches and a dynamic coast that experiences seasonal erosion. The eastern coastline runs along four states (West Bengal, Orissa, Andhra Pradesh and Tamil Nadu) and one union territory (Puducherry). It stretches over about 2545 km. The coast has numerous wide delta-forming estuaries, sand dunes and wide beaches. The shelf forms a gentle slope. The climate is dry and humid, and seasonal cyclones are experienced.

As mentioned in the foregoing, the marine and coastal environment of India includes geomorphological features that harbour a unique and rich biodiversity. The coastal area of the country supports a significant proportion of the country's population, thereby exerting tremendous pressure on our coastal and marine resources. The Marine Protected Area Network is a tool for managing natural marine resources for biodiversity conservation and for the well-being of people dependent on the resources. The Coastal Regulation Zone Notification, 1991, National Biodiversity Act, 2002 and the Environment (Protection) Act, 1986 have been enacted by India for conservation of the coastal and marine environment along with the Wildlife (Protection) Act 1972, which also provides for establishment of wildlife protected areas (PAs) by state governments. According to Rodgers et al (2000), 6.79% of the Indian coastline has been protected under MPAs, but most of them are in the Andaman and Nicobar Islands and a few are on the mainland coast of India. There are 24 coastal and marine PAs in mainland India with an extent of approximately 8214 km^2, which is about 4.92% of the total area covered under the entire protected area network. Four of them are marine national parks, and the rest are wildlife sanctuaries. The Gulf of Kachchh Marine National Park, the Gulf of Mannar National Park, Sundarbans National Park, Bhitarkanika Wildlife Sanctuary and Coringa Wildlife Sanctuary are some of the important MPAs on the peninsular India.

India is one among the 17 mega biodiversity countries, and it is well known that apart from its terrestrial area, the coastal and marine counterparts hold rich biodiversity. Venkataraman & Raghunathan (in this ENVIS Bulletin) have given empirical data on the biodiversity of the coastal and marine areas of India in detail. Hitherto, the coastal and marine biodiversity of India was represented only from well-known areas that were already conserved as the PAs mentioned in the foregoing. Besides these existing PAs, potential areas of high biodiversity values are yet to be identified. Coastal and marine habitats having rich biodiversity along the coastline are yet to be represented and highlighted for conservation measures. A separate long-term research exercise is required to develop a tool for site identification and prioritization for designation of important conservation areas.

Importance of Study

It is known that there is a mosaic of habitats such as coral reefs, estuaries, intertidal mudflats, mangroves, backwaters, sand dunes, rocky shorelines, sea grass meadows and lagoons. But detailed studies on the coastal and marine biodiversity of the Indian mainland are lacking, and so these habitats and the biodiversity are represented poorly. It is obvious that the biodiversity is distributed widely among different associated habitats and conserving a single area would never support all the important species and ecological processes worth protecting. Furthermore, biodiversity can only be conserved by preventing habitat loss and by restoration. The importance of any single species in the functioning of an ecosystem may not be high, but protection of a mosaic of habitats will certainly preserve diversity among the species of conservation importance. Also, to achieve the Biodiversity Aichi Targets with reference to the marine environment are to preserve ecologically sensitive areas and maintain the health of the marine environment by protection, sustainable use and conservation of marine living resources. This has the prerequisite that

sites that harbour both flora and fauna of conservation significance and diverse habitats supporting them are to be identified.

Review of Existing National and Global Existing Tools

Identification and conservation of a potential site is not a new science, and these actions have been carried out for a very long time. Several tools/methodologies do exist for identifying potential sites, but their approaches vary for different ecosystems and species of conservation significance. Existing methodologies for identifying and conserving marine and coastal PAs at the global (macro-level) scale involve the following: (i) *Biodiversity hotspots*, discussed in detail by Myers (1988), on the basis of different habitats; (ii) *major tropical wilderness areas*, ecosystem based, covering large biogeographic areas (Myers 1990; Mittermeier 1990) and (iii) *mega-diversity countries*, entire countries identified for conservation through biodiversity assessment (Mittermeier et al 1997). Many other options exist for site identification, which are applicable to both terrestrial and coastal areas. Birdlife International uses two different tools to identify conservation areas—Important Bird Areas (IBAs) and Key Biodiversity Areas (KBAs). The EU's Habitat Directive uses Special Area Conservation (SAC) as a part of the NATURA site network, and World Wide Fund for Nature and The Nature Conservancy identify potential conservation sites and designate them as Marine Eco-regions.

In India a micro-level approach in which sites are identified on the basis of the status of threatened taxa (Untawale et al 2000) and species richness and habitat types (Singh et al 2000) is used. It is used within a provincial or regional scale that covers a relatively small area at the country level. Untawale et al (2000) identified a few sites and proposed they be declared important areas for conservation, but a lack of systematic prioritization with minimal data and an *ad hoc* method prevented support from being gathered. Similarly, Singh et al (2000) and Singh (2003) also suggested different sites along the Indian coastline for conservation, but they failed to gather support. According to Untawale et al (2000), the data on marine species and ecosystems are sparse. Hence a detailed inventorization needs to be carried out to identify priority areas for conservation.

Various tools, such as MARXAN, C-PLAN, SPEXAN (Spatially Explicit Annealing Tool, to assist the Nature Conservancy), SITES (Site Selection Module, based on regional representative system of nature reserves), SPOT and ZONATION, have been developed for assisting with identification of priority areas for conservation. All are computer-modeled target-oriented tools, using complex algorithms for identification of conservation targets.

Methods

The marine protected areas (MPAs; biosphere reserves, national parks and sanctuaries) of the mainland Indian states were formally visited with the assistance of state forest department officials. During the visits, the ongoing management plans were reviewed. Discussions were held with the PA managers, members of NGOs, community stakeholders, etc. to document the current/existing conservation practices and issues relevant to protection. Information regarding existing linkages and knowledge sharing structure was collected to develop a network of MPAs.

Potential site identification

It is imperative to identify and designate coastal and marine sites that have the potential to support diverse organisms/habitats but are not under the existing PA network so that they may be considered for conservation. Designating and protecting such sites will definitely improve the ecological services of coastal

habitats, which will be ultimately helpful for biodiversity conservation as well as the well-being of humans in the region/state.

Survey and tool design

For identification of potential areas for conservation, we carried out a 4-year long independent process in the 13 coastal states. Prior to the survey, the available literature was gathered. Baseline information was gathered to identify the sampling design and approach. A series of discussions were held with local institutes, organizations, experts from NGOs, public agencies and concerned departments to index potential sites so that they represented the coastal and marine biodiversity maximally. A total of 350 sites (Table 1) were identified. Habitats such as estuaries, backwater areas, river mouths, mangroves, nesting beaches of turtles, rocky and lateritic shorelines, estuarine and offshore islets and so on within 5 km from the high tide line were included. Topographic maps (1:2,50,000 scale) from the Survey of India were used to plot, locate and access the sites. In a preliminary survey, all listed sites were visited physically with the help of state forest department staff. For every site, observations and information collected in the field were documented. Secondary information from state forest departments, institutions and NGOs was compiled to explore the possibilities of designating as candidate sites for conservation. A confirmatory survey was then conducted to examine conservation issues pertaining to the site to evaluate the candidature.

This study was designed with a representation approach addressing our objective of identifying important coastal and marine habitats on the Indian mainland to prepare a directory in terms of 'ICMBA', i.e., Important Coastal and Marine Biodiversity Areas. This approach was adopted to promote conservation of coastal and marine ecosystems supporting diverse fauna, flora and ecological processes. Identification, delineation and representation of potential sites in this manner was considered an important aspect for concentrating conservation efforts. The emphasis of ICMBA on priority setting provides a local perspective for implementing efforts by the state governments and other conservation groups.

Development of identification tool

The problem of identifying and selecting areas for conservation is that this usually requires the use of comprehensive methods that maximize the preservation of species in the long term. It is also important to select targets that will view protection through a wider lens based on local perspective. In developing an identification tool for a broad conservation approach, setting conservation priority targets specific to the country's context is the prime phase. This phase is crucial if limited resources are available to address the existing issues at all levels. The initial data analysis espoused the idea of developing a global generic framework and then using it in the Indian context for identification. The identification exercise began with six different targets that were often considered important features for safeguarding coastal habitats and their biodiversity. Conservation-related targets were picked up from standard global approaches and designated 'conservation amplifiers' because they improve the opportunities for consideration or simply allocate more weight to protection measures. The tool was developed with six different criteria as conservation amplifiers and 26 subunits as indicators or goals respective to each criterion. The conservation physiognomies of the six criteria and their indicators are described in the following.

Criterion 1: Ecosystem resilience

Ecosystem resilience is the capacity of an ecosystem to cope with disturbances (both anthropogenic and natural), without shifting into a qualitatively different state (Hollings 1973). In general a resilient ecosystem is capable of withstanding any typical impact and has the ability to rebuild itself if damaged to some extent. The size of the ecosystem, its adequacy to maintain ecosystem level processes, contiguity or linkage with surrounding ecological units, presence of different types of habitats adjacent to it and linkage

with existing PAs (as wildlife corridors) are important features for any site to be resilient. This criterion has five different goals that are important concerns for any site to be considered for conservation.

a. *Area* – The area of the site is an important measure because the ecosystem will be resilient enough only if it has considerable area. Similarly the purpose of conservation (i.e., resilience success) also largely depends on the size. Small and insular sites and sites having large perimeter-to-area ratios are susceptible to external impacts, and their resilience cannot be well preserved.
b. *Habitat diversity* - An important component of this criterion is knowing the degree of habitat diversity the site encompasses. Diverse habitats support a site's resilience. Higher habitat diversity increases ecosystem efficiency and productivity, stabilizes the overall ecosystem functioning and makes the ecosystems more resistant to perturbations. It is well known that coastal and marine habitats are often associated and interrelated.
c. *Ecosystem contiguity* - This goal verifies the existence of contiguity or through-flow between habitats, and this decides the habitat fragmentation. The degree of through-flow is the determining factor for habitat contiguity and is an important component of the resilience of an impaired habitat since equilibrium can be maintained by nutrient exchange from associated habitats.
d. *Site adequacy*- This gauge highlights the competence of the identified site to maintain ecosystem level processes, i.e., nutrient flow, salinity changes, etc. The appropriateness of the habitat size or the spatial extent of the important features of the habitat governs resilience. Associated niches or buffer areas, if any, may be merged with the identified sites if they are not adequate to support and maintain ecological functions.
e. *Wildlife corridor* - This deals with the connectivity of the site with the existing PAs adjacent to it, if any. The site may be connected either by vegetation or by water and serve as a passage for nutrient through-flow or for biodiversity spill-over. A typical site may be considered as a separate entity for conservation or may be merged with an existing PA.

Criterion 2: Ecosystem function

Sustainability of any typical ecosystem largely depends on its function and processes and should have the ability to keep them within homeostatic limits so as to maintain its well-being. Critical physical, chemical and biological processes such as water retention capability, carbon trapping and cycling, nutrient exchange, biotic and abiotic energy flux and protection against natural catastrophes determine the habitat integrity. Hence it is imperative to examine the site's habitat integrity before considering it for conservation. The most important goals related to major ecosystem functional mechanisms are described in the following.

a. *Freshwater discharge/recharge function* – The presence of sufficient freshwater drainage and provisions for recharging facilities have been considered to give value to a site.
b. *Erosion control system* – Dynamic coasts are prone to erosion, and this poses serious problems to the sustainability of an ecosystem and its function. Ranking is based on the presence of any natural features that control erosion to sustain the ecosystem.
c. *Carbon sequestration*– Sites with diverse habitats having provisions to sequester carbon are valued.
d. *Natural protection* - Sites having any natural features that protect their habitats against disaster so as to sustain the ecosystem function are identified.

Criterion 3: Biodiversity uniqueness

Biodiversity is a prime issue for any conservation action. Species richness, abundance and their status determine the degree of protection needed to conserve their habitat. Often species richness and abundance were categorized on the basis of weight ranking. Sites were prioritized for conservation on the basis of presence of species of conservation significance, such as threatened and endangered species that are not abundant. The presence of threatened, restricted-range, flagship and endemic species alone was considered for conservation instead of richness and abundance of any given species in an identified site. Sites having provisions for species of conservation significance to gather, breed and forage (for migratory species) were also considered. All goals in this criterion were ranked based on the presence/absence of the respective following categories.

a. *Globally threatened species* – This goal verifies the presence of globally threatened species in the site.
b. *Regionally threatened species* – This goal is ranked depending on whether the site harbours any regionally threatened species.
c. *Restricted range species* – Whether the sites support any restricted-range species was considered in this ranking.
d. *Flagship species* – Sites were ranked on the basis of whether they supported any flagship species.
e. *Endemic species* – Sites were ranked on the basis of the presence of any endemic species.
f. *Nursery and breeding provision* – This goal looks at whether sites support species of conservation importance in nursing and breeding.
g. *Species congregation* – Sites were ranked based on whether species of conservation significance congregated at them.
h. *Migratory species congregation* – This goal identifies sites based on the congregation of migratory species on them in winter.

Criterion 4: Cultural, religious and aesthetic significance

The social and cultural significance of a site was recognized through its specific heritage status, which is often linked with cultural, historical, religious and aesthetic importance associated with human activity. Some areas have one or more specific intrinsic features such as customary practices of indigenous people, with historical imprints often causing a site to be considered to have conservation significance because of the biodiversity associated with it. Conserving biodiversity based on values under this criterion is often more sustainable because of the applicability of statutory regulations. Observations at sites exhibiting four characteristic indicators under this criterion receive points in the scoring system.

a. *Cultural value* – This indicator looks for ethnic or customary practices at a site that involve traditional beliefs worth conserving.
b. *Religious value* – This looks for religious beliefs and related activities being practiced at the site that could make positive contributions to biodiversity conservation.
c. *Historical value* – This indicator seeks to conserve sites with historical backgrounds and archeological resources that are associated with coastal components.
d. *Aesthetic value* – This represents the visual appeal and pleasantness of a site, including elements such as waterscapes, scenic views and unobstructed views of habitats.

Criterion 5: Socio-economic potential

This represents the common customary tenure, income generation opportunities and land use options of a site. Revenue can be generated from various activities, including natural resource extraction, recreation, forestry and farming, use of water resources and transport. The revenue generation potential

determines the site's importance to the resource users and the level of importance then reveals how the site can be conserved sustainably. This criterion has four indicators that examine the conservation relevance through an economic lens.

a. *Renewable natural resource extraction opportunity* – Information for this indicator is collected either by direct observation at the site or through an informal questionnaire issued to local dwellers who extract resources for their livelihoods.
b. *Ecotourism prospects* – Ecotourism is considered to be an asset to any habitat because it brings together sustainable travel practices that promote conservation and benefit local communities through income generation. Therefore, sites that could attract tourists were noted.
c. *Support for agriculture* – Sites associated with freshwater swamps and backwaters often support agriculture on which most of the local dwellers depend. Observations were made on agricultural practices adjacent to the sites.
d. *Aquaculture and fisheries* – Most of the income generation in coastal areas is either from capture fisheries or from fishery farming systems. Whether a site supports farming systems and capture fishery practices was noted.

Criterion 6: Land tenure

This is an important criterion in any conservation planning exercise. It gives information/details about the rights holding of the site. It wouldl be easy to plan and protect a site if the possession is with the government. Access, resource extraction, infrastructure development, supplementary conservation measures and related activities may get delayed if the site is under private tenure, and acquisition better conservation may take time. This criterion with a single indicator looks at site ownership.

Scoring system for ICMBA site identification

The information collected from 350 sites was sorted and a matrix of 26 goals spread over 6 criteria was prepared (Table 2). Binary scores were assigned to each of the indicators because it was assumed that weight-based ranking could minimize the candidature score, which could decrease further during the prioritization process. For example, with weight-based ranking of area, only sites having larger areas get considered as candidate sites, but smaller areas receiving the smallest weights can also support species of conservation significance. This scoring system ranks all indicators of every criteria with identical weights, which reduces the possibility of subjective evaluation and ensures that no indicator is overlooked. Every site is given an equal opportunity to be considered a candidate site with just Yes/No or Presence/Absence responses regarding the indicator, without weights being assigned to the values (species abundance/richness/area etc.). Candidate sites are ecosystems or habitats in an area that have potential to the point that they qualify for protection as ICMBAs. The candidate status of a site alerts resource managers of that region to the need for conservation and motivates them to adopt measures to prevent further degradation.

The total score of a site was divided by the total number of indicators to obtain the score ratio (the Conservation Priority Index (CPI) of a site). The total score of each was calculated, and if any site scored a CPI of 0.5 or greater, it was categorized as a candidate site for conservation. Candidate sites with a CPI well above 0.7 was prioritized for consideration as needing immediate action. The ecological features, supplementary features and environmental settings of prioritized sites were highlighted to emphasize the urgency of conservation.

Results

This strategic study has resulted in the identification of coastal and marine areas for conservation in each maritime state of India. Of the 350 sites examined, 106 sites were identified as candidate sites— 62 sites on the west coast (Table 3, Figure 1) and 44 on the east coast (Table 4, Figure 2). All these 106 sites had CPI scores of 0.5 and above. About 22 sites with scores greater than 0.7 were considered as priority sites. Each identified site has its own priority and characteristics. Details of the location, major habitat types, biodiversity, threats, conservation status, conservation significance and designation category of each identified site are provided separately.

Identified Important Coastal and Marine Biodiversity Areas of West Coast

1. **Koteshwar:** This intertidal mudflat is adjacent to the Narayan Sarovar Wildlife Sanctuary. It is located at the mouth of Kori Creek, at the northern extreme of Kachchh District. The site comprises widespread mudflats with stunted mangrove growth. The climate is arid and the area is devoid of dense terrestrial vegetation. It is well known as the feeding ground for wetland birds. Mangroves and mangrove-associated species are important floral forms. The site is also known to support some herpetofauna. Since the site is very dry, no agricultural activities are practiced around it. Fishing is the only socio-economic activity and that too with no commercial demand. The site is not protected under any conservation measures, but the entire area is under the control of the Border Security Force and Naval Coastal Guard. No potential threats have been recorded around the site. Because of the low demographic profile, the pressure on fisheries is also meager, with minimal habitat utilization. The extensive mudflat, with mangroves, supports an enormous wealth of marine fauna and wetland birds, which are considered as an important ecosystem asset for the region. The establishment of mangroves by the forest department has improved the habitat by attracting more fauna to dwell in it. This site has been designated a community reserve involving the Border Security Force and Naval Force.

2. **Jacau:** This candidate site is located at the north-western extreme of Gujarat and has extensive mudflat habitats. The climate is dry and the area has sparse terrestrial vegetation dominated by thorny scrubs. Mangroves are the important floral components of the salt marshes. numerous diverse soil-dwelling fauna is found in the mudflats. Pelicans, Painted Storks and various wetland birds gather here for feeding. The site supports a variety of fishes, molluscs and crustaceans, which support fisheries. Fishing and fish processing are the main economic activities around this site. This is one of the important fish landing centres of Kachchh. Camel and cattle rearing are other related activities, but camel rearing depends on the existence of mangroves. No legal protection exists around here to conserve this mudflat habitat. However, private sectors running industrial units are involved in improving the site by conducting afforestation programmes. Waste generation from fish processing units deteriorates the environment by addition of excess nutrient. Fly ash from cement factories hampers the growth and survival of the established mangroves. Trimming of mangrove foliage for feeding camels threatens the well-being of the mangroves. The extensive mudflats supporting mangroves and salt marsh flora, with the potential to harbour different marine animals, are the ecological asset of the region. The site has been proposed as a community reserve involving the fishermen community and the Border Security Force.

3. **Suthri:** This site is a narrow beach associated with an open grassland on either side of the Kankavati River, which meets the Arabian Sea near Suthri, in Kachchh District. It is the northernmost beach habitat on the west coast of India. It experiences an arid climate.. The narrow strip of beach, bordered by minor dunes with turf of *Cyprus* grasses, extends uninterrupted up to Laeja. Sand binders are the important floral components. These are dominated by *Cyprus* grasses

and runners such as *Ipomoea*. The important avifauna consists of shore birds on the beach and grouses and passerine birds on the dry grassland. The site has been used rarely by sea turtles. Fishing is the only livelihood option. No other revenue-yielding activities were observed here during this survey. The entire strip of this narrow beach is devoid of protection, and the local fishing community has free access to it. No potential threat factors were recorded around this site. Since this site is the only beach of the Kachchh coastline that will potentially be used sea turtles, it deserves to be considered for protection. This candidate site was proposed as a s a community reserve involving the local fishing community for routine monitoring of the beaches for turtle nesting.

4. **Porbandar:** The designated site is located adjacent to the bird sanctuary in Porbandar, in Porbandar District of Saurashtra. The climate is dry but with productive agricultural cropland around. The backwater swamps (locally known as *Kerly*), with an extent of around 100 km^2, narrow beach, saline wetlands and vegetation cover around this site are important habitats. The monospecific mangrove thickets within the islets and fringing the swamp and the vast stretches of halophytes in the swamp area are the important flora. The resident and migratory avifauna need to be considered. Porbandar is one of the important fish landing centres of the Saurashtra coastline. The turnover from fish and fishery products (from processing units) along the coast is comparatively high. Tourism at this historical site and eco-tourism in and around the bird sanctuary and beach and related activities yield good revenue to the local community. The bird sanctuary is provided complete protection by the forest department, but the mangroves and backwater swamp are exposed to the public. Unregulated fishing within the swamp, fishing vessel traffic and hunting of birds, which is reported frequently around this site, hinder the free movement of migratory birds to the sanctuary and the feeding ground nearby. Free access of the public to the swamp areas and tourism-related disturbance along the beach are other observed threat factors. The presence of the bird sanctuary, the potential turtle nesting beach, the backwater swamp, islets with mangroves, salt pans and minor aqua farms form a mosaic of habitats forthe diverse flora and fauna. The backwater swamp and mangrove act as the feeding ground for most of the wetland birds visiting the sanctuary. They are significant in terms of conservation measures. This site has been proposed as a wildlife sanctuary, and the area may be extended to cover all the above-mentioned habitats to facilitate safe and free movement of birds.

