**Template for Submission of Scientific Information
to Describe Areas Meeting Scientific Criteria for
Ecologically or Biologically Significant Marine Areas**

Title/Name of the area:

Important Coastal and Marine Biodiversity Areas of India

Presented by (*names, affiliations, title, contact details*)

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Abstract (*in less than 150 words*)

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. The site 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 A total of 350 potential sites were surveyed all along coasts of peninsular India, of these, 106 sites were identified and prioritized as ICMBA.

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. 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.

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.

Location

Peninsular India
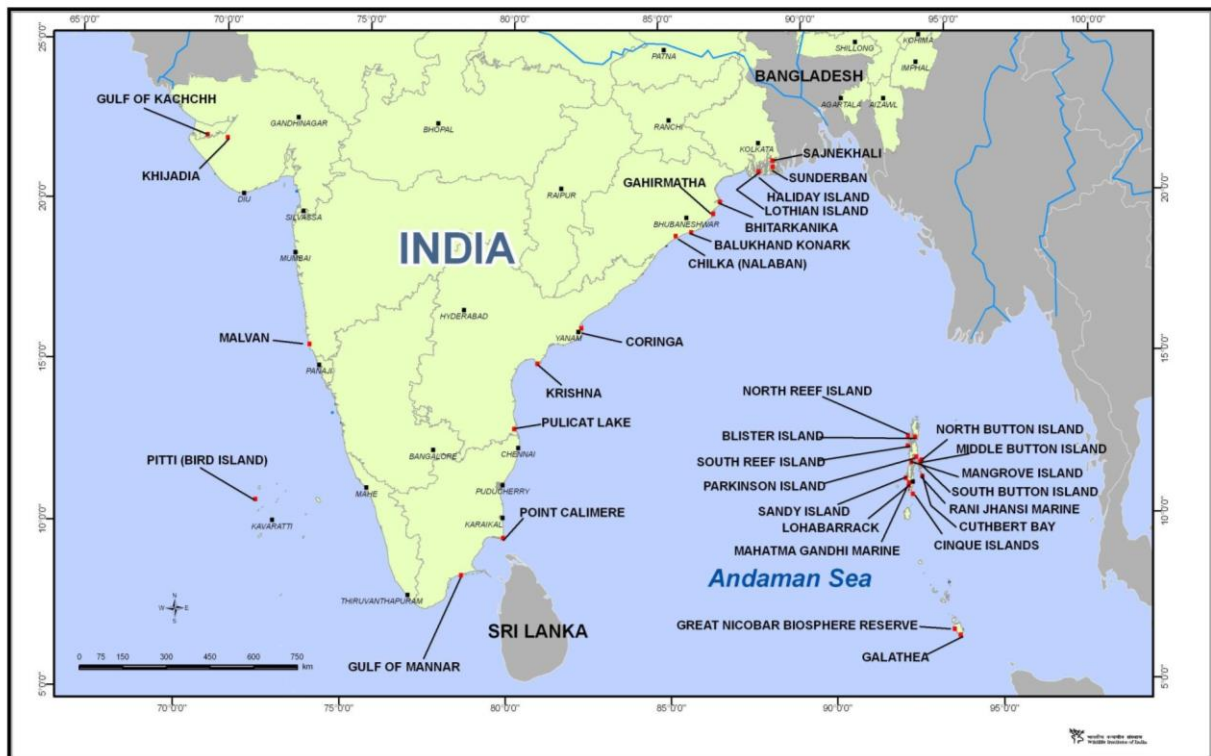
Feature description of the proposed area

Identification and selection of ecologically important areas for conservation is that this usually requires the use of comprehensive methods that maximize the preservation of species in the long term. A total of 106 important coastal and marine biodiversity areas of India have been identified based following conservation physiognomies of the six criteria and their indicators;

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.

Feature condition and future outlook of the proposed area

Site 1: 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.

Site 2: 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.

Assessment of the area against CBD EBSA Criteria
(Discuss the area in relation to each of the CBD criteria and relate the best available science. Note that a proposed area for EBSA description may qualify on the basis of one or more of the criteria, and that the polygons of the EBSA need not be defined with exact precision. And modeling may be used to estimate the presence of EBSA attributes. Please note where there are significant information gaps)

CBD EBSA Criteria (Annex I to decision IX/20)	Description (Annex I to decision IX/20)	Ranking of criterion relevance (please mark one column with an X)			
		No information	Low	Medium	High
Uniqueness or rarity	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.		X		
Explanation for ranking					
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive.			X	
Explanation for ranking					
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.			X	
Explanation for ranking					

Criteria	Description	Don't Know	Low	Medium	High
Vulnerability, fragility, sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.				X
Explanation for ranking					
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.			X	X
Explanation for ranking					
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.			X	X
Explanation for ranking					
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.		X		
Explanation for ranking					

Sharing experiences and information applying other criteria (Optional)

Other Criteria	Description	Ranking of criterion relevance (please mark one column with an X)			
		Don't Know	Low	Medium	High
Add relevant criteria	As mentioned above				
Explanation for ranking					

References

K. Saravanan, B.C. Chowdhury & K. Sivakumar (2013). Important coastal and marine biodiversity areas on East coast of India. In Sivakumar, K. (Ed.) Coastal and Marine Protected Areas in India: Challenges and Way Forward, ENVIS Bulletin: Wildlife & Protected Areas. Vol. 15 Wildlife Institute of India, Dehradun-248001, India. 292-298 pp.

Maps and Figures

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