14

Gaps in Coastal and Marine Biodiversity Conservation in India

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Summary

Marine biodiversity conservation in India is in its infancy. Many factors can be attributed to this major cause; a lack of attention at the national policy level (including the lack of a marine conservation policy), lack of an enforcement mechanism, lack of financial and human resources, self-defeating mandates of various departments and large-scale development interests of power and port infrastructure. Ever-expanding economic aspirations leading to large-scale coastal infrastructure development are bound to have their own ecological footprint, resulting in severe consequences both for coastal and marine biodiversity and for coastal communities. This paper draws attention to some key gap areas in the field of marine biodiversity conservation in India.

Keywords: *Biodiversity; bunds; coastal armour; Kharland; Konkan; mudflats; neglected ecosystem; sea turtle, sea grass.*

Introduction

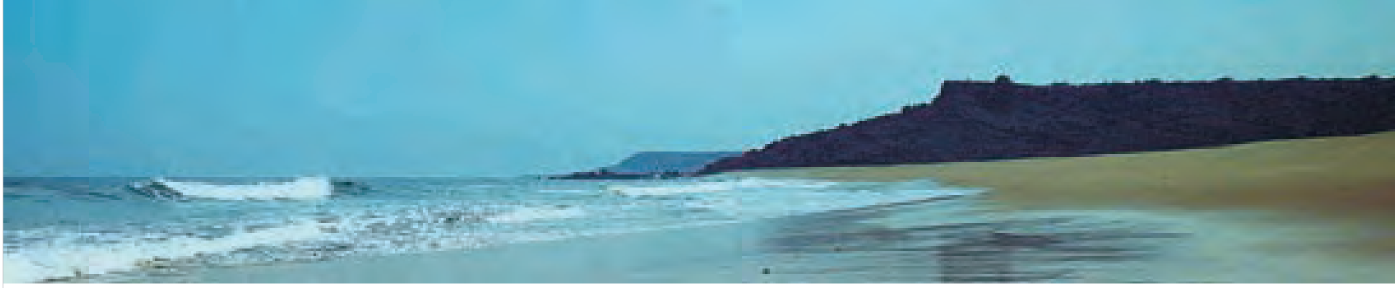
The Archbishop Ullathorne of Birmingham, in his autobiography From Cabin Boy to Archbishop, mentions his early life on ships that ran from Hull to Scandinavia. He wrote during one voyage to the Baltic, 'we have been held here in port for three days, so thick have been the shoals of fish, we cannot leave the harbour' (Ullathorne 1941). There could not be a starker contrast with the experience today, nor is this change confined to northern waters. The story is the same all across the world.

Over the last five decades, we have developed a much more profound understanding of the way oceans influence our life. Worldwide, more than 50 percent of the population lives in coastal areas-a figure that will rise to 75 percent by 2025. Among the 63 most populated urban areas (with 5 million or more inhabitants in 2011), 72 per cent are located on or near the coast (UN 2011). The footprint of such large populations on our marine and coastal biodiversity is thus of a great magnitude.

For generations, we believed that it was beyond our power to deplete our oceans' vast resources. We now see the fallacy of this view, as we see mounting evidence of our impact upon the oceans. Thus over the last two decades the debate on the needs of marine protected areas (MPAs) has gathered momentum. Despite the large number of MPAs in India, there exist major gaps in research, conservation and management that can be broadly classified into five categories:

1. Landscape/seascape/ecosystem level research
2. Habitat level research on coastal and marine biodiversity
3. Species level research on coastal and marine biodiversity
4. Socio-economic and policy-level research
5. Conservation and management-related issues

Of these, conservation and management related issues are discussed in the present paper with few case studies.



Methodology

The paper is primarily based on a literature review of the proceedings and recommendations of previous conferences and seminars and is supported with some case studies.

Discussion

1. Ambiguities in the Wildlife (Protection) Act 1972 Amendment of 2001

Realizing that conservation according to an exclusion policy will be difficult in the years to come, the Government of India, through amendments made in 2001 to the Wildlife (Protection) Act, 1972, provided space for communities to take an active role in biodiversity conservation by notifying two categories of reserves, namely community reserves and conservation reserves. The intent was to engage local communities to take an active role in biodiversity conservation through the co-management approach. However, a lack of clarity in the amendments overshadowed their intent. This is illustrated below.

Case study 1.1: Agatti Conservation Reserve-Story of a successful MPA process laced with policy failure