5. **Madhavpur:** This site is a long coastline lying between Porbandar and Madhavpur, in Junagadh District, in Saurashtra. The climate is dry, and with there is little dense vegetation cover around the coastline. Three species of sea turtle, commercially important fishes, dolphins, porpoises and the Whale Shark are the most important marine organisms recorded around this site. The dense mangroves and associated swamp support diverse avifauna in winter. Sand binders and grasses growing parallel to the beach make up the noteworthy vegetation coverage. Fishing and fisheries-related activities are the main economic activities observed. The Gujarat State Forest Department has established a hatchery and protects the viable nesting beaches of this area. An interpretation centre has been set up to create awareness among the public and fishermen. Intensive and illegal fishery practices along this coastline are the main activities posing problems to the nesting and feeding marine organisms. The tourism development around the beaches is expected to become a threat in the near future. The coastal waters adjacent to this site are highly productive and are potential breeding grounds of many commercially important fishes. The dense mangrove vegetation of Kerly Lake and the wintering birds need to be conserved. Nesting of sea turtles has been recorded on the narrow beach. The open sea is well known for dolphin, porpoise and Whale

Shark sightings. The site has been designated a marine conservation reserve involving the fishing community. Routine monitoring of the endangered and flagship species has been suggested. The area under protection may be extended towards the open sea after the marine aquatic habitat has been studied well.

6. **Diu:** This candidate site is a composite habitat with a rocky shoreline, mangrove cover, mudflats and an extended saline swamp lying between an island and the mainland in Junagad District, but within the union territory of Diu. The site has a dry climate and has sparse terrestrial vegetation. Tidal action flushes the entire mudflat-and-mangrove area. Monospecific mangroves (*Avicennia marina*), the salt marsh vegetation at the fringes of the mudflats and creeks and algal mats are the important salt-tolerant vegetation. There are other dry tropical tree species also. Molluscs, crustaceans of the rocky shoreline, fishes and wetland migratory birds are the species of conservation significance. Fishing and fishery-related processing are among the important economic activities in Diu. However, coastal tourism is the main industry here. The local forest department has imposed strict regulations to stop bird hunting around the mudflats of this region, and access is restricted to some extent. But there is open access to other important mangroves and the rocky shoreline is open, as a result of which there are violations by tour operation and related activities. The site needs stringent protection so that the illegal access and hunting are controlled. Tourism-related activities and illegal hunting are the two important threats observed around this site. Creating public awareness by establishing sign boards all around will minimize the problem. The composite habitat is an ecological asset to this region, and the richness of the biodiversity of these habitats highlights the significance for conservation. This candidate site has been designated a community reserve involving the dependent fishermen community and the local tour operating agencies.

7. **Gopnath:** This site is located on the northern shore of the Gulf of Khambat between Mahuva and Bhavnagar. The climate is dry, and the region is largely covered with scrub forest. Gopnath is gifted with a wide coarse-sand beach, paleodunes and the associated scrub vegetation cover. The exposed mudflats at Mahuva and near Bhavnagar are covered with sparse mangrove vegetation, and the beaches are fringed with sand binders and grass. The associated scrub forest has dry tropical thorn species and many medicinal plants. Molluscs, crustaceans and other coarse sand-dwelling organisms are the important marine fauna; however, the scrub supports different reptilian and ungulate species. Tourism operation related to beaches, recreation and pilgrimage to the Mahadev shrine is the important revenue yielding activity here. The scrub area is used to cultivate commercially important crops such as *Aloe* and other species of medicinal valued. Only the cultivated areas within the scrub forest have been protected by the local people and partly monitored by the forest department to protect wildlife. The beach and paleodune areas accessible by the public are devoid of any protection. The free access enjoyed by the people visiting the beach as tourists and the pilgrims visiting the Mahadev shrine during festivities generates waste and pollutes the beach and associated habitats. The waste generated by this and temporary camping this pose threats to the entire area, causing a deterioration of the quality of the habitat. The murky coarse-sand substratum of the beach area is a good habitat for marine molluscs and crustaceans and thus acts as a feeding ground for shoreline birds. The coast-associated scrub vegetation is an additional asset because it supports wildlife and important floral species. The site has been designated a community reserve involving the local communities and tour operating agencies.

8. **Bhavnagar:** This site is located a little south of Bhavnagar town, in the northern extreme of the Gulf of Khambat. An arid climate prevails, and this region is covered with sparse dry tropical vegetation. The high tidal amplitude of this area has produced a huge expanse of mudflats along the coastline. The wide mudflats and intertidal areas are covered with mangroves, dominated by *Avicennia marina*, and associated salt-tolerant floral species. The murky soil substratum of the mudflats and minor creeks is abundantly covered with marine algae. The mudflats of this region are reported to support passing wetland birds. The foraging wetland and shoreline birds, molluscs and crustaceans of the mudflats and nearby salt pans are important faunal species of conservation significance. Minor fishing activities and salt production are the main socio-economic values observed around this site. The agricultural croplands adjacent to the rivers fed by the Nalsovar are seasonal. Birds feed on the salt pans monitored by the Central Salt & Marine Chemicals Research Institute (CSMCRI) and salt workers, whereas the vast mudflats with mangroves are devoid of any legal protection and are being exploited by the fishing community. Intensive salt production and the related activities deter birds from congregating. Pollution from the industrial sector in the vicinity adds pollution to the coastal waters and thus poses a threat to the wetland birds and marine animals. The animals of the extensive mudflats, the mangrove and algal mat coverage and the molluscan and crustacean populations along the shoreline are the important life forms of conservation significance. The dynamic mudflats are an ecological asset in this region, serving as feeding grounds for various wetland birds. The site has been designated a community reserve with the involvement of the CSMCRI and the salt workers.

9. **Wadgham:** This site is at the confluence of the Sabarmati and Mahi rivers at the Arabian Sea, at the very end of the Gulf of Khambat. Because of the confluence of these two mighty rivers and heavy sedimentation, a large area of dynamic mudflats has been formed. The climate is dry, and there is sparse terrestrial vegetation, dominated by grass and thorn scrub. The most important edaphic factor influencing the region is the high tidal amplitude. The monospecific mangrove and the salt-tolerant marsh vegetation are the important floral components, and the foraging wetland birds, food-supplying molluscs and crustaceans, *Bonellia* and fishes are the significant fauna of this habitat. Fishing and salt production are the main socio-economic activities around this region. However, croplands are being maintained for seasonal production, but many of these are defunct because of salt ingress. There is no direct access to this site, and it is not possible to reach some parts near the waterfront. The dynamic mudflats restrict the exploitation, and thus there is no need for protection measures. The entire site has not been afforded any legal protection, but the mangrove plantations are monitored by the local people. As mentioned previously, access to certain areas of this candidate site is impossible because of the tidal influence and soft, murky mudflats. Occasional bird hunting has been locally reported, but this is not routine. The site is almost free of threats except for point source pollutants from the river discharge. The large flocks of foraging wetland birds, mudskippers and commercially important molluscs of this mudflat habitat are the important fauna of conservation significance. The vast mudflat is an ecological asset to this region, serving as aquifers. The site has been designated a community reserve involving the local people dependent on seasonal agriculture, with monitoring by the forest department.

10. **Aliabet:** Thise site is an extensive mudflat with an area of about 640 km^2 located at the mouth of the mighty River Tapi in Bharuch District, southern Gujarat. The climate is arid to humid, and there is sparse tropical vegetation. The site was earlier considered an island, and in the course of time it joined the mainland due to excessive sedimentation. A wide span of the mudflats and creek is covered with marshy vegetation, and two species of mangrove are found distributed all around.

About five species of marine alga are reported to be found here. Fisheries and cattle rearing are the two main economic activities here. There are a few aqua farms and salt pans in the southern portion, but these are seasonal or non-productive most of the times. Aqua farms and salt pans in the northern part, especially in Dahej, support many poor family of this region. The important minor fishery practice observed here is collection of mudskippers, with many poor local people depending upon it. The entire area lacks any legal protection and has free access on all sides. The marsh and mangrove habitats at an end are naturally protected by mudflats and a network of creeks. There are no potential threats at the site except salt making at a few salt pans and related activities. Fishing along the creeks and mudskipper collection do not pose any disturbance to the habitat because the activities are limited or restricted only to a certain area. Extensive mudflats with salt marsh vegetation and monospecific mangrove cover are important habitats for feeding wetland birds. The abundant availability of mudskippers in this region is an important aspect for conservation. The utilization of mangroves by *maldharis* for traditional camel rearing has additional conservation significance. The site has been designated a community reserve involving the local fishing community and salt workers.

11. **Purna:** The Purna is a perennial river originating from the Satpura range and draining into the Arabian Sea. The estuarine mouth is wide (1.7 km), and the tidal influence can be observed up to 25 km upstream. Extensive mudflats at the mouth and fringing mangroves along the river and islands are important features of this site. About 7 species of mangroves have been recorded within the estuarine islets, with *Avicennia marina* dominating. Seventeen mangrove-associated species and three dune binders have also been recorded around this site. This site is considered important in terms of the occurrence of rich mangroves and their associated biodiversity**.** In Gujarat within a mangrove area of around 400 ha. Estuarine fishes, crabs, mollusks, etc. and wetland birds are important faunal groups adding to the biodiversity value of this ecosystem. The areas adjoining this wetland are surrounded by minor salt pans, and these are seasonal in production. Fisheries are the only routine activity around this estuarine habitat; however, the fisheries potential has not yet been evaluated. The site currently does not have any conservation measures. Very recently, the Gujarat Ecological Education and Research (GEER) Foundation identified the importance of this site and has begun research activities. No potential threats were noted around this estuarine area except the intensive fishery activities. Due to a strong water current and the network of creeks, it is difficult to approach the mangrove islets. Only local enter it, and so the biotic potential of this habitat has long remained unexplored. The site comprises intertidal mudflats with mangroves, salt marshes, patches of beach with minor dunes, tidal creeks, etc. Extensive mudflats at the lower reaches or at the estuarine mouth lead to the formation of islands with a network of creeks. The site has been designated a conservation reserve, and it is suggested that the monitoring and research work at this habitat by the GEER Foundation be continued to catalogue the richness of the biodiversity.

12. **Ambika:** This site is an estuarine area in southern Valsad District, with a perennial freshwater source draining into the Arabian Sea near Bilimora. The site is located at the shadow area west of the Satpura range and is covered with sparse tropical vegetation. Where the river meets the sea, there are several islets with dense mangroves and vast intertidal mudflat supporting soil-dwelling animals. About 4 species of mangroves, 12 species of mangrove associates and many species of marine alga and tropical forest vegetation are important floral components. Commercially important fishes of the estuary, crustaceans, molluscs and, most importantly, wetland birds add value to the faunal diversity. Not many harvest activities related to the economic yield have been recorded

except fishing. The site is surrounded by cropland, with vegetables and some cash crops being cultivated. The site is freely accessible and is not protected under any scheme. Fishing poses a threat of some sort to the mangroves since fishermen go to every islet of this estuary and even stay there for some time. The wetland birds are threatened by local dwellers who wander around the mudflats and mangroves for firewood collection. The islets with mangrove are the most important habitats of this estuary, supporting molluscs and varieties of birds. The estuarine area is a good fishing ground for commercially important species, and if given protection, the site will recruit several other marine fauna too. The site has been designated a community reserve involving the local fishing community and bird watchers' association.

13. **Damanganga:** Damanganga is an estuary located adjacent to Daman town, south of Valsad District. Mudflats at the estuarine mouth and immediately inside are the important habitats of this site. The site is surrounded by dense settlements and experiences routine intrusions**.** The climate is humid, and there is dense terrestrial vegetation. Molluscs, crustaceans and fishes are the important fauna recorded from here, and three species of mangrove, five species of mangrove associates and two marsh species of vegetation have been reported from within the estuarine area. The mudflats supply enough food for various wetland birds. A complete catalogue of the richness of the biodiversity of this area is not available. Fisheries are one of the main economic activities apart from agriculture. Since the basin is comparatively productive, agriculture is practiced along the entire length of the river on both sides. The site is not protected under any conservation measure by either the state or central government. Local social groups and bird watchers insist that the state government pass stringent rules to monitor the area since it supports numerous varieties of birds. Hunting wetland birds is reported from here as a routinely activity. Untreated municipal sewage from Daman entering the mouth of the estuary poses a problem in the coastal waters. The mangroves, marsh vegetation, numerous wetland birds, estuarine fishes, crabs and molluscs represent the biodiversity value of this site. The site has been designated a community reserve involving the local fishing community.

14. **Umergaon:** This coastal wetland is located between the towns of Nagrol and Umergaon at the southern border of Gujarat. The wetland is drained by the River Varoli. Mudflats with salt marshes and mangroves dominate. The extensive mudflats at the mouth of the estuary support bird congregations. Because of its marshy nature, the wetland nurtures birdlife. Algal mats and the molluscan fauna associated with them supply enough food for the wetland birds. The salt marsh grasses (two species) and mangroves (two species) and several species of associated vegetation are important assets of this ecosystem. Fishing and mudskipper collection were the only livelihood options observed around this site. However, hunting wetland birds has been occasionally reported. The wetland is open and is not protected under any scheme. Bird hunting, fishing and mudskipper collection are reported to be routinely carried out. Domestic sewage from Nagrol and Umergaon municipal areas is being routed toward this wetland. The GIDC adjacent to the wetland is an important source of pollution. New aquaculture farms are coming up around this wetland, and these will pose a threat to this coastal wetland in the future. The presence of a number of mangrove species along with salt marsh species around the swamp and tropical tree species in the adjoining areas are the important floral species worth considering for conservation. The molluscs, crustaceans and polychaetes are an enormous source of food for migrating wetland birds. Similarly, the estuarine habitat is a suitable fishing ground for commercially important fish species. The site has been designated a community reserve involving a local fishermen's group and the industries adjacent to this site.

15. **Vaiterana:** Vaiterna Creek is also known as Vaiturni River or Waitarna River. The flow is from the Vairtana and Tansa rivers. It has tidal mudflats, and large sand flats are often exposed on both sides during low tide. The islets of the creek have mangrove vegetation which also forms a fringe along the embankment. The site is located between Saphale and Virar towns, at the northern end of Maharashtra, adjacent to Gujarat state. About 11 exclusive mangroves and 9 associated species are the important vegetation documented in and around the islands of this creek. The sheltered islets are reported to support diverse birds (42 species) and the mudflats, polychaete worms. About 17 species of fish, 4 prawn species and 3 crab species were being caught within this creek. Vaiterna River is considered to be the main source of drinking water for Mumbai city. Most of the local dweller practices sand quarrying, and only a few are engaged in fishing. The shallow water and the mudflats of the creek are being utilized for shell fishing. The freshwater swamps upstream, the sparse mangrove vegetation of the islets and the fringes of the water course, and the mudflats are important habitats for birds. The mudflats and the swamps are the important habitats for numerous polychaetes. Illegal sand dredging is the main threat posed to this site. This dredging has been going for a long time. The dredge wastes are reported to be degrading the entire fringing vegetation of the river. Anthropogenic interference is said to be deterring bird congregations. Sheltered creeks, mangrove islets, vast mudflats and shallow water areas are the significant habitats to be considered for conservation activities. The site has been proposed as a community/conservation reserve. The local fishing community and sand miners need to be made aware of the importance of the area and should be involved in protection measures.

16. **Bassien:** The Bassien or Vasai creek forms and complex network with Thane via the Ulhas River. Manori and Malad creeks are situated south of Vasai. The mouth is wide, with bar-built islets with sparse coastal vegetation. Minor beaches at the sides of the mouth are dynamic and seasonal. Malad and Manori creeks are covered with thick mangroves, whereas Vasai has fringe vegetation comprising seven species of mangrove and six associated species. According to visitors and local dwellers, these areas harbour 12 species of fish, 3 prawn species and 4 crab species. The mudflats and the saline swamps of these sites are well known as bird watching sites, with nearly 75 bird species having been found here. Green and Olive Ridley turtles are reported to have nest along the beaches. Fishing (finfishes and shellfishes) is the main economic activity for those who dwell along the creek. Sand mining is illegal; however, a few people still practice it to some extent. Bassien or Vasai Creek is wide and has no legal protection, whereas Mald and Manori creeks are being monitored by local bird watchers. Conversion of mudflats and mangrove areas into residential and industrial plots and illegal sand quarrying are the main threat factors. Newer settlements are coming up rapidly adjacent to the mangroves along with other infrastructure development. Hydrocarbon residues from petroleum units and storage tanks degrade the flora and deteriorate the ecosystem as a whole. Dense mangroves supporting numerous wetland birds, vegetated islets and sheltered creek areas are significant habitats requiring protection. The site has been proposed as a community/conservation reserve.

17. **Thane:** Thane Creek is located adjacent to Sanjai Gandhi National Park and is connected with the Ulhas River. The creek is sheltered well between Mumbai and Uran. The area around the site is highly populated and so experiences a high level of anthropogenic disturbance. Wide mudflats with mangroves and open creek waters are the main ecological features. About nine mangroves, 12 mangrove-associate species, 206 bird species, 25 fishes, 7 prawns, 13 crabs, 30 reptilians and macrobenthos such as diverse polychaete worms are the important plants and animals that have

been documented from this site so far. Wetland birds such as flamingos, Curlews, Avocets, sandpipers, gulls and terns congregate on the exposed mudflats and creeks to feed on polychaete worms and fishes. Fishing and crab and prawn collection are the important revenue generating activities around the creek. Much the mangroves has been protected by the Soonabai Pirojsha Godrej Marine Ecology Centre. The remaining mangrove patches are being monitored by the state forest department and by NGOs. However, disturbance by routine human activities is not under control, and so degradation is continuing. Conversion of coastal areas into residential and industrial plots, sewage discharge, dumping of waste and salt-works are the important threats experienced by this site. Most of the mangrove area has already been degraded. Large mangrove portions have recently been reclaimed for infrastructure development by the municipal corporation. The well-developed mangrove woodlands, wide expanses of mudflats along the sheltered coastline, diverse flora and fauna and protection and monitoring activities of Soonabai Pirojsha Godrej Foundation's Mangrove Interpretation Centre are the important features to be considered for conservation. Part of the site has been identified as an IBA. The site has been proposed as a conservation reserve. The Soonabai Pirojsha Godrej Marine Ecology Centre can be involved further in management of the site since they already have experience in protecting the entire area.

18. **Dharmtar:** The lower reaches of this site are referred to as Dharamtar Creek or Estuary. It is formed by the flow from the Amba River. The estuary is wide and opens into the Mumbai harbour area. It is shallow and is navigable to some extent. It is sheltered between the towns of Uran and Alibag. The southern part of the creek is fringed with dense mangroves, eight mangrove species and four associated species. However, the diversity of fishes, crabs and prawns of this estuary has not yet been quantified. Information from local dwellers and fishermen reveals that the faunal diversity of the site is similar to that of Thane Creek. About 56 species of bird have been reported from the mangrove areas around Dharamtar Creek and Patalganga swamp. Fishing is the only revenue generating activity around the site. However, water transport-related activities also yield some economic returns. The site is not afforded any protection by the state government or by any NGOs. The swamp and mudflats of this region are being reclaimed for infrastructure development and for industrial activities. The navigational traffic poses a threat to the ecosystem, and docking around the creek damages the mangroves. Sewage discharge into the creek and dumping of waste on the mudflats threatens the estuarine fauna and flora. It has been proposed that a port be established at Karanja with bulk cargo container facilities. The diverse flora and fauna of the estuarine area, the thick mangrove flora fringing the creek and the wide, open intertidal mudflats and brackish swamps are the important habitats having significant conservation value. The site has been proposed as a community/conservation reserve. The local fishing community needs to be involved in protection activities.

19. **Kundalika:** The site is well known for Curlew Fort, on a rocky promontory, which was a stronghold of the Portugese in the past. Kundalika Estuary is also known as Revdanda Creek. It has fringing mangroves and mudflats extending north–south. There are about 17 islands within this river course, but about half of them are influenced by tidal inundation. About 10 exclusive mangrove species and 8 mangrove-associated species are important among the flora apart from the terrestrial vegetation. Thirty-two wetland bird species were recorded, and a questionnaire administered to local fishermen reveals that there are 4 species of prawn, 5 crab species and 23 fish species within the estuarine and mangrove areas. The mudflat and the swamp substratum are highly used by diverse polychaete worms. The establishment of a port with bulk cargo facilities at this site has been proposed, and agreement has already been entered into for this. The historical

Portuguese Curlew (Korlai) Fort, rocky promontory, sheltered beach, palm groves, fringing mangroves, brackish swamps, mudflats and islands are the considerable ecological assets of this site is worth managing. The site may be proposed as a s a community/conservation reserve.

20. **Murud–Janjira:** This site is a sheltered estuarine area at the confluence of Mhasala and Rajpuri creeks. There are rocky formations at the mouth and larger boulders sparsely distributed throughout. The beaches on either side are dynamic and are picnic spots of this region. Mangroves cover the mudflats covered sparsely and fringe the northern part of the bay, forming a unique habitat. About 11 mangroves, 5 mangrove associates and the diverse seaweeds on the rock boulders are the important floral species reported from here. According to the local fishing community, 10 species of estuarine fish, 3 crabs and prawns and 35 species of wetland bird are found around this creek. Reports mention that sea turtles nest along this coastline during the breeding season. Fishing and related activities are the main source of income of the fishing community, who depend on this creek for their livelihood. The creek is being used for navigation. Tourism-related activity around the beaches supplements the local dwellers' incomes to some extent. There are no stringent protection measure around the site; however, local bird watchers and researchers often visit the ecosystem and report their observations to the relevant authorities to check activities causing environmental degradation. Petroleum hydrocarbon residues from oil spills and tanker traffic are the threats related to the activities in the region. Reclamation of mudflats and mangrove areas for urbanization and industrialization are development-related factors that damage the entire ecosystem. The turtle nesting beaches, rocky shorelines, boulder substratum of the mouth area, fringing mangroves along the bay, mudflats and bird congregations are the ecologically significant features worth protecting. The site has been proposed as a community/conservation reserve.

21. **Shrivardhan:** This site is an estuary-like coastal wetland sheltered perfectly between the towns of Shrivardan and Kurawade, in central Raigad District. The presence of a long beach in the north and rocky boulders at the southern mouth protects the habitat from direct tidal influence. Thick mangrove patches form islets in the middle of the water body. The habitat is highly influenced by human intervention. The nearly 15 species of seaweed found along the rocky boulders are important components of the vegetation in addition to 5 exclusive mangroves and 7 mangrove-associated species. The coast is well known for nearly 23 species of shoreline bird and 35 other mangrove wetland birds. Fourteen species of fish and 5 crustaceans have been recorded from the site. The offshore area is famous for dolphin watching. The area is famous as a seaside resort for its long fine-sand beach. Tourism is lucrative for tour operators. Fishing and tourism-related business activities fetch a good revenue for the local people. The beach and coastal vegetation are monitored by tour operators. Our survey did not record any potential threat to this ecosystem; however, anthropogenic interference due to tourism and destructive fishing obstructs the well-being of the mangrove. The sheltered beach, seaside vegetation, mangrove patches, shallow water areas, rocky boulders and offshore dolphins are important features worth conserving. The site has been proposed as a community/conservation reserve.

22. **Harihareshwar:** This site is located between the towns of Harihareshwar and Bankot, in the southern part of Raigad District. The coastline is of a rocky type, with a pocket beach to the north. The Savitri River drains through the estuary into the Arabian Sea. Harihareshwar is an important tourist spot in the region, with a famous Shiva temple and beach resorts. The beach of Velas village is well known as a turtle nesting site. Both Green and Olive Ridley turtles are reported to

nest every year. Twenty-four species of estuarine fish, 9 crustaceans and 35 wetland birds form the important fauna. Ten exclusive mangroves, 8 associated species and diverse seaweeds have been reported from around this site. Since the place attracts tourists, tourism and related businesses are the main livelihood activities of local dwellers. Fishing in estuarine and neritic waters provides a revenue to the fishing community. The rocky boulders and the geological formations of this coastline are being studied for a long time but no stringent measures are being taken to protect the rocky shoreline. The beach is however is an important area for tourism. Sahyadri Nisarga Mitra, who work for sea turtle protection, are monitoring it continuously. No potential threats have been reported, but unregulated tourism-related activities do disturb the turtle nesting beaches and birds of the rocky crevices. The dolphins of the coastal region, Olive Ridley and Green turtle nesting sites on the beach of Velas, shoreline birds and fringing mangroves are significant features to be considered for protection. This site has been proposed as a community/conservation reserve. Monitoring can be done as a joint venture with Sahyadri Nisarga Mitra.

23. **Dabhol:** This site is at the mouth of the Vashishti River, nearly 170 km south of Mumbai, between the towns of Dabhol and Anjanvel. There are headlands and intersecting cliffs around this site. The mangrove woodland of this site has an extent of about 10 km^2, and it has very old specimens of *Avicennia* and *Sonneratia*. Adjacent, to the south, is a long, narrow beach formation up to Guhagar. About 9 exclusive mangroves, 7 mangrove-associated species and numerous macroalgae make up the important flora. The barnacles, bivalves, gastropods, polychaete worms of the estuarine substrate, fishes, crustaceans of the estuarine and neritic waters and sea turtles are the important biodiversity of this coast. Fishing is the main livelihood activity for the local fishing communities. Recently, this has changed to construction activities and tourism-related business. The estuarine mouth is monitored by the Dabhol power plant authority for their routine movement. No other legal conservation measures, taken either by private sectors or by government departments, were noticed. The Dabhol power plant (Enron project), port traffic, harbour management activities such as dredging, ship movements and other related infrastructure construction have destroyed much of the ecosystems. What was once a fishing ground has been damaged or changed by these activities of the recent past. The fringing mangroves, raised mudflats, shoals and dynamic sand bars of the creek/estuarine mouth and the turtle nesting beaches are the biologically valuable habitats of this site to be considered for protection. The site has been proposed as a community/conservation reserve. The site needs stringent rules to monitor and regulate the port and service jetty activities and to monitor the impacts of power plant-related activities.

24. **Jaigad:** This site is known for Sandkhol beach and a rocky shore in Ratnagiri District. Sashtri estuary is close to the town of Jaigad. The beach and swampy areas of this estuary are turbated with diverse crustaceans; echinoderms and enormous barnacles, and a variety of molluscs have been reported from the rocky shores. About 10 species of mangrove, 5 mangrove associates and different rock-associated seaweeds are said to exist here. The coastal waters and the estuarine mouth are said to be an important fishing ground and to largely support the local fishing community. No potential threat factors been observed except dredging activity near the estuarine mouth. The estuarine fishing ground, fringing mangrove swamp, mineral-rich beach (ilmenite deposits) along the bay and boulders of the shoreline are vital ecological features. The site has been proposed as a community/conservation reserve.

25. **Purnagad:** This site is known as Purnagad or Muchkundi estuary. It is located a little south of the town of Ratnagiri. A rocky shoreline, wide beaches at Ganeshgule, a fort and rocky reef areas are the important ecological features of this site. About 9 species of mangroves, 7 species of mangrove associates, 11 species of seaweed, abundant fishes, crustaceans, molluscs and numerous benthic life forms contribute to the biodiversity values to this site. Fishing is the main livelihood activity of the local community, which dwells around this site. Tour operation and vending are the other money-earning activities for those around Ganeshgule. No legal measures have been taken to protect the site, but the local fishermen are involved in protecting the turtle nesting beaches with the assistance of NGOs. Visitors to this site are reported to cause damage in the name of the deity. No potential threat was recorded here. A rocky wave-cut platform, the exposed estuarine habitat, its muddy substratum, mangrove swamps and pocket beaches in the vicinity are the important ecological features worth conserving. The site has been proposed as a community/conservation reserve.

26. **Vijaydurgh:** This site is an exposed estuarine complex in southern Ratnagiri, including Jaijatpur and Vijaydurg creeks (Arjuna and Vaghotan rivers). It is located between Ambolgarh (to the north) and Vijaydurg (to the south).. as the important features here are a port, a fort, habitats such as creeks and mangroves, fishing grounds, islets and rocky shores. Five exclusive mangroves, eight mangrove-associated species, numerous macro-algae (found along the rocky shoreline), several commercially important fishes, crustaceans and molluscs are said to be found here. According to unauthenticated documents, Whale Sharks, dolphins and porpoises are observed in the adjacent waters occasionally. Jaijatpur and Vijaydurgh creeks are good fishing grounds and so the local community depend on fishing along this coastline for their livelihood. There is no legal instrument protecting this coastline, but a proposal to establish a nuclear power plant encountered tremendous opposition, as it was expected that the plant would lead to ecological degradation of the region. NPCIL's Jaijatpur Nuclear Power Plant proposal and its related activities were expected to pose a threat to the coastal and marine biodiversity as a whole. The movement of vessels and minor tourism-related business spoil the free nature of the coastline to a minimal extent. The potential fishing grounds of the estuarine complex, Rajapur Bay, interspersed rocky shores, pocket beaches, narrow mudflats and mangroves are significant features worth protecting for the livelihood of the dependents. The site has been proposed as a community/conservation reserve with the involvement of local governance. The coastal and marine biodiversity of the site need to be studied in detail before any infrastructure development. Central- and state-level research institutes and NGOs should be involved in monitoring and assessment-related studies.

27. **Devgad:** This site is an exposed estuarine habitat with fringing mangroves and the adjacent coastline. It is located south of Vijayadurg and extends up to Mithmubr. There is little tidal action, but this site with high salinity accommodates certain salt tolerant plant species. The important habitats observed include offshore islets, rocky outcrops, beaches and dynamic sand bars.. Seven mangroves, five mangrove-associated plants and the numerous macroalgae of the estuary are among the important components of the reported vegetation. Several commercially important fishes, crustaceans, polychaetes, molluscs and numerous shoreline (migratory) birds are said to found along this coastline. Nearly 32 fishing villages located around this site depend on fishing-related activities. Minor tourism-related business also provides significant revenue to those involved in boat operations. Both the coastline and the estuarine area are not protected, but some local individuals interested in sea turtles monitor the beaches routinely. Since the site is an important habitat for shoreline birds, bird watchers do visit here frequently. Tourism- related

activities such as camping and diving around islets spoil the beach and shallow habitats. A windmill established on an outcrop is said to affect the movements of birds. Devgad Fort, the sheltered estuarine area, the mangrove cover and the coastal areas of Mithbao and Mithmubri are significant features worth protecting. The site has been proposed as a community/conservation reserve.

28. **Angria Bank:** This site is a submerged coral area in the Arabian Sea located nearly 105 km west of the coastline on the continental shelf, off Malvan. According to reports and documents, the site has a clear water plateau, with coral development and associated marine life forms atop an undulating basalt sea floor, at a depth of 20–50 m. Several coral-associated plants, including 57 species of seaweed, are among the important species of the flora. The site is well known as a spawning ground for numerous fishes. Several species of coral are also known to be founder here. Abundant molluscs, crustaceans, dolphins, sharks and other marine organisms have been reported in literature that has not been authenticated. The site attracts Indian and international tourists, especially divers, because of its coral and thus benefits minor tour operators. Since it is an important fish spawning ground, fishing is an important livelihood activity here. No protection measures are in place for conserving this area. Divers, researchers involved in studying the coral, the Mumbai-based organizations Reef Watch, BNHS and freelance coral divers monitor the area. The state forest department and the Maharashtra Tourism Development Corporation are interested in protecting this and in developing it into a tourist spot, respectively. No potential threat factors have been reported around this site. However, unscientific coral exploration and diving activities are expected to cause damage to the reef and its associated fauna. The undisturbed, intact coral plateau in a remote area, the spawning ground of several commercially important fishes, molluscs, sharks and dolphins are the remarkable features worth considering for conservation. Since this site is outside the territorial water of India but within EEZ, a special protection framework is required to conserve this unknown but rich marine biodiversity area. Further, this site is already a part of International Indian Ocean Whale Sanctuary that many unaware of.

29. **Achra–Malvan:** This site is a larger area including Achra and Kolam creeks, the rocky Malvan coastline and the Shivaji Fort. The rocky coast (with dispersed lateritic formations), shallow neritic waters and mangrove-fringed creeks are noteworthy habitats. The famous Shivaji Fort is the most important historical feature and corals around it are important ecological feature of this area. According to local fishermen, there are 8 species of mangrove, 6 coast-associated plant, 1 sea grass, numerous macro-algae, minimum three species of sea turtles, 39 species of coastal wetland bird, 13 estuarine fishes and crustaceans in this area. However, spill-over from Malvan Marine Sanctuary adds to the diverse fauna. Fishing is the main livelihood activity recorded here. Apart from this, tourism and related business activities provide supplementary revenue to those involved. The fishing community takes care of turtle nesting sites with the help of Sahyadri Nisarga Mitra and the BNHS. Despite Malvan Marine Sanctuary being an MPA, no stringent protection has been provided to the adjacent habitats. A lack of protection and unregulated tourism-related activities pose significant threats to these habitats. Changes in the land use pattern have led to the disappearance of rare mangrove species from this site. The mangroves of Achra and Kolamb creeks, sea grass meadows, turtle nesting beaches, rocky reefs at the islets of Kura and sparse rocky boulders in shallow waters are critical wildlife habitats need management and conservation. The Malvan Fort area is already a sanctuary, and the area could be extended up to Achra Creek. The site has been proposed as a community/conservation reserve. The opposition raised (by traditional fishing gear users—*Rampani*) towards Malvan Sanctuary can be overcome by make the

local fishing community aware of the importance of marine biodiversity and involving them in management of this site.

30. **Vengurla:** This site comprises barren rocky offshore islets with an extent of approximately 10 km^2 to the northwest of Vengurla. There are about 20 islets, and a few have vegetation, dominated by grasses and scrub. The pocket beach on the coast near Ubhadanda, rocky shoreline of Gabit Vadi and Karilkachal Channel are important areas. Numerous shorebirds have been reported, but we recorded only 17 species during our survey. The White-Bellied Sea Eagle, Edible Nest Swiftlet, terns and sandpipers are among the important birds reported to be found here. Sea turtles, a chiropteran species and dolphins passing the channel are other important species among the fauna. The mixed fishing community of the 19 fishing villages around this site focus mainly on shrimps, and to some extent they earn revenue from tourism-related activities. However illegal poaching of swiftlet nests also provides a good revenue. The site is open to access without any legal protection measure. The BNHS and local bird watchers monitor the site and congregating birds. To some extent the Vengurla Port Authority monitors the nearby shallow water areas. No potential threat factors have been recorded around here, but routine fishing and tourism activities do disturb the congregating birds. Egg and nest collection activities carried out by the local community have also been reported. These activities need to be monitored and regulated to protect the birds. The rocky coastline, turtle nesting beaches, shallow channel, minor caves and crevices in the rocks are the important habitats worth conserving. Since numerous shorebirds congregate here, the site has been identified as an IBA. The site has been proposed as a community/conservation reserve. Monitoring and research work can be carried out with the BNHS.

31. **Terekhol:** Terekhol is located at the southern end of Maharashtra, at the border with Goa. This site is popularly known as Redi. It has a sheltered estuarine area with mangrove islets. A lateritic formation protects the habitat, there are wide areas between the islets. This sheltered estuarine area harbours 8 mangroves, 6 mangrove associates, 2 sea grasses and numerous macroalgae. Twenty-three coastal wetland birds, fishes, crustaceans and bats (around the lateritic crevices) are the important species among the fauna reported to depend this site. Fishing and tourism-related activities are the two important forms of livelihood. Other socio-economic values of/around this site are not known. No legal protection measure has been taken around the site. Fishing and tourism-related activities pose minimal threats to the pristine swamp vegetation. The swampy mangrove islets, shallow fishing ground, lateritic crevices and sheltered coastline are the key habitats having significant conservation values. The site has been proposed as a community/conservation reserve and should be monitored by the state forest department.

32. **Morjim:** This site located in the northern coast of Goa, close to Maharashtra. It comprises a long fine-sand beach and the estuary of the Chapora River (around 28 km in length), where there is a mangrove swamp. Chapora Fort, at the village of Anjuna and fine-sand beaches at the mouth of the estuary and at Anjuna are the important ecological features of this coast. About 5 species of mangrove, 7 mangrove associates, several seaweeds (within the Chapora estuary), 14 species of shoreline bird, 2 species of sea turtle, crabs, molluscs, shrimps and numerous commercially important fishes (in the shallow offshore waters) are said to found around this site. Tourism and tourism-related vending, services and business are the prime livelihood options for the local dwellers. The state forest department is intensely involved in establishing hatcheries for nesting sea turtles and keeps watch over the beaches, having posed stringent rules. Local volunteers are also involved in monitoring the coastline for any activities that post threats to the beaches.

Disturbance caused by unregulated tourism, camping and beach games are a few threats reported to faced by this site. The sand dunes, turtle nesting beaches, mangroves, mudflats and headlands are significant ecological features to be considered for conservation since they harbour rich coastal and marine biodiversity. The site has been proposed as a community/conservation reserve involving tour operators and the local fishing community.

33. **Mandovi:** The Mandovi–Zuari estuarine complex and the interlinking Cambarjua canal are the largest coastal ecosystem of Goa. They comprise mudflats, swampy marshes, islets, etc. The nearly 62 km long Rachole or Mandovi River and the 91 km long Zuari River open to the Arabian Sea, forming a wide estuarine habitat at their confluence. The beach, sand spits, bay waters, isles, bird sanctuary, shipyard and fishing harbour are important features. There are 12 species of exclusive mangrove, 10 species of mangrove associate, 45 species of bird, several commercially important fishes, 13 species of penaeid prawn, numerous molluscs, polychaetes, etc. among the important plants and animals reported to be found within and around this. The local fishing community depends on this site largely for its fishery resources. Tourism is also excellent livelihood option for them during the seasons when tourists visit the area. Boating services and mariculture practices also yield revenue for many people of the community. Goa Shipyard, the port authorities, National Institute of Oceanography, tour operators and volunteers are involved in protecting the site. The state forest department also monitors vital habitats for pollution and reclamation activities. The Salim Ali Bird Sanctuary and its surroundings are provided protection under the IWPA. Vessel traffic from the port and fishing harbour, oil spills resulting from maintenance at the shipyard, disturbance caused by tourism and construction of residential and industrial infrastructure pose significant threats to this fragile ecosystem and thus deteriorate its quality, as described by many reports. The site is adjacent to Carambolim Lake, which is an IBA. The dynamic beach, open estuarine habitats, mangrove islets and mudflats are vital ecological features of this site that are worth conserving. The site has been proposed as a community/conservation reserve involving the local fishing community jointly with NIO.

34. **Galgibagh:** This site located in the southern part of Goa's coast. It comprises a long sandy beach interspersed with lateritic outcrops and the Talpona (11.2 km) and Galgibag (3.8 km) creeks backwaters, with fringing mangroves. The beaches are famous for beach resorts and scenic spots. About 12 mangrove and mangrove associate species, 2 sea turtle species and 15 shoreline bird species have been recorded from this site. According to the local fishing community, 22 commercially important fishes, 4 species of crab, 3 shrimp species and 7 species of mollusc, including bivalves and gastropods, are being collected from inshore and offshore waters. Fishing and tourism operation are the two main sources of revenue of the local dwellers. Vending and tourism-related business are also good money-generating options. The state forest department, with the help of the local church administration and volunteers, is involved in sea turtle conservation and monitoring. Since turtles attract national and international tourists, a few tour operators involved in creating awareness and protecting nesting beaches. Reclamation of mangroves for residential infrastructure, disturbances caused by unregulated tourism and related activities and sand quarrying are the main threats to this ecosystem. The turtle nesting beach, mangrove-ringed creeks, offshore fishing grounds and lateritic headlands are the significant ecological features worth conserving. The site has been proposed as a community/conservation reserve involving the state forest department and the tourism sector.

35. **Kali:** Kali estuary (Kalinadi), opens to the Arabian Sea with a tidal creek—Devgad or Mavin Hole. At the northern part of the mouth is a rocky promontory, and there is a long, narrow beach at the southern portion. Two species of sea grass have been found in the intertidal areas. Fringing and patchy mangroves are found all along this estuary. There are 7 species of exclusive mangrove and 16 associated species. The faunal diversity of this estuarine area is being documented by a research institution in Karwar. Fishing (finfish and shellfish) and minor aquacultural practices are the notable livelihood activities around here. Beach tourism, cottage resorts and trips to offshore islands are revenue-producing activities. The mouth of the estuary is under the control and surveillance of the New Mangalore Port Authority. The mangroves in the islets, in Devgad creek and around the embankment are being monitored by the forest department and the Department of Marine Biology, Karnatak University. Sand mining and tourism are the two important threatening factors. The estuary supports the livelihood of the local fishermen. The islets and *Cyperus* swamps are feeding and breeding for several wetland birds. The site has been proposed as a community reserve involving the fishing community and tour operators.

36. **Tadri:** The Aghanashini, or Tadri, is a 121 km long river that drains into the Arabian Sea to the north of Kumta. This wide-mouthed estuary extends along the coast for about 13 km, forming a vast backwater expanse. Several islets with exposed mudflats form important ecosystems that harbour a rich biodiversity. The mudflat and the estuarine environment harbour 11 species of mangrove, 22 species of coastal wetland-associated vegetation, several species of mollusc, polychaetes, crustaceans and a number of finfishes. Waders and sandpipers are common all along the intertidal areas of this estuary. Finfish and shellfish fisheries, agriculture and shrimp farming are important livelihood activities. Clam, prawn and crab collection are fishing activities in the mangroves and islets. *Kagga* rice cultivation in *gaznis* (kharlands) and shrimp farming between raised bunds are major food production practices here. No legal protection has been given to this wetland, but continuous monitoring is carried out by the forest department. The mangrove patch of Masurkurve islet was considered a sacred grove, and it is protected by the local dwellers. Vessel traffic, bottom sand mining, effluents from the nearby industries and municipal sewage from Mangalore are the most threatening factors. Traditional rice cultivation is practice in *gaznis*. The mudflats and vegetated islets harbour a rich biodiversity, including 11 species of mangrove. The intertidal area is a feeding ground for several species of bird. The site has been proposed as a community/conservation reserve.

37. **Hanovar:** The Sharavathi is the major drainage system, with mangrove and mudflats where it meets the sea, near Hanovar. It runs parallel to the coast from near Pavinkurve up to Bangani. Mavinkurve and Kalsanmote are important islets in the estuary, with dense fringing mangroves. The extent of the entire wetland and coastal area is estimated to be around 27.6 km^2. Ramathirtha, in Hanovar beach, and the island of Basavaraj Durga are famous tourist spots here. The wetland harbours 10 species of mangrove in the estuarine mudflats and islets, 24 species of coastal wetland-associated vegetation, several species of benthic and intertidal animals and a number of finfishes. About 40 wetland birds, including common birds such as teals, ducks, waders and sandpipers, forage in and around this area. Finfish and shellfish fisheries and aquaculture are the important livelihood activities along the estuary. Part of the estuary is under the control and surveillance of the New Mangalore Port Authority. The mangroves in the islets and around the intertidal areas are monitored by the local fishermen. The forest department has established mangroves in the tidal creeks adjacent to the estuaries. Frequent release of freshwater due to hydro-electric project activity often dilutes the estuarine water, and so decrease in salinity influence

the diversity of the estuary. Because of the mouth bar of the estuary, large patches of mangroves, tidal swamps, and congregations of wetland birds this site must be considered for protection. The site has been proposed as a community/conservation reserve.

38. **Murudeshwar:** The coastline of Murudeshwar extends up to Bhatkal, in Uttar Kannada District. Clusters of rocky islets and narrow strip of beaches of scenic beauty are characteristic of this coastline. Netrani Island, nearby, has several tropical forest species of plant and various marine macroalgae. Echinoderms and coral-associated crustaceans have been reported from the rocky islets. The White-Bellied Sea Eagle and Edible Nest Swiftlets are also reported to seek refuge there. Fishing and tour operation around the shallow waters of the islets and beaches were livelihood activities observed here. The site has not been protected under any conservation measures. Along with Netrani Island, the islet clusters are being monitored by many research Institutions to catalogue the marine diversity. The forest department has initiated measures to protect this site, including Netrani Island. Routine underwater exploration by tourists and camping around the beaches pose threats to the environment. The site is reported to support a rich diversity on account of a conducive shallow marine environment. Giant clams, holothurians, coral-associated fishes, mollusks, crustaceans and sea birds are the important life forms of conservation significance. The site has been proposed as a community/conservation reserve.

39. **Netrani:** Netrani is an uninhabited island located about 19 km off Murudeshwar. The island has several tropical forest plant species so that it is like a tiny fragment of the Western Ghats. The shallow water harbours 14 species of coral, 19 coral reef fishes, giant clams, holothurians, etc. Dolphins, whales and sea turtles are reported to use the passage between the island and the coast. White-Bellied Sea Eagles, Edible Nest Swiftlets, foraging turtles and sea snakes are important animals frequently reported from here. Fishing around the shallow waters of the island is the livelihood activity observed here. The island is being monitored by many research institutions that undertake exploration around it. This island is considered sacred by the local fishermen, and the entire island is protected. Recently the forest department showed interest in protecting this island legally. The Karnataka State Biodiversity Board (KBB), NIO (of Goa) and CMFRI (of Cochin) conducted a survey with the assistance of many marine institutes to catalogue the marine biodiversity of this island. KBB has proposed this area be declared a marine sanctuary to safeguard the marine life from the Navy (Sea Bird Naval Base), who target this island during firing practice. Continuous diving and underwater exploration by tourists in an unscientific manner damages the corals and clam beds. This is the only site in Karnataka harbouring a high marine biodiversity, including corals, giant clams and holothurians. The site is well known for its good population of White-Bellied Sea Eagle and Edible Nest Swiftlets. The site has been proposed as a community reserve involving the participation of the local fishing community and tour operators under the supervision of the forest department.

40. **Kundapur:** The Haladi is the main river of this site, with the Kollur and Chakra rivers joining it to form an estuarine complex between Hanovar and Gangoli. This complex spreads out into the intertidal areas as extensive mudflats, patches of mangroves, a salt marsh and backwater areas. The strandline is almost a sandy beach with minor dunes and short stretches of rocky shoreline. The total area of this coastal wetland is estimated to be around 7.3 km^2. The estuarine complex harbours 7 species of mangrove and 20 species of associated plant, salt mash species and beach vegetation. Polychaetes, molluscs, crustaceans are among the benthic fauna, and several estuarine fishes contribute to the richness of the aquatic biodiversity. Sea turtles are reported to

nest around the beach. Finfish and shellfish fisheries, aquaculture and salt extraction are the important livelihood activities around this estuarine complex. Clam, prawn and crab collection are important fishing activities within the mangroves. The forest department has established mangroves on the islets and exposed mudflats and protects the area. Nurseries have been set up adjacent to the creeks for further establishment of mangroves. Sand mining, retting and logging along the embankments are potential threats. The estuarine complex with numerous islets, fringing mangroves, the dependence on fishing and congregation of migratory birds are significant aspects for conservation. The site has been proposed as a community reserve.

41. **Kodi Benge:** The Sitanadi, Madhisali and Swarnanadi river join together to form an estuarine complex and backwater and open into the Arabian Sea between Parapalli and Malpe. The flow is initially parallel to the coast, turning towards the north. The islets within the backwater and upstream support mangroves. A total of 6 species of mangrove and 21 associated species were recorded around this wetland. The substratum of this backwater supports a rich diversity of molluscs and crustaceans. The estuarine complex is surrounded by agricultural land and minor aqua farms. Finfish and shellfish fishing are the next major activities within the area. Since the forest department planted mangroves on the islets and in the intertidal areas, some sort of protection is given to these areas. No potential threats were observed around this estuarine complex except nutrient enrichment by agricultural runoff and aqua farm wastes. The existence of islets with mangroves, the benthos-rich substratum of the estuarine waters and the feeding areas of wetland birds in the swampy areas are important factors of conservation significance. The site has been proposed as a community/conservation reserve.

42. **Malpe :**This site is well known for its sandy beach with sand dune and sparse offshore rocky islets, which are locally called *jugu*. It is located about 14 km north of Udupi. The famous St. Mary's islets and backwaters where the River Udayavara meets the sea are ringed with swamp habitats. According to the local fishing community the islets support several seaweed species and molluscs, e.g., limpets and mussels. Coastal arboreal birds congregate during the fish spawning seasons, and the swamp has salt-tolerant halophytes. This survey documented one mangrove species and five mangrove-associated plant species. Turtle nesting has also been recorded on this beach. Fishing around the islets and at offshore areas is the main livelihood activities recorded here. However, the local community depends on the port, beach tourism and related operations for their earnings. The Malpe port authorities are taking care of the mouth area and maintain it for their regular operations. Whereas the backwaters are open for fishing, the beach, offshore waters and islets are getting crowded due to tourism and diving activities. The site has no legal protection for conservation. Vessel movements, dredging and maintenance activities of the port and disturbance caused by divers are the main threats here according to the local community. The offshore islets, rocky shoreline, potential turtle nesting beach with sand dunes, shallow waters suitable for diving, backwaters and swamp are significant habitats worth conserving. The site has been proposed as a community/conservation reserve.

43. **Mulki-Pavanje:** The Mulki (Shambavini) and Pavanje (Nandini) rivers forms an estuarine complex where they meet the Arabian Sea, about 44 km north of Mangalore. The Pavanje River runs parallel to the coast for a short distance before joining the sea. The numerous tiny islets and exposed intertidal areas are important habitats for various life forms. Seven species of exclusive mangrove and 19 associated species were recorded around this site. The wetland harbours many species of polychaete, mollusc and crustacean and numerous fishes. Fishing and aquaculture are

significant livelihood options noted within the estuarine area. Clams, prawns and crabs are collected around and within the mangroves and creeks and are important food resources. Part of the estuarine-backwater area has been given protection by the forest department because they have established mangroves there. No potential threat factors were observed around the wetland except sand mining. The wide mouth of the estuary supports a rich biodiversity which supports the livelihood of traditional fishermen. Because of the congregation and breeding of wetland birds here, this site must be considered for protection. The site has been proposed as a community/conservation reserve.

44. **Netravati:** Gurpur–Netravati is an estuarine habitat located near Mangalore. The Netravati joins the Arabia Sea almost at a right angle, whereas the Gurpur River runs parallel to the coast for a short distance before joining the Netravati River. Together they form a simple estuary. The estuarine confluence is now completely under the control of the New Mangalore Port Trust. The discharge of water from the river system is estimated to be around 9310 m^3 $second^{-1}$. The influence of the tide is felt to a distance of about 20 km inland. Mangroves (8 species) and associated plants (18 species) fringe the estuarine areas. Molluscs (*Meretrix*, *Donax*), polychaetes (*Sabellaria*, *Diploria*) and crustaceans (*Penaeus indicus*, *P. monodon*, *Metapenaeus monoceras*) and a number of finfishes are important life forms. Finfish and shellfish fisheries and aquaculture are important livelihood activities observed all along the estuary. Clam, prawn and crab collection are important fishing activities within the mangroves. Part of the estuary is under the control and surveillance of the New Mangalore Port Authority. The mangroves on the islets and around the intertidal areas are being monitored by the local fishermen. The forest department has undertaken mangrove establishment in the tidal creeks adjacent to the estuaries. Vessel traffic, bottom sand mining, effluents from nearby industries and Mangalore municipal sewage are the most threatening factors. The wide mouth of the estuary supports a rich biodiversity that supports the livelihood of traditional fishermen. Because of the congregation and breeding of wetland birds here, this site must be considered for protection. The site has been proposed as a community/conservation reserve.

45. **Kumbala:** This site is an estuarine system of the Shriya River (65 km in length) where it meets the Arabian Sea near Kumbla, in Kasargod District, bordering Karnataka. The existence of a sand bar, shallow backwater-like water area parallel to the coastline, fringing mangroves and sea grass patches are important ecological features of this site. The site is known to support a flora including 4 species of exclusive mangrove, 9 mangrove–associated species, 1 species of sea grass and 6 species of seaweed. Local fishermen report that they catch nearly 17 species of fish from this estuarine habitat, apart from 7 crustaceans and 9 molluscs. Amateur bird watchers report that about 26 species of shorebird have been spotted in this habitat. Finfish fishing is the main source of income of the local fishermen, apart from fishing in the offshore waters. Collection of clam shells in the appropriate seasons has also been reported. The coastline is open and is not afforded any protection by the state forest department or by any other organization. Collection of oyster and clam shells is said to disturb the sea grass patches. Apart from this, fishing over the sea grass patches was also damaging the sea grass and mangroves. The dynamic beach, sand bar, mangroves, swampy mudflats, sea grass patches and clam beds are habitats of rich biodiversity and are thus significant for conservation. The site has been proposed as a community/conservation reserve.

46. **Magrol:** This site is an estuary, fed by the Mogral-Puthur river, which originates from Kanathur, running a length of 34 km before reaching the Arabian Sea. The estuary is often blocked by a sand bar, which forms a beach. The estuarine habitat supports 3 mangrove species, 8 coastal-associated plant species and varieties of freshwater swamp grasses. According to the local fishermen, the wetland harbours 12 species of commercially important fishes, 3 crab species, 4 prawn species, 2 bivalve species, etc. Shorebirds such as Greenshanks, sandpipers, plovers and terns are reported to gather here. Fishing is the main source of income here. Apart from finfishing fishing, oyster and clam collection from the mudflats and shallow water areas of the estuary support the fishermen. Although the beach is not a hotspot for tourists, occasional visits bring revenue to service vendors. Amateur bird watchers gather here to monitor congregating waders. Overexploitation of the clams and oyster beds and sand mining are reported to be threatening the mudflats here. Camping tourists are said to dump waste and chase the shorebirds. Poaching of birds from the swamp and estuarine habitat has also been reported. The dynamic beach, sand bar, estuarine mudflat, mangroves, clam beds and offshore water are significant habitats worth conserving. The site has been proposed as a community/conservation reserve.

47. **Chandragiri:** This estuarine habitat is located between the town of Kasargod, in the north, and Chandragiri fort, in the south. It receives freshwater drainage from the Chandragiri or Thalangara River (104 km in length). Kadapuram (in the north) and Keezhur (in the south) adjoin the site. A dynamic sand bar, beach, mudflat and salt swamps always form a mosaic of habitats. Five mangrove species and 8 mangrove-associated plant species are often found in association with numerous terrestrial species and freshwater swamp sedges. The survey recorded 12 species of bird, including shanks, sandpipers, curlews and gulls,. on the shore and within the estuarine mangrove areas. The site is well known for its extensive distribution of oysters, and the bed shelters numerous other molluscs and acts as a breeding ground for varieties of fishes. Fishing for finfish, oyster collection and minor tourism activities are the prime revenue-generating activities of those living around this site. Except for the fort area, the estuarine mouth, mudflat and mangroves are not under any monitoring system. The substratum may support the establishment of oysters up to 2 km upstream of the estuarine area. This substratum, the sand bar, the mudflat, mangroves and associated coastal vegetation are the ecologically important features of this site. The site has been proposed as a community/conservation reserve.

48. **Edayilakadu:** Edayilakkadu is one of a few islets, including Madakkal, Tekkackaadu and Vadakkudaadu, located within a 24 km strip of the Kawaipuzha *kayal*, which runs parallel to the coast. The islet is well known for its forest, which is said to be a fragment of the Western Ghats. This forest is mainly Tropical Evergreen Forest, but there is a fringe of mangroves. The forest receives attention because of its location right to the coast. Endangered reptiles, bats and monkeys within the forest and the fishery resources of the *kayal* are important animals of this site. Edayilakkadu is well known for the deity of the snake temple inside the thick forest. The deity is known as *theeyam* and the forest receives protection from the local dwellers as a sacred grove. The forest patch is the source of minor extractable products, which are utilized in a sustainable manner by the dwellers. The Kerala Forest Department undertook mangrove plantation programme around the islets in the *kayal* and monitors the mangroves. Poaching of animals and harvesting of forest products are the noticeable threats. The islet needs to be protected because of its fauna and floral components. The site has been proposed as a community/conservation reserve.

49. **Azhikkal:** Azhikkal is a coastal village with a small port and a fishing harbour. It is surrounded by the towns of Matul, Papiniseri, Kattampally and Azhikal, in Kannur district. The Valapattanam River empties into the Arabian Sea at Azhikkal. The site has estuarine areas, a marshy swamp, mangroves and a wide beach. The Indian Coast Guard Academy's training unit is under construction close to the site. Four typical mangrove species, 16 salt-tolerant plant species and 5 microalgae are reported from around this site, apart from several terrestrial species, from palm groves and shelterbelts. The estuarine area is reported to harbour 25 fish species, with 11 crustaceans and 6 molluscs. The offshore area is well known for congregations of gulls, terns and shorebirds. Apart from fishing, which is the main source of income, the local fishing community also operates boats for offering joy rides to tourists. The site is being monitored by the port authorities and the Coast Guard for any legal activities that are damaging the area. The Pappinisseri Eco-tourism Society plans to develop a mangrove theme park to create awareness among the local community and tourists. The Azhikkal port authorities plan to develop this site into the third major port of the state. The infrastructure development and reclamation around the site are expected to exert an influence on the fragile ecosystem. Dredging at the estuarine mouth, illegal tourism operation and beach camping deteriorate the habitat and are said to disturb the congregating gulls along the shoreline. The mangroves, estuarine mudflats, fringing swampy areas and wide beach are significant ecological features worth conserving. The site has been proposed as a community/conservation reserve.

50. **Dharmadom:** The Kadakkavu estuarine complex supports a rich biodiversity with its varied habitats. It extends 4 km inland, and it has dense fringing mangroves. There are several islets within the estuary. The estuary provides provides fishery resources including crabs and prawns, which are nourished by the rich organic detritus from the surrounding vegetation. The islets and the adjacent area are rich in faunal and floral diversity. The cccurrence of the Otter *Lutra lutra* here has been reported frequently, and some turtle nests have also been seen. Extensive oyster and clam beds make the estuarine complex highly productive in terms of fisheries. About 20 ha of the mangrove patch in an islet is dominated by *Sonneratia caseolaris*, which makes it of prime importance for conservation—no such area in Kerala has a similar distribution. Oyster and clam fishing are routinely practiced along with fishing for estuarine finfishes. The forest department has developed mangrove patches with *Rhizophora mucronata* by planting, and is the mangroves have grown well like a green wall to a height of 6 m. The mangroves and the adjacent estuarine habitats are well protected and are being monitored with the involvement local community. Substratum disturbances caused by clam collection, overexploitation of oyster beds, fishing in the newly planted areas and occasional felling of mangroves are some of the threats to this ecosystem. The inundated areas with mangroves, oyster beds, clam substratum, otters in the estuarine habitat and fishery resource potential of this site are important diverse aspects for conservation. The site has been proposed as a community/conservation reserve.

51. **Kolavipalem:** This site has a wide and long beach adjacent to a minor creek harbouring mangroves. This part of the northern Kerala coast is well known as a place where Olive Ridley Sea Turtles nest and breed. The site has a wide beach formation that is conducive for turtle nesting. Adjacent to it is a mangrove patch dominated by *Sonneratia caseolaris* and *Rhizophora mucronata*, the latter being raised since 2003. The site has a shallow creek, which is a fine feeding ground for fishes. The site was also well known for clam fisheries, and thus it is suitable for other fisheries as well. The beach is being used as the nesting site of Olive Ridley Turtles. The site is essentially a coastal fishing village. Local fishermen fish along the coastal neritic waters and in the creeks for

clams and crabs. The entire area is under the control of an NGO, Theeram. With financial help and moral support from the forest department, the local community protects the turtle nesting areas. With the participation of the community, mangroves have been raised all along the creek and protected. Other than natural erosion of the beach, no significant threat was observed here because of the integration of the community in the protection of the beach and adjacent habitats. The congregation of endangered sea turtles for nesting and breeding congregation along this beach, the lush natural growth and the established mangroves, which provide environmental education facilities, are significant for conservation. The site has been proposed as a conservation reserve.

52. **Beypore:** This site is an estuarine habitat created by the Chaliar River. It is located 10 km south of Kozhikode, between Beypore and Feroke. It is an old maritime centre of the state with a fishing harbour and port. The site harbours 4 species of mangrove and 12 species of associated vegetation. The adjacent palm groves and agricultural areas add to the floral diversity. Local fishermen reports that nearly 20 species of fish, 6 species of crab, 3 species of prawn and 4 species of bivalve are found in the estuarine habitat. More than 40 species of bird are found along the beach, in the swamp and on the mudflats and mangrove trees. Apart from fishing, traditional ship (*Uru* or Arabian trading vessel) building, tour operation and oyster and clam collection are revenue-generating activities of the local communities. The port authorities protect the estuarine and offshore habitats from physical modifications, and the traditional fisher folk monitor the estuarine areas for any damage to their fishing grounds. Personal communication from the local leader reveals that there is a proposal to develop a marine park to protect the habitat. This is awaiting for financial support. Movements of cargo vessels, ship breaking and discharge from the rayon factory at Mavur are threats around the site. It is said that the proposed all-weather port at the site will affect the biodiversity. The natural harbor, clam and oyster beds of the estuarine area, mangroves, swamp vegetation and traditional ship building are the salient features that need to be conserved. The site has been proposed as a community/conservation reserve.

53. **Kadalundi:** This site is well known for congregations of migratory birds, and 40 species of wetland bird are reported to find refuge here seasonally. The local governing body claims that this wetland is a bird sanctuary; however, this had not been notified officially at the time of this study. There are mangroves on the islets and along the estuarine embankment of the Bharathapuzha, with*Avicennia officinalis* dominating. Mangrove-associated vegetation is also found to a significant extent nearby. The forest department, along with the Kandal Samrashna Samiti, has planted mangroves and developed new mangrove patches over an area of 75 ha. The mangrove vegetation around the islets and the clam and oyster beds of the estuarine substratum support a large fishery resource. The site has already been declared a bird sanctuary recently and hence has not been prioritized.

54. **Edakazhiyur:** The beach of Edakkazhiyur is identified as an important turtle nesting site. It lies south of Ponnani, near Chavakkad. The coastline has extensive coastal shelter belts planted with Casuarina. The site is a well known tourist spot because of its wide sandy beach formation. Other than coastal fishery resources, the beach is a known nesting site of the endangered Olive Ridley Sea Turtle. Fishing is the only livelihood activity of the fishing community that dwells around this site. Occasionally, tour operation and vending businesses help them to a minimal extent. The local community is carrying out sea turtle conservation activities along with an NGO, Green Habitat, and the forest department along the Edakkazhiyur coast. The community is also involved in shelterbelt plantation and takes an active part in beach cleaning programmes. The forest department has

proposed that this area be given special consideration for turtle conservation. Plantation of non-native species in coastal shelterbelts, artificial illumination on the beach and generation of garbage by tourists are the threats recorded here. Turtle egg poaching has also occasionally been reported. The suitable nesting site for the endangered Olive Ridley Sea Turtle is itself an important aspect for conserving this beach site. The site has been proposed as a community/conservation reserve.

55. **Kole:** The Kole wetland spreads over Thrissur and Malappuram districts, with the northern lowlands lying 7.5 m below MSL and salt water having a pronounced influence. *Kole* refers to the practice of rice cultivation (under water-logged conditions), which is carried out from December to May every year. It is connected with Vembanad *kayal* by a channel running parallel to the coast. About 241 wetland bird species have been reported, including 7 threatened species listed in the Red Data book. The wetland supports the Spot-Billed Pelican (*Pelecanus philippensis*), a vulnerable species. Ninety-one species of resident/local migratory bird and 50 species of migratory bird are found in the Kole wetland. Rice cultivation in Kole began in the 18th century through reclamation of *kayal* lands (backwaters) of Thrissur by erecting temporary earthen bunds. Although the site is a little far from the coast, typical saline agricultural practices are followed. The potential fisheries resources, the socio-economic dependence of the local dwellers on the site and the eco-physiological importance of this wetland are significant. The river basin is being managed and irrigation projects are being implemented to enabling rice cultivation during summer. The local governing body and research institutions monitor and protect the wetlands, and a proposal has been submitted to the state government to provide legal protection. Pollution due to industrial effluents, agrochemicals and sewage, agricultural land reclamation and bund erection and related blockage of the feeding channels and poaching of migratory birds are the threats that have been identified. The intricate network of freshwater and brackish water channels of this low lying area provides breeding and feeding grounds for resident and migratory birds. Traditional Kuttanad rice cultivation has historical importance. It deserves to be protected by having Kole designated a Ramsar site. This site has been proposed as a community reserve involving the farming community, and it is suggested that the bird population be monitored.

56. **Vypin–Fort Kochi:** Vypin is located where the Cochin backwaters meet the Arabian Sea. This site extends up to Fort Kochi, in the south. According to early reports, the area once harboured well developed mangroves. Relict and degraded mangroves are in evidence in some of the islands (Wellington) within this region. The dominance of *Sonneratia caseolaris* in the mangrove vegetation is a peculiarity here. The adjacent salt marsh swamp harbours *Avicennia*, *Acanthus*, *Acrostichum* and *Rhizophora* species. The estuarine areas of Vypin have a good fishery potential, with more than 75 species of marine and estuarine fish. The clam and oyster beds in the interior of Vembanad are worth mentioning. Sharks, skates and rays are landed, and dolphins and many marine mammals visit this area. Clams and prawn are the most important products of the fisheries, next to finfishes. The estuarine mouth and neritic waters off Vypin are well known for their high marine fish congregations. Fishing using Chinese dip nets is a noteworthy fishing practice, and eco-tourism generates income for local fishermen. No legal protection exists for this site, except some portions that lie within the bounds of the Port Trust of Cochin and the naval base. Encroachments, reclamation of swampy areas, dredging, dumping and discharge of municipal sewage are threats observed around here. Cargo and ship traffic, constructions and other tourism-related activities are the present threats noted in the vicinity of this site. The coastal shelf waters between Vypin and Fort Kochi are well known as a place for watching dolphins. The site has been proposed as a community or conservation reserve.

57. **Kumbalanghi:** Kumbalanghi is a model village with mangroves growing luxuriantly in integrated farms, known as *pokkali*, and on bunds of aquaculture ponds. The site runs parallel to the Chellanam coast, west of Vembanad Lake, with a network of saline channels feeding the aquaculture ponds and paddy fields. *Excoecaria agallocha*, *Rhizophora apiculata*, *R. mucronata, Bruguiera gymnorrhiza* and *Kandelia candel* are the dominant mangroves. They enrich the ecosystem by supporting a high productivity of the fisheries. Raising mangroves on the aqua-farm bunds is an example of best practices in integrated fish farming. The saline environment of this region supports traditional salt-tolerant paddy cultivation. The Department of Tourism supported and developed a part of this area as a model village. Most of the land of this area is under private ownership, and hence this wetland habitat lacks legal protection from poachers and exploiters. Overharvesting of the fish stock, land reclamation, mangrove felling and excess usage of fertilizers are notable threats faced by this saline wetland. The pristine mangroves, traditional integrated fish-cum-paddy cultivation, adjacent salt marshes and feeding grounds for migratory birds are significant features for conservation. The site has been proposed as a community/conservation reserve.

58. **Vembanad–Kumarakom:** Kumarakom is located in the eastern portion of Vembanad *kayal*. The Meenachil, Manimala, Achankovil and Pamba rivers discharge into the lagoon adjacent to this site. The site is well known for house-boat tourism and bird watching off the shallow part of the lake. The embankment and minor creeks support mangroves and swamp forests suitable for resident and migratory birds. It is a Ramsar site (Ramsar site no. 1214). The Kumarakom part of Vembanad *kayal* is renowned for its waterfowl population, the largest along the western coast of India. Over 90 resident bird species and 50 migratory bird species have been reported from here. Mangroves such as *Bruguiera gymnorrhiza*, *B. sexangula* and *Rhizophora mucronata* are well established here. Local people earn a good revenue by providing tourism-related facilities such as house-boats, speed boats and home stays. The involvement of the state tourism department in improving the tourism-related facilities and managing them provides protection to some extent within the swampy area. The open shallow water and the foraging area of the birds are frequently disturbed by poachers and boats. A proposal to establish a system of protecting and monitoring the site by the local governing body is under consideration. Speed boats, water sports, bird poaching, encroachment, land reclamation for establishing resorts, agricultural runoff and other tourism-related disturbances are notable threats faced by this site. The mangrove patches, swamp (supporting bird congregations), brackish–freshwater wetland ecosystem (which provides opportunities for bird watching and environmental research, education and awareness) are significant for conservation. The site has been proposed as a community/conservation reserve.

59. **Kayamkulam:**This is a mangrove site in Kayankulam *kayal* with luxuriant mangroves supporting fishery resources. It is a 50 acre mangrove patch owned and monitored by the Fisheries Department of Kerala in Kollam. It is an important environmental hotspot of the Kerala coast, with 10 exclusive mangrove species. The species *Lumnitzera racemosa* is restricted only to this area and is found nowhere along the Kerala coast. The fisheries potential is noteworthy, with respect to estuarine and brackish water fishes, prawns and crabs. Migratory birds roost and breed seasonally here. A significant number of fishermen depend directly on the various fishery resources of this wetland. The estuarine and brackish water fishery resources support them on a regular basis. In 1996, the Fisheries Department stepped in to preserve the ecosystem and proposed that a mangrove research and demonstration centre be initiated here. The success of the programme has

now prompted the department to propose the establishment of a mangrove research centre. Other than the intact mangrove patch, mangroves fringe the embankment of the backwaters. Sand quarrying, overexploitation of fishery resources, coir retting and tourism-related disturbances are threats observed around here. The prospects of eco-tourism, environmental education potential and opportunities for mangrove and fisheries research within the site are significant. The site has been proposed as a community/conservation reserve.

60. **Ashtamudi:** Ashtamudi is the second largest lake and the deepest coastal wetland in the state. It is palm shaped, with eight prominent arms, and adjoins Kollam. The Kulathupuzha, Chendurni and Kalthuruthy river join to form the Kulathupuzha and drain into this lake. It enters the sea at Neendakara through an arm that acts as a single outlet. The estuarine mouth is 6.4 m deep at the confluence. The lake supports 43 marshy and mangrove species, including *Syzygium travencoricum*, an endangered species. The occurrence of sea grass beds at the mouth has been reported. Fifty-seven species of resident and migratory birds, more than 100 species of fish, 5 prawn species, crabs and black clams (*Katelysia opima* and *Paphia malabarica*) are known to be found in this lake. In winter, the lake supports more than 20,000 waterfowl. Ashtamudi is the second biggest in the State fish trading centre, next to Vembanad estuary. Thousands of fishermen depend directly on the estuary for their livelihood. Other than fishing, opportunities for agriculture, coconut husk retting, inland navigation and eco-tourism are benefits provided by this wetland. Although Ashtamudi Lake was designated a Ramsar site (Ramsar site no. 1204) in November 2002, no legal protection has been given to this coastal wetland. Indiscriminate aquaculture practices, overexploitation of clam beds, poaching of birds, heavy tourism, operation of speed boats, encroachment and pollution are threats. Lush mangroves, fishery resources that support livelihoods of local communities. The site has been proposed as a community/conservation reserve.

61. **Paravur:** This site is located in the northern part of Trivandrum District. It is an estuarine complex of Paravur *kayal*. It is connected to the Edava–Nadayara backwaters by a canal system. The Ithikara River (56 km in length) empties into this habitat and opens into the Arabian Sea. The sand bar at the mouth of the *kayal* and the beach near Kappil are the well known attractions of the site. The palm groves around the wetland, the associated swamp vegetation, 3 species of fringing mangrove, including the densely distributed *Acrostechum*, and 7 species of mangrove-associated plant enrich the floral diversity of the site. About 24 species of commercially important fish, 7 crustaceans, including 2 prawns, 3 bivalves and numerous polychaete worms (from the retting area) are the faunal counterparts of this habitat. Tour operation and related vending businesses are the main revenue-generating options of the local dwellers. Operating joy rides, providing local conveyance via water navigation, minor fishing and large-scale retting of husk are the other livelihood activities observed around the wetland. The site is not protected by any private or government agencies; however, the tourism sector controls the water and monitors the area for degradation. Water and solid pollutions are seems to be threatening the entire habitat and thus affects the fishery resources. The barrier beach, backwater swamp, mangrove-vegetated areas, coconut groves and shallow water canals are the important ecological features of this site that are significant for protection. The site has been proposed as a community/conservation reserve.

62. **Kadinamkulam:** The Kadinamkulam *kayal*, drained by the Vamanapuram River, is located between Perunguzhi and Perumathura. It is oriented north–south and is a backwater-like wetland extending parallel to the coast. At times of heavy discharges, a sand bar forms a temporary

estuarine system. The backwater swamp is dominated by *Acrostechum*, which is distributed all around the shallow areas. Five typical mangrove-associated species, including the widespread *Cerebraodellum*, and numerous freshwater submerged plant species have been recorded from this site. About 65 species of fish, of which 58 are commercially important, have been reported, and according to the local fishing community, the backwaters and offshore areas harbours 5 crab species, 2 prawn species and 3 bivalve species. The dynamic beach is said to be occasionally used for nesting by sea turtles. Fishing and retting are the two main income-generating activities around this wetland habitat. Minor tourism-related activities and water transport also support the people dependent on this site. The state tourism department plans to take over the wetland area for various development activities to attract tourists to this site and to Veli *kayal*, nearby. There is no legal protection. Coconut husk retting and waste dumping are sources of pollution, and these are detrimental to the aquatic organisms. The pristine nature of the backwater, swamp vegetation, ringing mangroves and turtle nesting beach are the salient ecological features significant for conservation. The site has been proposed as a community/conservation reserve.

Identified Important Coastal and Marine Biodiversity Areas of East Coast of peninsular India

1. **Jambudweep:** Jambudweep is a small island that is partly covered with thick mangroves. This mangrove island can be approached from Bakhali or Frazarganj, in District 24 Parganas. The climate is humid, like that of the mainland, and the island experiences a similar pattern of tidal influence. The entire Island is under the control of the forest department and is devoid of human habitations. The island harbors 7 species of mangrove and 12 mangrove-associated species, along with other terrestrial vegetation. Although there are no reports of turtle nesting, turtle sightings have been reported. Being located in the Ganges fan, the site has been turbated by fishermen for commercially important fishes. Similarly sightings of porpoises and River Dolphins have also been reported often from around this site. The island and its vegetation provide a roost for a large number of seabird species. Fishing and fisheries-related activities are the main economic activities. The West Bengal Forest Department established a mangrove nursery and undertook extensive mangrove plantation in and around this island. An interpretation centre has been established to create awareness among the public and fishermen. Intensive and illegal fishery practices around this island are the main activities posing problems to the nesting and feeding marine organisms. The shallow waters adjacent to this site are highly productive and are a potential fishing ground for many commercially important fishes. The mangroves and mangrove-associated vegetation are an ecological asset and support a functioning ecosystem. The site has been designated as a conservation reserve. The entire island and surrounding waters need to be monitored for threats that could disturb endangered and flagship species of the region.

2. **Jambuchar:** This site is a cluster of islands with mudflats and mangrove cover, lying within and just within the mouth of the Hoogly estuary. The islands are surrounded by highly populated towns such as Haldia and Kakadip, which are very close by. The climate is humid, like that of the adjacent mainland. Regular flushing of freshwater, tidal inundation and excessive sedimentation are important features of these islands. All the islands are with amidst mudflats and minor creeks covered with mangrove vegetation. Five species of mangrove and seven associated species of plant are found on the islands. Paddy cultivation is being practiced in the large island close to Haldia. The commercially important fish species that are being fished, wintering of various birds and sightings of River Dolphins add value to the islands' biodiversity. Fisheries and paddy cultivation are the two main economic activities here. The entire area does not have any legal

protection. It is accessible from all sides. Although the mangrove habitats are naturally protected by the flow in the estuary, the islands are freely accessed by ferries or fishermen's boats. All these islands need to be protected under stringent regulations so as to conserve the ecosystem. The site experiences threats from visitors and tourists. During festival times, pilgrims gathered at a shrine on Sagar Island and visit these sites. Fishing around these islands and vessel traffic from Haldia port pose various threats to the ecosystem. Extensive mudflats with mangrove vegetation, bird congregation, potential fishing areas around the islands and salt-tolerant paddy cultivation are the important features for consideration for conservation. The site has been designated a conservation/community reserve involving the local fishing community and farmers.

3. **Junput:** Junput is an intertidal area to the east of Midnapore District, between Digha and Haldia. The site has a vast expanse of intertidal mudflats and fine-mud beach areas conducive for various soft-sand dwellers. The climate is arid, unlike the rest of the humid Sundarbans. Three species of exclusive mangrove, 5 mangrove–associated species and 3 sand-binding species were recorded along the intertidal mudflat areas and adjacent to the coastline. The soft-sand-dwelling Red Crabs, molluscs and wetland birds are important faunal groups adding to the biodiversity value of this ecosystem. Routine fishing all along the shallow coastal waters and minor tourism operations are the two main livelihood options of the coastal community; however, the fishery potential has not yet been evaluated. The site is devoid of any conservation measures. Very recently research work has been initiated to catalogue the macrobenthos of these mudflats and to identifying the importance of this site in terms of biodiversity support. No potential threats have been recorded around this estuarine area except intensive fishing and minor tourism-related activities. The site comprises intertidal mudflats with mangroves, a beach with small dunes, tidal creeks, etc. The extensive soft-sand coast is a potential Red Crab habitat, which is considered to be a species of conservation significance. The site is considered important in terms of the vast expanse of mudflats. The site has been proposed as a conservation/community reserve, and it is suggested that research work be taken up to catalogue the richness of the biodiversity of the intertidal areas.

4. **Talseri–Udaipur:** This site is just around 5 km south of Digha and is located near the mouth of the River Subarnarekha on the northern Balasore coast. The wide, sandy beach is a well known (Purabi Das Beach Park) tourist spot because of scenic locations such as mudflats that are exposed during the low tide and Red Crab habitats. The coast is turbated with different species of commercially important finfishes and shellfishes. There are occasional reports about turtles nesting, and the fine-sand beach is protected for Red Crabs. A Finless Porpoise carcasse was found during this survey, indicating that the offshore waters are a potential habitat for marine mammals. Twelve species of coastal vegetation, including mangroves, have been recorded around the Talseri–Digha beach. Fishing is the main livelihood opportunity for the local people. Since the beach has been attracting tourists in recent past, vending businesses and other tourism-related services help the people a lot. The state forest department has set up boards to protect the beach as a Red Crab habitat. According to local fishermen, horseshoe crabs congregate here for breeding. However, no legal measures are in place to provide stringent protection. Unregulated tourism leads to beach damage. Camping and dumping of food and other wastes on the beach damages the intertidal areas. Trampling and movements of vehicles are some of the observed activities that pose threats to the Red Crab habitat. The wide fine-sand beach, intertidal mudflats and traditional pole fishing are the important ecological features and practices that need to be conserved. The site has been proposed as a community/conservation reserve.

5. **Subarnarekha:** This site is well known as tourist spot for its nearly 500m wide intertidal area exposed during low tide. The estuarine area lies in the deltaic region forming alluvium deposits, backdune areas at forefront, mangroves in islets and fringing, saltmarsh and associated wetlands. 18 species of exclusive mangroves with nearly 24 species of associated vegetation including halophytic vegetation creeps along the dunes, macroalgae as epiphytes on roots of mangroves and as free floating species. The marine mammal Porpoise, horse-shoe crab, river terapin, red crabs are the important fauna apart from numerous fish and shell fish species frequently reported within and around this site. Fishing and agriculture are important livelihood options, besides, beach resorts, hotels and tourism related business and operation are the other revenue generating activities observed around. The Digha and Talseri beaches and Shakarpur fishing harbour supports the local community to a larger extant in this context. The mangrove patches all around the Subarnarekha estuary has been monitired by Forest Department and routine plantation activities have been undertaken. Casuarina plantation has been taken al along the degraded dune areas and being maintained under social forestry. Sewage discharge from resorts and beachside hotels, unregulated tourism operation and related activities, removal of dune vegetation, urban development related alterations, beach mining activities were reported to deteriorate the habitats around the beach. Wide intertidal area supporting macrobenthos, porpoises, occasional congregation of horse-shoe crabs, river terapin, mangrove patches, sand dunes are the important habitats worth protecting. The site has been proposed as a community/conservation reserve.

6. **Chandipur:** The Chandipur intertidal mudflat is a unique coastal ecosystem in Balasore District that is well known for its tourism attractions. The mudflat is well known as congregation site for the endangered horseshoe crabs and abundant Red Crabs. A tranquil beach with a Casuarina plantation protecting the coast, sand dunes covered with vegetation, a 1–4 km wide intertidal mudflat along the coast, breeding site of horseshoe crabs, the mouth of the Budhabalanga River and, the fishing village of Balramgadi are the major features of this site. Sporadic nesting by sea turtles along the Budhbalanga–Panchupada stretch has been reported. Fishing and tourism are the main income-generating activities along the Chandipur coastline. Aquaculture activities are also being practiced on a small scale. Jeep riding on the mudflat during low tide, tourists overcrowding, shell collection and littering by tourists are visible threats that need to be regulated. The abundant Red Crabs, living fossil horseshoe crabs, sea turtles and benthic fauna of the mudflat and littoral scrub jungle are of conservation significance. Part of the Chandipur coastline is under the control of the Indian Army as an integrated test range, and the rest is monitored by the state forest department but with no stringent protection measures. The site has been proposed as a community/conservation reserve.

7. **Karanjmal:** This site is a mangrove area running parallel to the coast between the fishing villages of Chudamani and Khapuria. The dense mangrove spreads from the mouth of the Kasia River, in the north, to Dhamra port, in the south. The habitat is partly degraded because of frequent natural disasters and the lack of any barrier at its mouth. Although it is degraded, 6 species of exclusive mangrove and 18 species of coastal vegetation were found spread around the swamp and salt pans. The coast is fairly well known for congregations of horse-shoe crabs. Aquaculture farms and abandoned ponds support wetland birds. Otherwise, the faunal diversity of this site is yet to be studied in detail. Capture fishing, aquaculture, salt pans and collection of fuel wood from the degraded mangroves are a few of the income-related activities that were recorded. Presently the state forest department is monitoring the site and is involve the local community in mangrove plantation on both sides of the Kasia mouth and in sites behind the degraded mangroves, parallel

to the coast. The intertidal habitat where horseshoe crabs congregate and degraded woody mangroves are the salient features requiring safeguarding and are worth conserving. Wastewater discharge from aquaculture farms and fuelwood collection and poaching in the degraded mangroves are the detrimental activities around this site. The site was proposed as a community/conservation reserve after a thorough study of its biodiversity was conducted.

8. **Bhophal/Barunei:** This site is a long stretch of beach located near mouth of the Hansua, a little south of Garhirmatha Wildlife Sanctuary. The Hansua is a minor distributary of the Brahmini River. It drains into the Bay of Bengal. There is a dense mangrove forest at the northern side, and the mouth is protected by sand bar islets locally called *Hukitola*. Numerous plants and animals are reported to be found around this coastline. Nine species of exclusive mangrove and 15 species of associated vegetation are found on the beach. Sea turtles nest on the beach also. The livelihood of the local fishing community is affected during the ban on fishing imposed when the turtles nest. However, egg poaching is said to occur. Since the state forest department limits its monitoring to the north of Barunei, there are anthropogenic disturbances to some extent along this coastline. The mouth of the Barunei mouth has been identified for port development. Researchers and institutions involved in sea turtle studies do gather along this coast, and according to them there has been a shift in the *arribada* a little south from Gahirmatha, and so large numbers of nests have been found here in the recent past. The sea turtle congregation along this coast is the most significance asset worth conserving. The site may be considered as part of Gahirmatha WLS or it can be declared as a sperate community or conservation reserve involving the local communities in the management.

9. **Jambu Dweep:** This site is located at the mouth of the River Gobari, a distributary of the Mahanadi that meets the Bay of Bengal near the fishing village of Jambu. The estuary has dense mangroves sheltered by sand bar islands lying within Hukitola Bay. The mangrove cover of the site encompasses patches of reserve forests. These reserve forests have 7 exclusive mangrove species and 16 species of mangrove-associated vegetation including many halophytes. The faunal diversity of this forest area is yet to be studied, but according to local fishermen the bay harbours many commercially important finfishes and shellfishes. Fishing in the bay and creek and collection of shrimp seeds and forest products are the livelihood activities recorded around these forest blocks. Although the area is a Reserve Forest but protection is meagre. Access to many parts of the forest was quite limited, and we could not survey the forest entirely. Hukitola Islet with endangered flora, degraded mangrove islets of Jambu Dweep and the network of creeks at the mouth are the ecological features of this site that deserve management and conservation. The site is also requires detailed biodiversity assessment. On the basis of these studies, the declaration of a community or conservation reserve may be considered.

10. **Paradip:** This site is a network of creeks and beaches located where the Mahanadi River enters the Bay of Bengal. The network of creeks of the Antharbanki River, mangrove swamps, fishing villages and port berths are important features of this site. The site encompasses a long, wide beach at the south, where occasional turtle nesting has been reported. The beach is dynamic and experiences seasonal change. The estuarine area has 6 mangrove species and 14 mangrove-associated plant species, along with numerous phytoplankton and alga species. No data are available on the fauna of the site except for commercially important finfishes, shellfishes and sea turtles. Discharges from the IOCL oil refinery, petrochemical industries, Paradip Port Limited, Paradip Phosphate Limited, IFFCO (Indian Farmers and Fertilizers Cooperative) plant and SKOL Breweries and agricultural runoff along the river course are seems to be degrading the water

quality of the Mahanadi and are thus detrimental to the coastal and marine organisms at the site. The creek network and beach area are monitored by the port authorities and also by industrial security force, but illegal turtle egg poaching and destruction of mangroves are occasionally reported. The socio-economics of the local dwellers largely depends on employment opportunities at the port and industries. A very small number of fishermen derive their livelihood from the estuarine creeks by fishing. The most significant feature of the site is the wide beach, which provides habitat for nesting sea turtles, and the mangrove islets and creeks, which support livelihoods of local fishermen. The site has been proposed as a community or conservation reserve, and monitoring can be carried out by involving the port authorities and industrial security agencies.

11. **Devi:** This site is one of the best-known beaches where the *arribada* takes place. It is located near Nuagarh, where the Devi River meets the Bay of Bengal. The Devi is one of the major tributaries of the Mahanadi River. The estuarine habitat includes dense fringing mangroves on numerous islets, swampy areas and a long wide beach towards the south of the estuary. Astaranga is a fishing village alongside the estuary with aquaculture farms. Nine species of exclusive mangrove and nearly 16 species of coastal vegetation have been reported from around the site. The faunal diversity of the site has to be documented. The socio-economic activities of this site are centred on capture fisheries and aquaculture. Discharge from the aquaculture farms and industrial areas in Paradip, at the northern portion of the estuary, are the detrimental factors that have been reported. Illegal poaching and collection of turtle eggs by the local fishermen for consumption have also been reported occasionally. Turtle nesting beaches, mangrove islets, mudflats and swamps where birds congregate are important habitats that need to be conserved. The site has been proposed as a community or conservation reserve. CCI (Community Conservation Initiative), an organization that involves the local community in all aspects of nature conservation and resource management activities in the region may be involved in the management of this site along with local communities by the State Forest Department.

12. **Chilka:** Chlilika is the largest brackish water lagoon in India, with an area of about 1165 km^2. The entire wetland has already been designated a Ramsar site. It encompasses Nalabana bird sanctuary, and there is an island within. About 546 plants (including both aquatic and terrestrial plants) and 102 algal species have been so far recorded from this site. Nearly 400 vertebrate species have been recorded, and 60% of them are birds. Of the 205 species of bird recorded, the Flamingo, Spot-Billed Pelican, Pintail, Bar-Headed Goose, Avocet, Curlew, Spoonbill and plovers are the most important species. The endangered Irrawady Dolphin and Olive Ridley Sea Turtle are of conservation importance. Nearly 280 species of fish, 38 crustaceans, molluscs, reptiles, including crocodiles, several amphibians and a diverse benthic fauna have been reported from this wetland. Approximately 70% of the population dwelling around this wetland directly depends on fisheries and related activities for its livelihood. Sedimentation and related nutrient enhancement are the only threats known to exist here. The site has been proposed as a wildlife sanctuary, including the existing Nalabana bird sanctuary. The removal from the Montreux record by the Ramsar bureau with regard to the restoration interventions of the Chilka Development Authority is supportive of consideration for declaration as an MPA.

13. **Rushikulya:** Rushikulya is situated at about 15km north of Gopalpur, in Ganjam district. A nearly 5 km long stretch of this coastline is well known for the mass nesting of sea turtles. Seasonal and annual siltation and flooding of the Rushikulya River cause changes in the beach profile. The

nesting beach is very wide, with scattered minor sand dunes. The estuarine formation of the Rushikulya River influences the saline environment, and barrier spits are formed on both sides. The Glossy Marsh Snake (*Gerarda prevostiana*), Golden Jackal, Striped Hyena, Jungle Cat and White-Bellied Sea Eagle are the important animals apart from the mass nesting sea turtles. Thirteen species of coastal vegetation, 119 species of phytoplankton 134 species of zooplankton have been recorded. The fishing communities of the villages of Gokharkuda and Kantiagada depend on the fishery resources of this site to a great extent. Overfishing by vessels from Gopalpur port, discharges from the Chloro-Alkali plant, aquaculture waste drainage and mining of beach placers along the Chhatrapur coastline are potential threats observed around the site. The turtle nesting beaches, the aquatic vegetation of Tampara Lake and its associated vegetation are the features of conservation significance. The state forest department, along with the Rushikulya Sea Turtle Protection Committee (RSTPC) and individual volunteers, monitors the mass nesting and undertakes measures that are necessary for successful hatching. This site has been proposed as a Community Reserve and needs to be managed by the local communities. Further, this site is also proposed as an important international sea turtle conservation site.

14. **Gopalpur:** This site is a backwater environment located on the Gopalpur coastline a little south of Rushikulya, in Ganjam District of Orissa. The site has a bar mouth across the backwater, a small creek at Harpur and a long, wide beach of tourism importance, popularly known as Gopalpur-on-Sea. Coral boulders are reported to be found off the Gopalpur coast. Nearly 18 species of phytoplankton and 40 species of marine alga have been reported from this coast. Occasional nesting of sea turtles has also been reported. The activities of OSL Port, at Aryapalli, north of the estuary, related development, heavy mineral sand mining from the Chatrapur mineral sand deposit area and related processing activities of IREL and unregulated tourism activities are the threats observed along this coastline. Erosion at the northern portion because of breakwater construction also poses a problem to the beaches of importance for tourism. There is no monitoring along the entire coastline, and the beach is subject to different anthropogenic disturbances. The minor sand dunes, the Estuarine Biology Regional Centre and the Orissa Shrimp Seed Production Center (OSSPC) (for cultivating Tiger Prawn), in addition to the sea turtle nesting beaches, make the site important. The site has been proposed as a community or conservation reserve involving the tour operation agencies and port development authorities.

15. **Bahuda:** This site is a swampy area where the Bahuda rlver meets the Bay of Bengal. This is near the villages of Sonepur and Ichchapuram, at the Andhra Pradesh border. The site has a vast tidal flat fringed with mangroves and a dense *Pandanus* grove. The southern part of the coastline comprises a long beach with sand dunes—this is a famous picnic spot. Nearly 25 species of fish, 16 species of mollusc, 10 crustaceans and 4 polychaetes have been reported from the swamp. Sea turtles are reported to occasionally nest on the beach of the site. Patasonapur and Keutasonaper are fishing villages that depend largely on the fishes of this swamp, and a few tribal hamlets utilizes the *Pandanus* for making baskets and for their livelihood. There is no legal monitoring or protection measure at this site, but according to local fishermen, bird watchers and turtle researchers do visit the site frequently. The salt marsh, vast tidal mudflat, *Pandanus* grove, fringing mangroves and long turtle-nesting beach are the significant ecological features that need stringent protection. The site has been proposed as a community or conservation reserve. This site should be managed by involving the local tribal community and promoting sustainable resources use.

16. **Nuvvalarevu/Bendi backwaters:** This site is a backwater swamp with an expanse of marshy lands near the village of Palasa, in northern Srikakulam District. The backwater area receives freshwater during the monsoon through the Bendi Gedda stream and drains into the Bay of Bengal. Salt pans, aquaculture farms and sea turtle nesting beaches are the salient ecological features of this site. Two species of mangrove, 6 species of mangrove-associated vegetation and 2 species of sea grass are widely distributed across the site. Nine species of mollusc have been reported, and sea turtles have been reported along the beach. According to local fishermen, five crustacean species and 13 species of fish are collected, and 18 species of bird are observed around the swamp. However authentic documentation on the fishes and crustaceans is not available. The site has not been provided any legal protection. Revenue from salt pans, aquaculture and minor capture fisheries off the coast and in the swamp meet the daily requirements of the local community. The sand dunes of the beach, turtle nesting areas, stunted mangroves and salt marsh are significant ecological assets that require protection. Except for collection of turtle eggs, no threats were observed around this site. The site has been proposed as a community or conservation reserve as applicable, involving the local community participation in the management.

17. **Naupada:** Naupada swamp is a large wetland associated with the cropland located near the village of Kakrapalli in Srikakulam District. The wetland is a fragile, complex ecosystem consisting of a mosaic of freshwater swamps, salt marshes and a network of creeks and mudflats. It has an area of about 20 km^2. The swamp is used by numerous migrant birds those use Central Asian Flyway. It is also approachable from Telineerpuram, a well-known pelicanry. Three species of mangrove, 8 mangrove-associated species, 4 submerged aquatic species and 9 species of sandy strand vegetation have been recorded from around the swamp. About 120 species of bird have been recorded around the swamp. The coastal beaches of this swamp are well known as turtle nesting sites. There was no legal protection at this site until the construction of a thermal power plant was proposed. When the proposal came up, several research institutions and organizations concerned with conservation insisted that the site be protected for the uniqueness of its habitat and biodiversity. The proposed thermal power plant, which will be located in the swamp and in the adjoining area, is the major threat to this pristine ecosystem. Construction work involving leveling of the wetland, canal work and related engineering activities have disrupted the water spread and thus impaired the well-being of the wetland. The Naupada swamp is an Important Bird Area, and the state forest department has identified it as an ecologically sensitive area. The site is the single largest saline swamp area in the country, with mosaic of habitats. The site deserves to be recognized as an ecosensitive area because of the uniqueness of its habitat and species diversity. Therefore, this site has been proposed as a community/conservation reserve.

18. **Kalingapatnam:** This site is a pair of long beaches running on either side of the mouth of the Vamsadara River, near Kalingapatnam, in Srikakulam District. The Kalingapatnam port and fishing harbour, turtle nesting beach, sand spit, mangroves in Meghavaram and Srikurmam temple (in the south) are important appealing features of this coast. The site is reported to have 4 species of true mangrove and 11 species of mangrove-associated vegetation in the village of Meghavaram. The site extends up to Bhavanapadu.. Sea turtle nesting has been reported frequently from along this coast when the *arribada* was taking place in Orissa. Documentation of other coastal and marine biodiversity is lacking. The site is a well-known fishing harbour, and fisheries brought revenue to the local community. The site also is an important tourist spot because of Saheb Darga and the temple at Srikurmam, in which sea turtles are represented, near the coast. No legal measures have been taken to protect the coast except monitoring during the sea turtle nesting season. The sea

turtle nesting beach, sand dunes, open mudflats with dense halophytes, scrub mangroves and strand vegetation on dunes are significant assets require conservation measures. The site has been proposed as a community or conservation reserve with the vision of popularizing Srikurmam temple to highlight the importance of protecting sea turtles.

19. **Gangavaram:** Gangavaram is a large mudflat-and-swamp area a little south of the Visakhapatnam coast. A major private port for handling coal and iron ore that has been developed here is well known. Degraded, scrubby mangroves and the long Yarada beach at the north of the site are salient ecological features. The site is reported to have three mangrove species and 7 species of mangrove-associated species, but port construction activities have destroyed the mangrove habitats in most of parts of the area. A faunal catalogue is not available for this coastal area, but researchers from local institutions do visit here for biodiversity assessment because of the nesting of turtles and occasional flocking of birds. The fishing village within the port area depends on fishing along the coastline, but now the local community has turned to labour at the port. Port infrastructure development and related activities, discharge from the steel plant at Visakhapatnam and oil spills from the Visakhapatnam port are factors detrimental to the existing of these habitats. Yarada beach, which is of importance for tourism, the turtle nesting beaches at the north, the flocking of migratory birds on the mudflats and the scrub mangroves area remarkable habitats deserving protection. The site has been proposed as a community or conservation reserve with monitoring by the port authorities.

20. **Pudimadka:** Pudimadka is a fishing village in Visakhapatnam District. There is a minor backwater system at this site with fringing mangroves. The site is well-known for shark and Yellow-Fin Tuna fishing and for sporadic nesting of turtles on the beaches. Four species of mangrove (in the backwaters) and 8 species of mangrove-associated vegetation (on the mudflats) have been reported. No details are available about the coastal fauna except sea turtles, benthic foraminifera and nematodes; however, large quantities of fishes are landed around here. Since the site is a fishing village, the socio-economics largely depends on the revenue from capture fisheries, which is supplemented by salt production and aquaculture. Poaching of sea turtle eggs for shark bait has been reported. Discharge from aqua farms and salt pans and the related reclamation pose certain degrees of threats to the mangrove habitat. There is no protection of any sort. Monitoring is required to check the turtle egg poaching and shark fishing. The sea turtle nesting beach, swampy mudlfats and fringing mangrove habitat are key biological landscapes of the site that need conservation. The site has been proposed as a community or conservation reserve involving the participation of local fishermen in the management.

21. **Bangarammapalem:** This site is a degraded mangrove wetland of the Sarada–Varaha estuarine complex. It is located south of Visakhapatnam and is sheltered by hillocks on the beach. There is sporadic turtle nesting on the beach, which is a famous tourist spot of the region. The salt pans, shrimp farms, scrub mangroves and open mudflats are important features. Three species of mangrove and 10 species of coastal plant were identified. Details of the fauna of this site are not available except that prawns and fishes are cultured here. The site is said to support flocks of migratory birds in winter, when the Sarada and Varaha rivers flood. The livelihood of the local people is largely dependent on revenue from shrimp farms and salt pans. Reduced freshwater discharge and reclamation of salt pans have stunted the mangroves and created scrub. Discharge from the shrimp farms and brine from the salt pans overload the habitat with nutrients and so are detrimental to the site. There are no protection measures at the site except occasional monitoring

by researchers. The estuarine complex, mudflats on which birds congregate, sheltering hillocks and turtle nesting beach are substantial natural features worth conserving. The site has been proposed as a community or conservation reserve involving the participation of salt and shrimp farmers in the management.

22. **Yenam*:*** This site is located a little south of the Coringa mangroves, on the bank of the Goudami Godavari, in Yenam. This is the largest mangrove patch in the union territory of Puducherry. Twelve mangrove species and 18 mangrove-associated plant species were recorded during the survey. Fourteen commercially important fish species, 9 crustaceans and 7 molluscs have been reported from the creeks and estuary but many more must be there. Collection of prawns and crabs for local consumption and fuel wood collection are the only activities that the local people were observed to be involved in, but they depend on fishing in the Godavari estuary for their livelihood. The mangrove site has not been protected officially, but private security agencies from the on-shore gas terminal (OGT) that is being constructed monitor the area. Destruction of mangrove areas for OGT infrastructure development and urbanization adjacent to the creek are the detrimental activities that were noted around the site. Although it is small in size, the fact that the site is the largest mangrove patch of Puducherry warrants conservation. The site has been proposed as a community or conservation reserve.

23. **Gokulalanka:** Gokulalanka is a large island located where the Godavari River meets the Bay of Bengal, a little south of Coringa Wildlife Sanctuary. The site forms an estuarine network with the Vainateyam River, consisting of intact mangroves within a network of creeks. Eleven mangrove species and 21 species of associated vegetation, including halophytes, have been recorded in the survey. A faunal catalogue is not available, but according to local fishermen there are 20 commercially important fishes, 12 crustaceans and numerous wetland birds. Sightings of otter and fishing cats by fishermen were also noted. The diversity of the estuarine benthic fauna of the habitat has not received attention. The socio-economics of the local fishing community largely depends on the capture fishery within the estuarine system. Collection of shrimp seed and fish fry also supports their source of revenue. Since the site is largely devoid of habitation, it is pristine and free from any sort of threat except fishing. The site has also not been monitored, but researchers from local institutions are said to visit the site for birds. Undisturbed mangroves, the estuarine environment and the benthic diversity of the site are significant features requiring protection. The site has been proposed as a community or conservation reserve involving the state forest department and the dependent local fishing community.

24. **Bantumeli:** Interu swamp is a brackish water area running parallel to the shoreline, located near Bantumeli, in the north of Krishna District. The swamp receives freshwater from the Pedalanka drainage, which is connected with Koleru Lake via Pedapatnam. The swamp has an average depth of 2.5 m, and it has dense mangroves and marsh vegetation, interspersed with numerous aquaculture farms. Twelve exclusive mangrove species and 18 species of coastal vegetation, including halophytes, have been recorded from around the swamp. Nearly 60 species of fishes are reported to exist within the swamp. The swamp is also a well known congregation area for about 55 species of wetland bird. Capture fishing, shrimp seed collection and fish–shrimp farming are the main revenue-generation activities. The swamp is not protected in any way. Researchers from local institutions visit the site. Overfishing, poaching and discharge from fish farms are the only threats here. The discovery of a Buddhist stupa by the Archeological Survey of India near the village of Manjuluru, the dense mangrove vegetation, the bird congregation area of the swamp and

the corridor connecting the site with Koleru Wildlife Sanctuary make it worth conserving. The site has been proposed as a community/conservation reserve.

25. **Machilipatnam:** Machilipatnam is a mangrove site that is connected to the Krishna riverine system and extends parallel to the coastline. The site receives freshwater from the Krishna River, which drains into the sea near Hamasaladevi. The Upputeru canal, running parallel to the coast, also drains freshwater from the Koleru, which is connected to Interu swamp at its north. Thirteen species of exclusive mangrove and 15 species of coastal vegetation were recorded. The faunal biodiversity includes 15 species of macrobenthos, 8 species of mollusc, 14 species of crustacean, 15 commercially important fishes, 25 wetland birds and reptiles, including sea turtles. Fishing, shrimp seed collection; minor salt production and extraction of NTFP from the mangroves is the main livelihood activity observed. Overfishing, aquaculture and extension of the port at Gilakaladindi are some of the threatening activities recorded around here. Bandar Fort, in Machilipatnam, the dense mangrove vegetation, the connecting Upputeru canal system, the connection with the Krishna riverine system, the mudflats and the bird congregation areas are special features of conservation significance. The state forest department must monitor the site because of the proximity of the site to Krishna Reserve Forest. A local NGO, CERP, works intensively to conserve the mangroves of this site with the involvement of the local community through various training programmes. The site has been proposed as a community/conservation reserve involving the participations of local NGOs and communities.

26. **Hamsaladeevi:** This site is popularly known as Hamsaladevi Paya and as Sagara Sangamam, and it is the site where the Krishna River meets the Bay of Bengal. There are dense mangroves and muflats on both sides of the wide mouth of the estuary. The site is located a little north of Krishna Reserve Forest, which is a salient feature of the site that needs protection. The survey records 9 species of mangrove vegetation and 17 associated flora. No record of the faunal diversity of the site is available, but the fisheries around the site provide a clear indication of the presence of a diverse fauna. The state forest department has taken tremendous mangrove afforestation efforts all along the creek and open mudflats near Palakayatippa, south of the estuary, and monitors them. Abandoned aqua farms have now been turned into bird congregation areas. The local fishermen of this site depend on the fisheries, salt production and aquaculture for their livelihood. Reclamation of land for aquaculture and waste discharge from the salt pans are the only threatening activities recorded around this site. The remoteness of the site from habitations and the wide distribution of mudflats, mangroves, abandoned aqua farms and bird congregating areas are significant ecological aspects that make the site worth conserving. The site has been proposed as a community or conservation reserve involving the local dependents and the state forest department.

27. **Nizamapatnam:** This site is located Guntur District. Its area is 1200 ha, and it consists of wetlands with mangroves on sand spits. The Nizamapatnam fishing harbour is famous for trawl landings because of the fisheries potential of the shallow bay waters. The swampy mangrove areas extend parallel to the coast from the Lankavini Dibba mudflat to Nizamapatnam, in the south. Six true mangroves and 17 associated plant species have been reported from this proposed reserve forest. Although the site is a well-known fish landing area, details about the fish, mollusc, crustacean and other fauna are lacking. But 221 species of epibenthic animals have been reported from the bay. Capture fishing in the bay is the main income-generating activity, but poor fishermen depend on the crustaceans and molluscs of the mangrove creek for their livelihood. The state forest department has a strong stake in protecting this site and undertakes mangrove plantation on the

open and degraded mudflats. Trawling in the bay and docking in the mangrove creek are among the threatening activities that were recorded. The shallow bay, mangrove creek, mudflats, occasional migratory bird congregations and corridors connecting the site with Krishna Wildlife Sanctuary are significant features requiring stringent conservation measures. The site has been proposed as a community or conservation reserve.

28. **Chinnaganjam:** This site is a seasonal backwater system with a small mangrove patch with an area of about 65 ha located between Pedaganjam and Pallepalem in Prakasam District. Salt pans, aquaculture farms, numerous islets, minor sand dunes and a dynamic beach are the key ecological landscapes of this site. Romperu canal, near Peddaganjam, drains freshwater during floods and makes the system brackish. There are two species of stunted mangrove and 6 species of associated vegetation. The mudflats and salt pans provide room for wetland bird congregations and so nearly 15 different wetland birds were identified during the survey. Information about the other faunal groups is lacking. The discharge from the aquaculture farms, brine from the salt pans and expansion of the salt pans degrade the environment. The socio-economics of this site is largely dependent on revenue from aquaculture and the salt pans; however, there is negligible fishing in the backwater. The site is not monitored. The backwater network, open mudflats, scrub mangroves and abandoned salt pans support congregations of migratory birds. The remoteness of the site from human habitations highlights the importance of protection. The site has been proposed as a community or conservation reserve involving the aquaculture and salt pan farmers, who must be educated to protect biodiversity for sustainability.

29. **Pennar:** This site is located between the fishing villages of Utukuru and Kudithipalem in Nellore District. It is a mangrove wetland. The Pennar drains into the Bay of Bengal via a bar mouth. The encompasses sandy islets, and the Buckingham canal intersects it. There are extensive aquaculture ponds and tidal mudflats with mangroves (1200 ha) at this site, and there is a sandy beach on the coast. Pathapalem Dibba, Erravenkhiah Dibba and Uttukuru Kalava are the tidal mudflats fringed with mangroves. Four species of exclusive mangrove, 12 species of mangrove-associated vegetation and different species of brackish water fish and mollusc were recorded during this survey, but details about the other plants and animals are not available, except for the Foraminifera. The socio-economics of the local community largely depends on shrimp farming, fishing in the brackish waters and oyster collection. The site is not protected by any agency, but the beach has been monitored occasionally for sea turtle nesting. Discharge from industrial areas along the river course, shrimp farms and oyster collection from the estuarine mouth area are threats recorded here. The scrub mangroves, oyster beds and turtle nesting beach are the important ecological habitats requiring conservation action. The site has been proposed as a community or conservation reserve.

30. **Kandaleru:** This site is a creek system with a backwater network located at the wharf of the industrial port of Krishnapatnam, south of Nellore District. The site is connected to Buckingham canal at the bar mouth. There are dense mangroves on the mudflats of Burada and Chintala and in the open estuarine areas. There are 6 species of exclusive mangrove, 11 species of coastal vegetation and 6 species of mollusc in this estuarine-creek habitat. Minor fishing, shrimp farming and collection of clams, cockles and oysters for lime production are the income-generating activities. The network of creeks, mangrove mudflats, open estuarine oyster bed and soft substratum on which clams are found are the ecologically significant habitats worth conserving. The breakwater at the south of the mouth of the estuary causes erosion of the beach at the north.

Development of port infrastructure and related activities, reclamation of mangrove mudflats for aquaculture, wastewater discharge from shrimp farms and, most important, overexploitation of the oyster beds are threats degrading the environment. The site has been proposed as a community or conservation reserve.

31. **Pulicat:** Pulicat Lake is the second largest brackish water ecosystem along the east coast of India. It lies at the southern end of Andhra Pradesh and opens into the Bay of Bengal in Tamil Nadu. The site is oriented north–south, parallel to the coastline. A gradient of fresh-to-brackish water swamps is found at the site, and there are a number of islets. The Swarnamuki and Kalava rivers drain freshwater into the lake and enrich the system with nutrients. Five exclusive mangrove species, 9 mangrove–associated species of vegetation, 3 species of sea grass, 6 species of submerged freshwater plant, numerous species of swamp vegetation, 45 species of phytoplankton, 65 species of fish, 5 prawn species, 29 crab species, 12 mollusc species and 41 species of bird, including flamingos, Spoonbill, Pelican, White-Headed Ibis and Whistling Teal, represent the important biodiversity of this site. Fishing is the main revenue-generating activity for about 32 fishing villages around this brackish water site. Lime shell mining, agriculture and aquaculture are also practiced around here. The site has been recognized as Ramsar site, as an IBA and as a bird sanctuary. It is monitored and protected by the Andhra Pradesh Forest Department. Nutrient enrichment caused by aquaculture effluents, lime shell mining activities and unregulated fishing are the main threats around the site. These are said to have depleted the fishery resources and to hinder bird congregations. Monitoring is confined to Sriharikota Island and the areas where birds congregate, with the total extent of the site being about 460 km^2. The spill-over areas, where a diverse fauna and flora flourishes, need to be considered. The mangroves and the sand dunes of Sriharikota Island are important features in weighing the conservation needs. The site has been declared a wildlife sanctuary, especially for birds. The entire stretch of water area needs to be covered to protect the rich biodiversity.

32. **Muttukadu:** This wetland is located in Kanchipuram District, near the village of Kovalam. It is located about 35 km south of Chennai, and it has a unique ecosystem with a freshwater-to-brackish water gradient. The coastal plain is sandy, with numerous sand dunes with strand vegetation. The wetland is a part of the Buckingham canal system, which runs parallel to the coastline and has an average depth of 1 m. Thirteen species of coastal vegetation were recorded during this survey, and numerous species of macroalga are said to be found in the water. Mullet, *Liza*, Milk Fish, *Sillago* and *Etroplus* are the important fishes. Four species of crab and two species of prawn are caught here. The site is a wintering ground for many important migratory birds such as the Flamingo, Spot-Billed pelican, Painted Stork and Ibis and a breeding ground for a variety of shorebirds. Fishing is the main livelihood option for the surrounding village dwellers, and the revenue generated is seasonal. Tourism and related businesses such as vending also bring some revenue to the dependents. The Tamil Nadu Tourism Development Corporation takes care of the backwater for tourism and monitors the surrounding areas for encroachment, but the sand dunes do not have any protection and are crowded because of beach tourism. Although no potential threats have been found around this site, tourism is said to be a detrimental factor damaging the beach and sand dune habitats. Camping along the beach, poaching of birds and release of effluents from hatcheries are also reported. The long stretch of backwaters sheltered by sand dunes, shallow substratum with a wide spread of oyster beds, sand dune habitat, turtle nesting beach and migratory bird congregations are salient features of this that are considered important for protection. The site has been proposed as a community/conservation reserve. The CMFRI can

be involved in monitoring the fishery and hatchery practices since they have a mariculture farm within the site.

33. **Kaliveli:** The Kaliveli wetland complex is located near Marakkanam, in Villupuram District. It is a brackish wetland with a unique freshwater-to-brackish water gradient. The coastal belt is sandy, with numerous sand dune ecosystems with strand vegetation. The wetland is a wintering ground for many important migratory birds and a breeding ground. The coastal plain around Kaliveli is considered to be the last vestige of the Tropical Dry Evergreen Forest (TDEF). The wetland supports 3 species of mangrove, 12 halophytes, 2 species of sea grass and varieties of strand and aquatic vegetation (in the sandy areas and in the water). About 15 species of fish, 25 species of reptile, 200 species of bird and 15 mammalian species have been reported from in and around this ecosystem. *Typha* harvesting is the single largest revenue-generating activity. Salt production, agriculture and fishing are the other important income-generating activities. The wetland provides various livelihood options to the dwellers around. There are no legal protection measures to conserve this ecosystem and its biodiversity. Most of the site is under private ownership as salt pans and agricultural lands or with the Revenue Department as salt pans. The state forest department has taken the initiative to regenerate mangroves near the estuarine mudflats and monitors them to some extent. Agricultural encroachment, expansion of salt pans and shrimp farms, urbanization adjacent to the wetland, accumulation of fertilizers, poaching and poisoning are the important threats posing several problems to this wetland ecosystem and its biodiversity. This wetland is the second largest brackish water lake in India and has a mosaic of habitats. The site has also been identified as an Important Bird Area and as a wetland of conservation importance by several institutions and organizations. The Alambarai Fort, at the mouth, is a historically important area. Since most of the wetland area is under private ownership or is classified as revenue land, it is obvious that this site must be designated a community/conservation reserve. NGOs working on ecological and socio-economic aspects can be utilized for developing conservation schemes in association with the state forest department.

34. **Ariyankuppam:** This site is located 3 km south of Puducherry, forming a backwater complex temporarily with the Ariyankuppam and Chunnambar rivers during the monsoon. Islets, fringing mangroves, palm groves, a scenic sandy beach with a French ambience and archaeological deposits are important features. Seven exclusive mangroves, 16 mangrove associates, 2 sea grasses, numerous macroalgae, 15 molluscs, 5 prawns, 9 crabs, 39 fishes and 27 bird species have been reported from around this site. Fishing and tourism are the two main livelihood activities here. The offshore neritic waters are a well known fishing ground. The fisheries generate much more revenue than tourism-related businesses. The state government proposes to develop more resorts around this site to augment the tourism-related economy. The site is not protected in any way, but after the tsunami, local NGOs and volunteers of the fishing village are interested in protecting the mangroves and are therefore monitoring the ecosystem for damage. Oil from docking, maintenance and repairing of fishing vessels, continuous dredging of the mouth, unregulated beach tourism, reclamation for infrastructure development and sewage discharge are the potential threats reported from this site. The Arikkamedu archeological spot, sand spit islets, backwaters, mangroves; turtle nesting beaches and sea grass beds are important ecological features of this site that can be conserved for conservation. The site has been proposed as a community/conservation reserve.

35. **Uppanar:** This wetland is located in Cuddalore District. It is a backwater ecosystem (Paravanar River) running parallel to the coastline and opens into the Bay of Bengal where the Gadilam River meets the sea, forming the Uppanar estuarine system. In general the coastal plain has a low topography, and so the backwater area extends 20 km landward. The site receive freshwater from Perumal Lake, to the south, and is surrounded by 59 different industrial units. The wetland area supports 3 species of mangrove, 14 mangrove associates, including facultative halophytes, 11 species of seaweed and varieties of strand and aquatic vegetation along the sandy areas and water. Nearly 15 species of fish, 32 species of bird, 5 crab species, 3 prawn species and 12 species of mollusc are said to found around this ecosystem. Fishing and fishing-related activities such as boat construction and repairing are the most important income-generating activities. This wetland also supports agriculture upstream and local navigation. The open estuarine habitat and the swampy habitat do not have any protection. Reclamation and encroachment around the industrial units are going on. SIPCOT monitors and safeguards the vegetation on their premises and not in the adjacent ecosystem. Agricultural runoff, encroachment, reclamation for industrial infrastructure, vehicular traffic and release of untreated effluent from industries are the important threats causing problems to this wetland ecosystem and its biodiversity. Fringing and widespread halophytes all along the swampy areas, the estuarine habitat, the exposed mudflats, the oyster beds and intertidal areas are important habitats supporting a rich biodiversity and must be considered for protection. The site has been proposed as a community/conservation reserve involving the SIPCOT management and local fishing community.

36. **Vellar:** Vellar estuary is one of the well studied estuaries of India. It is located in Cuddalore District; around 6 km north of Pichavaram, and is fed by the Vellar River, which opens into the Bay of Bengal after passing Porto Novo. The famous MGR Thittu, dynamic beach, saline swamp and shrimp farms are the important ecological features observed adjacent to the estuary. The floral and faunal diversity of this wetland includes 8 species of mangrove, 22 coastal associates, 3 species of sea grass, 10 species of macroalga, 63 fishes, 16 crustaceans, 14 molluscs and 43 birds. Fishing, aquaculture and agriculture are the major revenue-generating activities. Shrimp farming contributes the most to the total revenue, more than fishing, but it is seasonal. Since the ground and low-lying water are saline, agriculture is practiced only for a limited duration. The mangroves that have been developed and the estuarine habitats of the site are being monitored by researchers and scientists of the Centre of Advanced Study in Marine Biology, Annamalai University. The shrimp farming agencies take part in protecting their vicinity. Expansion of aquaculture ponds, discharge of untreated farm effluents, agricultural runoff, encroachment and reclamation for urbanization adjacent to the wetland are the major detrimental threats reported and recorded. The fringing mangroves, the shallow estuarine substratum, MGR Thittu, the dynamic beach and the sand spit are habitats worth conserving. The site has been proposed as a community reserve involving the local fishermen and aquaculturists, under the expert guidance of the Centre of Advanced Study in Marine Biology, Annamalai University.

37. **Pichavaram:** The coastal wetland at Pichavaram is the second largest mangrove forest in India. It is located about 10 km northeast of Chidambaram, in Cuddalore District of Tamil Nadu. It is well known as a unique ecotourism spot for its mangroves. The wetland provides an interconnection between two prominent estuaries, the Vellar and Pazhayar. It consists of a number of small and large vegetated islets between numerous channels and creeks. The site has 14 exclusive mangrove species, with one endemic species, *Rhizophora annamalaiana*, 34 mangrove associates and halophytes, 3 species of sea grass, 21 species of seaweed and various species of strand and

aquatic vegetation along the sandy beach and sheltered water areas. It also has 52 macro-invertebrates, 115 species of fish, and around 200 species of bird. Fishing and fishing-related activities, aquaculture and agriculture are the major revenue-generating activities. This wetland provides livelihood security to the local fishers. The entire mangrove area has been protected as a reserve forest by the state forest department. Several research institutes and NGOs monitor the site, carry out research activities and are involved in conservation-related campaigns. No potential threats have been reported or recorded from around the site; however, tourism pressure, agricultural runoff and discharge of effluents from aquaculture are expected to have an impact on the biodiversity. The large extent of the mangrove forest, vegetated islets, creeks, mudflats and fish and avian diversity contribute to the significance of the site for conservation. The site has been proposed as a wildlife sanctuary. Inclusion of the reserve forest, alone or along with the Vellar and Pazhayar estuaries, may be considered. The Centre of Advanced Study in Marine Biology, Department of Botany and Faculty of Agriculture of Annamalai University, M.S. Swaminathan Research Foundation and other stakeholders may be consulted.

38. **Pazhayar:** This site (Pazhayar or Pudupatnam) is located at the estuarine mouth of the River Coleroon, just 3 km south of the Pichavaram mangroves. Wide mudflats, a backwater canal system with mangroves running parallel to the coast, a fishing harbour at the southern end and a dynamic beach are the major features of this site. Four species of mangrove and 15 mangrove associates, including several species of halophytic vegetation, were recorded during the survey. According to local fishermen, 18 mollusc species, 37 polychaetes, 12 crustaceans, 32 fishes and more than 25 bird species are observed around this complex habitat. Fishing is the main livelihood option for the local dwellers. The site is famous for its fishing harbour, and nearly 9500 tons of fisheries products are landed here each year. Since the site has a fishing harbour and is being considered for trial mangrove plantations, the state fisheries and forest departments are taking care of this site by monitoring the area and habitat. Mechanized boat traffic, repair and maintenance-related oil spills, dumping of fishery waste, reclamation and infrastructure development/modernization of the fishing harbour are reported to be detrimental to developing mangroves and to the entire ecosystem. The wide estuarine mouth, mudflats, mangroves, halophytic vegetation, etc. are the significant ecological features needing protection. The site has been proposed as a community/conservation reserve. The state forest and fisheries departments can take over the monitoring activities with the involvement of the local fishermen's association.

39. **Thalainayar:** This site has a large extent of mudflats with sparse mangrove and halophyte vegetation. It was notified as a reserve forest in 1931. The site is located nearly 24 km north of Vedaranyam. This backwater–lagoon-like habitat receives freshwater from distributaries of the Cauvery during the monsoon and opens into the Bay of Bengal through the Adapar River, which is connected to the Vedaranyam canal. Three mangrove species, 18 mangrove-associated species, including halophytes, macroalgae, 5 species of crab, 36 avian species and 15 molluscs have been reported from this habitat. Prawns are cultured here.Since the site is a reserve forest, it is given some protection by the state forest department. Several local NGOs and researchers monitor the bird population. The aquafarm management also protect the area in their part. Aquaculture practices and discharge of untreated effluents deteriorate the entire ecosystem. Poaching is also reported during the winter. There have been protests against the proposed thermal power plant in the vicinity because of its impacts on the ecosystem's biodiversity. The wide expanse of the brackish water, creeks, mudflats, mangroves, salt swamp vegetation and habitat associated with the ecosystem are quite unique and worth conserving for their pristine nature. The site has been

proposed as a conservation reserve because it harbours the highest diversity of halophytic vegetation in Tamil Nadu. The site is also one of the largest saline swamp areas. The state forest department should protect the site with strict laws, involving the beneficiaries.

40. **Vedaranyam:** This site is a Ramsar site. It is located west of Point Calimere Wildlife Sanctuary. This large saline swamp area comprises mangroves halophytes, salt pans, mudflats and a canal system drained by the Valavanar River, which forms the Sellakanni lagoon where it meets the Palk Bay. The site is well known as a refuge for birds. Three species of mangrove, 12 species of coastal vegetation, including halophytes, 4 species of seaweed, 250 avian species, including terrestrial and wetland birds, 12 commercially important fish species, 8 crustaceans and numerous molluscs have been reported from the different habitats. Fishing is the main source of income for most of the village people. Salt production and related work are the next income-generating options. The mudflat habitat provides scope for salt production over a larger area. The site experiences some sort of protection because the state forest department is engaged in establishing mangroves adjacent to the canals and monitors the mudflats for bird congregations. The local fishing community is also interested in conserving the area since the fishers understood its value during the tsunami. The shallow canal and creeks, wide mudflats, salt pans, beach, mangroves and saline swamp vegetation are ecologically significant features of this site that require stringent protection. The entire site has been identified as an IBA, which increases the need for conservation. The site has been proposed as a community/conservation reserve. This area should be extended into the swamp in consultation with the Bombay Natural History Society and other research organizations involved.

41. **Muthupet:** The Muthupet mangrove is an identified Ramsar site. It is located at the southern tail end of a distributary of the Cauvery, in Thanjavur District. Five rivers drain their flow here and form a lagoon at the confluence. Dense mangroves (120 km^2), oyster beds and exposed mudflats are important features. The forest harbours 3 species of mammal, 6 reptilian species, 56 avian species, 73 fish species, 18 crustacean species, 16 mollusc species, 15 polychaetes, 6 mangroves and 13 species of mangrove-associated vegetation. Nearly 3000 families depend directly on this mangrove for their livelihood. Apart from fishing, collection of oysters, fish and shrimp seed are reported to be minor revenue-generating activities. This reserve forest is known to have been managed for long by coupe felling, but the practice has been stopped nowadays. The state forest department has made stringent efforts to protect this wetland and regulate the dependent community in many conservation activities. Various local and national institutions have undertaken various research activities and monitor the critical ecological processes of the site. Dense mangroves, a sheltered lagoon, a network of creeks, areas where birds congregate, the faunal and floral diversity, aesthetic tourist spots and mangrove plantations are significant features worth conserving. Since the site shelters numerous animals in diverse habitats, it has been proposed as a wildlife sanctuary. The state forest department should take prepare a management plan involving institutions concerned with different research and socio-economic activities.

42. **Adhiramapatnam:** This site has mangrove reserve forests located southwest of Muthupet mangrove and is drained by Agni estuary in the south. The mouth of the estuary, near the fishing village of Keezhathottam, is shallow and provides a suitable environment for establishment of sea grass beds. Being at the junction of the Palk Bay and the Muthupet Reserve Forest, the site supports a variety of animals and plants, with a mosaic of habitats. Five species of mangrove, 16 species of mangrove-associated vegetation, 4 species of sea grass, numerous macroalgae, 22

species of commercially important fish, 18 crustaceans, 24 species of mollusc and 42 species of shorebird have been reported from this habitat. Fishing is the only livelihood option for about eight villages located around this mangrove wetland. An NGO is involved in mangrove plantation with the help of the fishing community and is organizing a community awareness campaign regarding conservation. Destructive fishing, poaching and unscientific docking and maintenance of fishing gear are the threatening activities around here. The presence of rare sea grasses (*Enhalus* and *Thalassia* sp.) at the mouth of the estuary, mudflats on which birds congregate, efforts to plant mangroves and conservation by the community are significant for protection. The site has been proposed as a community reserve involving the fishermen's society with the coordination of OMCAR, an NGO involved in the establishment of mangroves and creating awareness.

43. **Palk Bay:** The Palk Bay is a long stretch of the coastline comprising shallow sea grass meadows, corals, fringing mangrove patches, creeks and a lagoon between Pudukottai and Ramnad districts. The site is connected to the Gulf of Mannar at its southern portion and the habitat is contiguous with the Great Vedaranyam Swamp, in the north. The site harbours charismatic species such as the Dugong, sea horses and pipe fishes and more than 50 species of mollusc, 20 hard corals, 4 species of mangrove, 16 species of coastal vegetation, including halophytes and 7 species of sea grass. The biodiversity is to be studied comprehensively. Fishing is the major revenue-generating activity for those who dwell along this coastline. Minor tourism-related activities, vending businesses, salt work and seaweed culture are other livelihood options. There are no protection measures anywhere on the coastline except a few pockets that have been monitored by the state forest department for mangrove plantation recently. Unregulated fishing, use of restricted gear, fishing-related activities that damage fragile habitats and poaching are threatening activities that have been reported from around here. These activities were observed the survey also. The coral patches near Mandapam (Kathuvallimuni and Velapertumuni reef), sea grass meadows in the shallow areas where Dugongs feed, mangrove patches (Devipatnam, Karangadu, etc.) in the creeks and canal plantations and the saline lagoon at Pillaimadam are the important ecological features that need to be afforded stringent protection for of the rich biodiversity. The site has been proposed as a wildlife sanctuary or marine conservation reserve. Local communities participation in the management of this proposed Conservation Reserve is important.

44. **Manakudy:** This site is located about 9 km from Nagercoil, at the southern tip of India, at the edge of the Indian Ocean. The swamp spreads over an area of about 150 ha. It receives a flow from the Pazhayar River and is interconnected with the Suchindram–Theroor bird sanctuary. Twenty-three species of fishes, 4 species of crab, 3 species of prawn, 3 species of mangrove and several halophytes found at the site make it an important area for conservation. The dynamic beach is one of the important nesting sites for sea turtles. About 95 species of wetland bird have been reported from around the estuarine-and-freshwater wetland complex of this region. The Grey Pelican, Painted Stork, Open-bill Stork, Spoonbill, cormorants, Darter, etc. are the important bird species recorded during this survey. Salt production and coconut husk retting are the major revenue-related activities practiced here routinely. Fishing is the next major economic activity; however, the production from this site is negligible. Lime shell dredging is another minor revenue-generating activity, but it is limited to certain seasons. The freshwater–estuarine interconnection between Suchindrum, Theroor and Manakudy forms an important wetland complex across these regions, but only the Suchindrum–Theroor bird sanctuary is protected. The bird congregations of the wetland, saline swamp areas with mangroves and turtle nesting beach are of conservation importance and so need protection measures. Coconut husk retting, lime shell dredging and salt-

work are the major threatening activities of this site. Since the activities are seasonal, there is no cumulative impact from these threats. Fishing within the site is reported to disturb the bird congregations sometimes, and there is a need to monitor the site. The mosaic of habitats (the freshwater–estuarine wetland complex), bird congregations, saline swamp with mangroves and turtle nesting beach are significant for conservation. The site has been proposed as a community/conservation reserve.

The total area of the all 106 identified sites is 10,595 km^2 and about 33% of the area (i.e., 3504 km^2) has been prioritized for immediate protection. Nearly 52% (2125.61 km^2) of the total identified area on the east coast (4108.1 km^2) and 21% (1378.74 km^2) of the total area on the west coast (6487.8 km^2) have been prioritized (Table 4-7). Regardless of the coastal length, total area of the identified sites and number of prioritized sites along the west coast, the prioritized area for conservation is relatively less compared with the east coast. This reveals that the sites identified along east coast are comparatively larger and harbours a greater diversity of organisms within their mosaic of habitats. However, it is emphasized that intensive site-specific research is needed with respect to delineation of areas before considering them for declaration as PAs.

Conclusions

The main outcome of this study is the preparation of a guideline in the form of a detailed framework for identification of ICMBAs in India. An atlas of important coastal and marine biodiversity areas of the Indian mainland has been produced. The atlas has state-wise candidate site fact sheets and lists of prioritized sites that require immediate conservation action. The formation of a standard framework and criteria for identification of a coastal and marine PA network, inclusion of identified sites in the PA network of maritime states, a roadmap for long-term conservation and sustainability opportunities and increasing the total PA coverage of the country are considered the objectives of the ICMBA atlas. The study also fulfils the major objectives of Agenda 21 with reference to the marine environment and Aichi target 11 with reference to increasing the protected area coverage. Site-specific feasibility studies, socio-economic evaluation of identified areas and ecosystem vulnerability analysis using a standard/global analytical model are required to strengthen the study.

The important activity contemplated as a result of this study is adopting measures aiming to identify important coastal biodiversity areas so that necessary habitat restoration programs can be initiated. Futher, this initiatives was also expected to strengthen the existing MPAs in the country. This is a preliminary analysis, at a broad-spatial scale, that we hope will serve as a framework for more refined analyses leading towards the establishment of a marine protected area network in India. A large number of these areas are already in place for conservation, but the high human population density will likely make the establishment of reserves difficult. It was hoped that the prioritization process would overcome these difficulties by emphasizing the importance of conservation. It is expected that in the near future, a marine conservation portfolio for India will be defined by combining the priority areas for conservation with the additional areas necessary to fully represent the conservation targets. This exercise also highlights the point that protecting potential areas harbouring a mosaic of habitats as ecological entities deserves greater emphasis compared with species-focused conservation action.

The criteria used for prioritizing conservation areas were based exclusively on physical, ecological, biological, socio-cultural and socio-economical features. The definition of areas in this study constitutes an approach to the creation of a network of marine protected areas in India, and feasibility studies should be carried out further, subject to availability of detailed information from intensive research. This exercise

identifies and categorizes a set of conservation areas that, if considered for protection, will conserve a wide range of coastal and marine biodiversity of the state/nation and provide a long-term science-based vision for biodiversity conservation success.

It is worth mentioning that this study has some biases in its identification approach and so some caveats apply.

- The study does not include threats as important indicators to ascertain whether a site should be conserved. The level of threat to coastal and marine biodiversity is often linked with the physical, economical and technical resources available for biodiversity conservation, and so careful prioritization efforts are required.
- The biodiversity data are of presence–absence of species and are not based on population densities of species.
- The perception and willingness of the resource users were not been taken into consideration—these are vital for any typical conservation planning.

The information mentioned in the foregoing was not available at the time of the study, but could be incorporated if it becomes available.

Apart from the biases, the consequent measures and follow-ups related to the outcome of this study are considered strengths and are listed below.

(i) Formation of a standard framework and criteria for identification of a coastal and marine PA network,
(ii) Inclusion of identified sites into the PA network of maritime states,
(iii) Increase of total PA coverage of the country,
(iv) Promoting intensive research opportunities targeting different habitats and species,
(v) Promotion of income generating opportunities for local communities and agencies from ecotourism and related activities, and
(vi) Development of a roadmap for long-term conservation and sustainability opportunities.

Overall, this exercise coordinates all maritime state forest departments, concerned research institutions and NGOs involved in various coastal and marine conservation-based activities to take part in identification of potential coastal and marine biodiversity areas of their region by involving them as part of the research team. It is hoped that the candidature status of a site alerts and motivates them to adopt required measures towards conservation.

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TABLES

Table 1. List of sites targeted and physically surveyed for identification of ICMBAs

State	Sites visited
Gujarat and Diu–Daman	Koteshwar, Sangi, Jacau, Gasabara, Mandvi, Mundra, Bhadreshwar, Tuna, Kandla, Narara, Khijadia, Piroton, Bedi, Positra, Dwarka, Gandhvi, Tekada, Porbandar, Madhavpur, Veraval, Somnath, Khadwad, Diu, Barkot, Pipavav, Navbandar, Gogha, Kuda, Koliak, Katpar, Gopnath, Alang, Velavadar, Dholera, Wadgham, Sabarmati, Dhuruwan, Samli, Aliabet, Dahej, Dumas, Batta, Dandi, Dholai, Katalwad, Umergaon, Nargol, Damanganga, Kolak
Maharashtra	Vaitrana, Bassien creek, Thane creek, Mulund, Mora Port, Alibag, Dharmatar, Kondalika, Harihareshwar, Savitri estuary, Adkhar, Harnoi, Vasishti estuary, Guhagar, Ganpatipule, Jaigad, Varwade, Dabhol, Dapoli, Ratnagiri, Purnagad, Vaijayadurgh, Devgad, Achra, Kolamb, Malvan, Vengurla, Arambol, Terekhol
Goa	Morjim, Anjuna, Charao Island, Dona Paula, Mandovi estuary, Rairachol, Colva, Calungote, Sal, Talpon, Galgibagh
Karnataka	Devgad, Kali, Tolnaka, Kantriwada, Gangavali, Madanagiri, Tadri, Nushikote, Burgi, Kumta, Devari, Hanovar, Kasargod, Murudeshwar, Netrani Island, Bhatkal, Byndoor, Upunda, Yadamavina, Turtle Bay, Arati, Kollur, Jaladi, Rajadi, Haladi, Gangoli, Vittalavadi, Paripally, Kodikanyana, Seeta estuary, Upinikote, Madhirali, Swarna estuary, Malpe, Kaup, Shambaviri, Nandini, Suratkal, Kuloor, Panambur, Mangalore Port, Ullal, Someshwar, Uchilla
Kerala	Manjeswaram, Kumbala, Kasargod beach, Chandragiri, Deenar, Bekal, Neithal, Kavai, Edayilakadu, Madakkal, Dharmadom, Kadakavu beach, Kizhakepaliya, Kadakkavupuzha, Kodivallipuzha, Chal, St. Angelos Fort, Kunjimangalampuzha, Dahlilpuzha, Padyil, Cherrukinnu, Kottampally, Keriadil, Kolavipallem, Kappad, Calicut, Beypore, Kadalundi, Mudhiyam, Vettam, Kuthaiazhimugam, Ponnani, Periambalam, Nalangal, Punnaiyur, Edakkazhiyur, Dwaraka beach, Rajah Islets, Thippalimedu, Chetwa, Ganeshamangalam, Thalikulam, Nattiga, Kothakulam, Kaipamangalam, Kuzhimuttom, Azhikod, Wellington Island, Vypin, Munambam, Cherai, Mangalavanam, Fort Kochi, Kumbalanghi, Anthakaranuzhi, Thanneermukkam, Arthankal, Komalapuram, Alapuzha, Valim, Punnapra, Thottapalli, Ashtamudi, Vallikavu, Azhikkal, Ayiramthengu, Neendakara, Saktikulamkara, Paravurkayal, Mulloor, Kappil, Varkala, Kadinamkulam, Kovilthoppu, Veli, Shangumugam, Valliyathura, Kovalam, Vizhinjam, Puvar
West Bengal	Mathurakhand, Sonakhali, Binodpur, Kuimuri, Mohabatnagar, Haldia, Kolaghat, Thakuran Island, Jambuchar, Fraseganj, Bakhali, Purabidas beach, Jambudweep, Digha
Orissa	Talseri, Pitchapur, Udaipur, Kasalphal, Balramgadi, Chandipur, Hansua, Udavali, Dangmal, Kontaikai, Kalibanjadia, Dhamra, Bahubali, Havaligati, Baraipur, Gupti, Chinchiri, Gundalva, Udayakani, Chandrabach, Puri, Asthranga, Nalabana, Gokhurkuda, Aryapalli, Rushikulya, Gopalpur, Bahuda
Andhra Pradesh	Sunapur, Nilas, Nuvularevu, Naupada, Bhavanupadu, Vamsadara, Srikakulam, Kalingapatnam, Nakavali, Konada, Komadarm, Bhiminipatnam, Vizakhapatnam, Gangavaram, Pudimadka, Bangarampalem, Uppada, Cholangi, Yenam,

Tamil Nadu and Puducherry	Kothapalem, Pedagollapalem, Bantumeli, Machilipatnam, Nizamapatnam, Kalva creek, Bapatla, Kotav, Ongole, Kaderu, Pennar, Krishnapatnam, Pulicat Pulicat, Ennore, Kovam creek, Adyar estuary, Kovalam, Kalpakkam, Muttukadu, Kaliveli, Auroville, Ariyankuppam, Chunnambar, Nallavadu, Moorthikuppam, Devanampatnam, Vellar, Pichavaram, Pazhayar, Chandrapadi, Arasalar, Thirumalairajan, Vanjur, Vettar, Kaduvaiyar, Seruthur, Puthupalli, Vetaikaranirupu, Pushpavanam, Talaingnayar, Maraikariyur, Muthupet, Kodiakarai, Mallipatnam, Manora, Mumbalai, Mimisal, Arasanagary, Pasipatnam, Karankadu, Kotakarai, Uppur, Thirupalakudi, Athangarai, Kanjirangudi, Sedukarai, Valinokkam, Vembar, Vaipar, Punnakayal, Veerapandipatnam, Nambiyar, Uvari, Kanyapukari, Manakudi, Manavalakurichi, Colachal

Table 2. Criteria and indicators for identification of ICMBAs

Criterion	Conservation goals/indicators
Ecosystem resilience	Area
	Ecosystem contiguity
	Habitat diversity
	Site adequacy (suitability measures to sustain biodiversity)
	Wildlife corridor
Ecosystem function	Freshwater discharge
	Erosion control
	Carbon sequestration value
	Natural protection against disaster
Biodiversity uniqueness	Presence of globally threatened species
	Presence of regionally threatened species
	Presence of restricted range species
	Presence of flagship species
	Presence of endemic species
	Nursery and breeding site provisions for species of conservation significance
	Congregation area for species of conservation significance
	Congregation area for migratory species
Socio-cultural value	Cultural value of the site
	Religious value of the site
	Historic value of the site
	Aesthetic value of the site
Socio-economic potential	Renewable natural resource extraction opportunity
	Ecotourism prospects
	Support for agriculture
	Aquaculture and fisheries support
Land tenure	Ownership/right holding (government or private)

Table 3. Identified Important Coastal and Marine Biodiversity Areas in West coast of India

State	District	Site	Coordinates		Major habitat type(s) and significance of site	Area (km^2)	CPI	Suggested category
			Latitude (North)	Longitude (East)				
Gujarat & Diu–Daman	Kachchh	Koteshwar	23°40′363″	68°33′614″	Mudflats, mangroves	146	0.53	CCR
	Kachchh	Jacau	23°14′245″	68°36′602″	Mudflats, mangroves	403	0.5	CCR
	Kachchh	Suthri	22°57′305″	69°00′121″	Turtle nesting beach, sand dunes	19	0.53	CCR
	Porbandar	Porbandar	21°39′150″	69°36′629″	Mangroves, bird congregations	261	0.65	WLS
	Porbandar	Madhavpur	21°15′717″	69°57′057″	Turtle nesting beach, offshore marine area	19.6	0.73	WLS
	Diu	Diu	20°23′034″	70°57′613″	Mudflats, mangroves	179	0.65	CCR
	Junagadh	Gopnath	21°26′090″	72 °06′531″	Rocky shoreline, turtle nesting beach	87	0.53	CCR
	Bhavnagar	Bhavnagar	21°45′678″	72°11′502″	Mudflats, mangroves	816	0.62	CCR
	Anand	Wadgham	22°16′414″	72°27′661″	Mudflats, mangroves	927	0.57	CCR
	Surat	Aliabet	21°38′294″	72°42′909″	Mudflats, mangroves	647	0.73	CCR
	Surat	Purna	20°56′254″	72°48′201″	Estuary, mudflats, mangroves, birds	147	0.73	CCR
	Valsad	Ambika	20°45′348″	72°51′202″	Mangroves, intertidal area	105	0.62	CCR
	Daman	Damanganga	20°24′654″	72°51′019″	Mangroves, intertidal area	9	0.62	CCR
	Valsad	Umergaon	20°12′265″	72°44′976″	Mangroves, birds	22.5	0.62	CCR
Maharashtra	Thane	Vaitrana	19°31′623″	72°51′116″	Creek, mudflats, mangrove islets	132.4	0.53	CCR
	Thane	Bassein	19°19′111″	72°51′203″	Sheltered creek, mangroves	150	0.65	CCR
	Thane	Thane creek	19°09′256″	72°58′671″	Mudflats, mangrove swamp, identified as IBA	152	0.77	CCR
	Raigad	Dharamtar	18°41′865″	73°01′625″	Creek, mangrove swamp	340	0.53	CCR
	Raigad	Kondalika	18°32′690″	72°55′915″	Creek, mangrove islets, rocky shoreline	98	0.62	CCR
	Raigad	Murud–Janjira	18°18′366″	72°57′990″	Turtle nesting beach, mangroves, mudflats	141.7	0.57	CCR
	Raigad	Shrivardhan	18°02′102″	73°01′037″	Sheltered beach, mangroves	9.6	0.62	CCR

	Ratnagiri	Harihareshwar	17°59′455″	73°01′136″	Rocky shoreline, turtle nesting beaches, fringing mangroves, shoreline bird congregations	21.77	0.62	CCR
	Ratnagiri	Dabhol	17°34′799″	73°10′910″	Turtle nesting beaches, sand bars, fringing mangroves	23	0.62	CCR
	Ratnagiri	Jaigad	17°17′545″	73°13′402″	Rocky shoreline, estuarine mangroves	40.75	0.62	CCR
	Ratnagiri	Purnagad	16°48′503″	73°19′349″	Estuarine mangroves, rocky shoreline, pocket beaches	9.4	0.73	CCR
	Ratnagiri	Vijayadurgh	16°33′592″	73°20′116″	Estuarine complex, mangrove creeks, rocky coast	48.45	0.62	CCR
	Sindhudurg	Devgad	16°22′475″	73°22′278″	Sheltered estuary, mangroves, rocky outcrops, islets	14.4	0.62	CCR
	Sindhudurg	Angria Bank	16°21′323″	72°08′083″	Offshore marine area, corals	400	0.53	CnR
	Sindhudurg	Achra–Malvan	16°12′326″	73°26′518″	Lateritic coastline, mangrove creeks, sea grasses	62.74	0.85	CCR
	Sindhudurg	Vengurla			Rocky offshore islets, rocky shoreline		0.5	
	Sindhudurg	Terekhol	15°43′411″	73°41′306″	Sheltered estuary, mangrove islets, lateritic coast	7.5	0.62	CCR
	North Goa	Morjim	15°37′019″	73°44′007″	Turtle nesting beach, estuarine mangroves	11	0.57	CCR
Goa	North Goa	Zuari–Mandovi	15°27′989″	73°48′297″	Estuarine complex, mangrove isles, bird sanctuary	84.5	0.69	CCR
	South Goa	Galgibagh	14°57′877″	74°03′201″	Turtle nesting beach, sheltered mangrove, rocky shoreline	3.5	0.57	CCR
	Uttara Kannada	Kali	14°51′206″	74°06′712″	Estuary, mangrove swamp, rocky outcrops	25.3	0.73	CCR
Karnataka	Uttara Kannada	Aghanashini	14 ° 50′521″	74°08′503″	Estuarine backwater, mudflats	46	0.65	CCR
	Uttara Kannada	Hanovar	14 °16′581″	74°27′958″	Bar mouth estuary, backwater, mangrove islets, birds	13.6	0.53	CCR
	Uttara	Murudeshwar	14°05′709″	74°29′149″	Offshore rocky islets, wide	30	0.57	CCR

	Kannada				beach			
	Uttara Kannada	Netrani	14°01′048″	74°19′559″	Offshore islet, corals, fragment of Western Ghats vegetation	5	0.73	CnR
	Udupi	Kundapur	13°38′865″	74°42′317″	Estuarine backwater, mangrove islets, salt marsh	16.7	0.73	CCR
	Udupi	Kodibengre	13°23′334″	74°44′704″	Estuarine complex, backwater, mangrove islets	15	0.65	CCR
	Udupi	Malpe	13°21′624″	74°41′874″	Turtle nesting beach, offshore islets, backwater swamp	38	0.53	CCR
	Dakshin Kannada	Mulki–Pavanje	13°05′835″	74°47′267″	Estuarine backwater, mangrove islets	3.5	0.53	CCR
	Dakshin Kannada	Netravati	12°51′254″	74°50′058″	Estuarine complex, backwater, mangrove islets	16.8	0.65	CCR
	Kasargod	Kumbala	12°35′876″	74°56′457″	Beach, estuary, mangroves, sea grass	4.7	0.53	CCR
	Kasargod	Mogrol	12°32′945″	74°57′304″	Beach, estuarine backwater	4.5	0.57	CCR
	Kasargod	Chandragiri	12°29′244″	74°59′372″	Beach, estuarine backwater, mangrove swamp	8	0.57	CCR
	Kasargod	Edayilakadu	12°08′144″	75°09′391″	Backwater islets, Western Ghats flora	38	0.57	CCR
	Kannur	Azhikkal	11°56′199″	75°28′277″	Beach, estuarine backwater, mangrove swamp	25	0.53	CCR
Kerala	Kannur	Kadakkavu	11°46′835″	75°27′649″	Estuary, mangrove islets, oyster bed	6.5	0.62	CCR
	Koshikode	Kolavipalem	11°33′812″	75°35′481″	Turtle nesting beach, estuarine mangroves	4.5	0.73	CnR
	Koshikode	Beypore	11°09′713″	75°48′065″	Estuarine mangrove	8	0.53	CCR
	Malapuram	Kadalundi	11°07′592″	75°49′951″	Estuarine mangrove, islets, migratory birds	4	0.73	WLS
	Thrissur	Edakkazhiyur	10°36′580″	75°59′435″	Turtle nesting beach	3.2	0.53	CCR
	Thrissur	Kole wetlands	10°32′527″	76°06′449″	Backwater swamp, migratory birds, Ramsar site	120	0.73	CCR
	Ernakulam	Vypin–Fort	09°58′381″	76°14′394″	Offshore mud banks, mangrove	110	0.77	CCR

		Kochi			swamp			
	Alapuzha	Kumbalanghi	09°51′502″	76°16′795″	Backwater mangrove swamp, *pokkali* rice fields	59.5	0.77	CCR
	Alapuzha-Kottayam	Vembanad	09°37′882″	76 °25′125″	Brackish water lake, migratory birds	230	0.65	CCR
	Alapuzha	Kayamkulam	09°07′496″	76°28′756″	Backwater mangrove swamp	21	0.65	CCR
	Kollam	Ashtamudi	08°56′306″	76°32′384″	Brackish water lake, clam beds	75	0.62	CCR
	Thiruvananda puram	Paravur *kayal*	08°48′762″	76°38′924″	Backwater complex, beach	12	0.57	CCR
	Thiruvananda puram	Kadinamkula m	08°38′150″	76°47′722″	Backwater swamp, beach	5.2	0.53	CCR

Note: CCR, community or conservation reserve; CnR, conservation reserve; WLS, wildlife sanctuary.

Table 4. Identified Important Coastal and Marine Biodiversity Areas on the east coast of India

State	District	Site	Coordinates		Major habitat type(s) and significance of site	Area (km^2)	CPI	Suggested category
			Latitude (North)	Longitude (East)				
West Bengal	24 Parganas	Jambudweep	21°35′126″	88°11′152″	Mangroves	5.12	0.65	CCR
	Midnapur	Jambuchar	21°59′976″	88°07′025″	Estuarine mudflat, mangroves	130	0.65	CCR
	Midnapur	Junput	21°45′596″	87°51′816″	Intertidal mudflats, Red Crab habitat	57.6	0.62	CCR
	Balasore	Talseri	21°36′340″	87°28′842″	Intertidal mudflat, Red Crabs	3.5	0.53	CCR
	Balasore	Subarnarekha	21°33′720″	87°24′281″	Mangroves, Red Crab habitats	38	0.62	CCR
	Balasore	Chandipur	21°27′071″	87°02′413″	Intertidal mudflats, Horseshoe crabs	81.56	0.73	CCR
	Bhadrak	Karanjmal	20°51′152″	86°56′835″	Mangroves, intertidal area	90	0.65	CCR
	Kendrapara	Barunei	20°29′600″	86°44′584″	Intertidal mudflats, mangroves	30	0.57	CCR
Orissa	Kendrapara	Jambu	20°24′075″	86°43′260″	Intertidal mudflats, mangroves	95	0.62	CCR
	Jagatsinghpur	Paradeep	20°15′530″	86°40′736″	Beach, mangrove swamp	260	0.57	CCR
	Puri	Devi	19°58′810″	86°19′528″	Mangroves, turtle nesting beaches	88.38	0.62	CCR
	Puri	Chilika	19°41′336″	85°17′659″	Brackish water lake, salt marsh, swamp, islets, migratory birds	1095	0.77	WLS
	Ganjam	Rushikulya	19°22′799″	85°04′355″	Turtle nesting beach, freshwater swamp	18.85	0.73	CCR
	Ganjam	Gopalpur	19°15′426″	84°58′326″	Wide beach	4.5	0.53	CCR
	Ganjam	Bahuda	19°13′720″	84°50′458″	Brackish water swamp	18.55	0.57	CCR

	Srikakulam	Nuvvularevu	18°40′754″	84°26′460″	Beach, brackish water swamp, mangroves	10.32	0.62	CCR
	Srikakulam	Naupada	18°33′740″	84°20′875″	Beach, brackish water swamp, salt marsh, bird congregation	28.98	0.77	CCR
	Srikakulam	Kalingapatnam	18°20′535″	84°07′449″	Turtle nesting beach, estuary, sand bars	10	0.57	CCR
	Vishakapatnam	Gangavaram	17°38′770″	83°11′945″	Sheltered mangroves, mudflats	3	0.57	CCR
	Vishakapatnam	Pudimadka	17°28′531″	82°59′599″	Sheltered mangroves, rocky outcrops	2	0.57	CCR
	Vishakapatnam	Bangarampalem	17°25′186″	82°51′718″	Estuarine mangroves, beach, rocky coast	4.2	0.62	CCR
	Puducherry	Yenam	16°43′513″	82°12′565″	Mangrove swamp	8.4	0.57	CCR
Andhra Pradesh & Puducherry	East Godavari	Gokulalanka	16°35′605″	82°17′885″	Estuarine mangrove, islets, salt marshes	148	0.62	CCR
	Krishna	Bantumeli	16°20′628″	81°20′410″	Brackish water swamp, mangroves, birds	28.44	0.77	CnR
	Krishna	Machilipatnam	16°07′919″	81°10′827″	Mangroves, creeks, halophytes	26.38	0.73	CnR
	Krishna	Hamsaladevi	15°58′627″	81°06′035″	Estuarine mangroves	42	0.62	CCR
	Guntur	Nizamapatnam	15°53′711″	80°38′584″	Brackish water swamp, mangroves	45.64	0.62	CCR
	Prakasam	Chinnaganjam	15°40′120″	80°15′331″	Mudflat, beach	14.85	0.57	CCR
	Prakasam	Pennar	14°34′881″	80°10′155″	Wide beach, estuary, sand bars	23.5	0.57	CCR
	Nellore	Krishnapatnam	14°15′341″	80°75′182″	Brackish water swamp, mudflat	48.6	0.57	CCR
	Nellore	Pulicat	13°34′080″	80°08′454″	Brackish water lake, islet, swamp, mangroves, birds	383	0.65	WLS
Tamil Nadu & Puducherry	Kanchipuram	Muttukad	12°48′343″	80°14′576″	Backwater, turtle nesting beach, sand	32.42	0.62	CCR

				dunes			
Villupuram	Kaliveli	12°14′115″	79°58′326″	Brackish water lake, swamp vegetation, migratory birds, sand dunes	101.4	0.81	CCR
Puducherry	Ariyankuppam	11°54′308″	79°49′553″	Estuarine mangroves, turtle nesting beach, sea grass beds	4	0.69	CCR
Cuddalore	Uppanar	11°41′490″	79°46′215″	Estuary, backwater, halophytes	9.567	0.53	CCR
Cuddalore	Vellar	11°30′103″	79°46′332″	Estuary, mangroves, sand spit	8.2	0.62	CCR
Cuddalore	Pichavaram	11°25′835″	79°47′601″	Mangroves, bird congregation	20	0.77	WLS
Cuddalore	Pazhayaar	11°21′220″	79°49′531″	Mangroves, halophytes	10.5	0.57	CCR
Nagapattinam	Talaingnayar	10°31′060″	79°43′634″	Brackish water swamp, mangroves, birds	37	0.65	CCR
Nagapattinam	Vedaranyam	10°18′993″	79°44′737″	Intertidal mudflats, mangroves, migratory bird congregation	210	0.61	CnR
Thiruvarur	Muthupet	10°20′301″	79°32′417″	Mangroves, creeks, halophytes, lagoon	70	0.65	WLS
Thanjavur	Adiramapatnam	10°18′260″	79°22′364″	Mangroves, sea grasses	32.25	0.62	CnR
Pudukottai–Ramnad	Palk Bay	09°38′813″	78°56′373″	Shallow bay, sea grasses, seaweeds, corals, sea horses, pipefishes, Dugongs	725	0.81	WLS
Kanyakumari	Manakudy	08°06′129″	77°29′019″	Estuarine mangroves, turtle nesting beach, bird congregations	4.41	0.57	CCR

Note: CCR, community or conservation reserve; CnR, conservation reserve; WLS, wildlife sanctuary.

Table 5. Prioritized Important Coastal and Marine Biodiversity Areas on the west coast of India

Prioritized site	Major habitat type(s) and site significance	Highlighting features specific to the site
Madhavpur	Turtle nesting beach, offshore marine area	Marine mammals and Whale Sharks
Aliabet	Mudflats, mangroves	*Maldharis'* dependence, mudskippers
Purna	Estuary, mudflats, mangroves, birds	Highest mangrove diversity of the state, pristine nature
Thane creek	Mudflats, mangrove swamp, identified as IBA	Identified as IBA, woody mangroves
Purnagad	Estuarine mangroves, rocky shoreline, pocket beaches	Estuarine benthic diversity
Achra–Malvan	Lateritic coastline, mangrove creeks, sea grasses	Corridor to the Malvan Marine Sanctuary, Sea grass habitat
Kali	Estuary, mangrove swamp, rocky outcrops	Estuary, sea grass habitat
Netrani	Offshore islet, corals, fragment of Western Ghats vegetation	Giant Clam habitat
Kundapur	Estuarine backwater, mangrove islets, salt marsh	Bird congregations in swamp
Kolavipalem	Turtle nesting beach, estuarine mangroves	Turtle nesting
Kole wetlands	Backwater swamp, migratory birds, Ramsar site	Ramsar site, brackish water rice fields
Vypin–Fort Kochi	Offshore mud banks, mangrove swamp	Mud banks, oyster beds
Kumbalanghi	Backwater mangrove swamp, *pokkali* rice fields	*Pokkali* rice cultivation

Table 6. Prioritized Important Coastal and Marine Biodiversity Areas on the east coast of India

Prioritized site	Major habitat type(s) and site significance	Highlighting features specific to the site
Chandipur	Intertidal mudflats, horseshoe crabs	Intertidal benthic diversity, horseshoe crab congregations
Chilika	Brackish water lake, salt marsh, swamp, islets, migratory birds	Marine mammals
Rushikulya	Turtle nesting beach, freshwater swamp	Tampara Lake, marine mammals
Naupada	Beach, brackish water swamp, salt marsh, bird congregations	Turtle nesting beach
Bantumeli	Brackish water swamp, mangroves, birds	Bird congregation areas
Machilipatnam	Mangroves, creeks, halophytes	Richness of halophyte species

Kaliveli	Brackish water lake, swamp vegetation, migratory birds, sand dunes	Reptiles and amphibians associated with swamp
Pichavaram	Mangroves, bird congregations	Endemic mangrove, *Rhizophora annamaliana*
Palk Bay	Shallow bay, sea grasses, seaweeds, corals, sea horses, pipefishes, Dugongs	Faunal spill-over from Gulf of Mannar, Dugongs

Note: CCR, community or conservation reserve; CnR, conservation reserve; WLS, wildlife sanctuary

Table 7

Coast	State	Coastal length (km)	Number of sites surveyed and examined*	No. of identified sites	Total site area (km^2)	Prioritized site area (km^2)
West	Gujarat	1254.7	44	15	3768.1	813.6
	Maharashtra	652.6	32	14	1651.71	224.14
	Goa	120	10	4	99	—
	Karnataka	280	46	12	209.9	47
	Kerala	569.7	75	17	739.1	294
East	West Bengal	157.5	16	3	192.72	—
	Orissa	476.4	25	14	1823.34	1195.41
	Andhra Pradesh	973.7	42	15	861.85	83.8
	Tamil Nadu & Pondicherry	937.5	60	12	1347.14	846.4
Total			350	106	10,595.93	3504.35

*Within 5 km on the landward side.