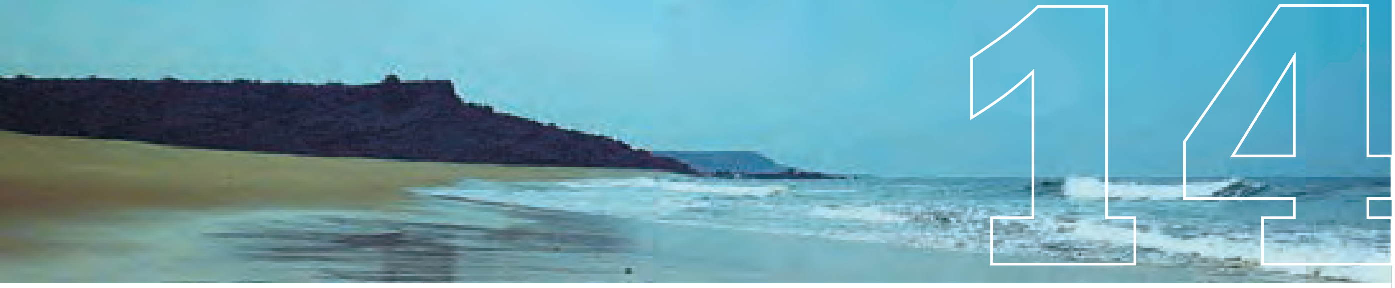
The problems that are unique to Lakshadweep are, naturally, problems of scale. The geographical, economical and social settings here vary considerably, and these islands can be considered to comprise various sub-systems: economic, social, demographic, cultural, political and ecological. The interaction of these sub-systems defines the sustainability of these islands. The Lakshadweep Archipelago, the only atoll formation in India, is one of the least researched coral reef systems in the Arabian Sea. It lies about 500 km from the mainland and comprises 32 km^2 of land on 36 islands (of which 11 are inhabited), 12 atolls and 5 submerged sand banks, and it is surrounded by a lagoon of area 4200 km^2 that is rich in marine wildlife. The population, which is directly dependent on marine resources, is growing rapidly and had reached 64,429 by 2011 (Census 2011). The social values and traditions of the islands provide a supportive social environment for community-based natural resource management and conservation.

With livelihoods closely linked with the reef resources, a formal means of affording protection in the form of sanctuary or national park is a remote and non-practical approach. However, the new amendments of 2001 to the Wildlife (Protection) Act, 1972 recognize establishment of community and conservation reserves in Lakshadweep. However, the implementation of community-based MPAs requires identification of not only major biological and ecological processes but also the socio-cultural, economic and political processes patterning the targeted area.

Project Giant Clam was thus aimed at establishing India's first marine conservation reserve. The idea of establishing an MPA at Agatti was triggered by the dwindling population of the bait fish Spratelloides delicatulus in the lagoon, a sign of reef degradation, caused by several anthropogenic stresses. A healthy bait fish stock is fundamental to the pole-and-line tuna fishery, the backbone of Lakshadweep's economy, and so the local communities expressed interest in an initiative that aimed at restoring this population. With support from the MoEF and funding from the Darwin Initiative and Whitley Fund for Nature, BNHS started Project Giant Clam in Lakshadweep in 2004, and the continues to date. In the first phase, of three years, household surveys were undertaken to understand the social and ecological settings of the islands (Deri et al 2008). This was supported through field research on coral reefs and giant clams (Apte & Babu 2007; Apte & Dutta 2010; Apte et al 2010, 2012). Subsequently, on the basis of the field research and community knowledge of the resource, the idea of an Agatti Conservation Reserve took root. In subsequent years, based on social and ecological research and the experience gained from capacity building exercises targeting the islands' youth, over 100 community consultations were arranged over a period of 2 years. These involved over 50% of the island's adult population (approximately 1800 people).

In January 2008 the Agatti Village Panchayat (elected local government) submitted a formal recommendation to the Lakshadweep Administration to establish the Agatti Conservation Reserve. A set of recommendations were prepared through the Agatti Conservation Reserve Management Plan. These recommendations were based on how the inhabitants wish to conserve their coral reefs, improve their livelihoods and continue to learn about reef conservation in the future (Deri et al 2008).

This was one of the very first experiments in integrating rigorous research, community consultations and consent prior to the designation of an MPA. During the legal consultations and boundary delineation process, however, major gaps/ambiguities in the Wildlife (Protection) Act played a major role in derailing the otherwise unique experiment in co-management. The way in which sections 36A(2) and 36C(2) under clauses 27 (4) and 33 (b & c) are interpreted is a major hindrance to the declaration of a conservation reserve. Section 33 leaves the control of the management of the protected area entirely with the Chief Wildlife Warden, making the co-management concept redundant. The Agatti Conservation Reserve proposal thus rests with the administration.



2. Conflicting mandates, lack of inter-departmental collaboration and coordination

Case study 2.1: Case of khar land bunds (Irrigation Department) and impact on mangroves (Environment and Forests Department) in the state of Maharashtra.

As a legal term, 'khar land' means tidal land which has been made cultivable or otherwise beneficial in any manner whatsoever by constructing an embankment that affords protection from the sea or tidal backwaters and includes all such land in whatever manner described, whether as khar, khajan, kharepat, gazni or otherwise.

The practice of embankment of khar lands by earthen bunds to bring them under cultivation has been in vogue over the last 800-900 years. After independence, in 1947, the government's attention was drawn to the problem of 'protection' of khar lands, and this resulted in the enactment of the Bombay Khar Land Act 1948. Through Clause 3 of the Act, the Khar Land Board was established in 1949. More recently, according to Coastal Regulation Zone (CRZ) Notification of 1991, a detailed review of proposed khar land development schemes was undertaken. Taluka-wise maps were prepared after studying the CRZs of four districts, namely Thane, Raigad, Ratnagiri and Sindhudurg.

In many places, restricting the ingress of seawater into agricultural land or settlements is necessary. In many places bunds also provide connectivity to villages. However, the bunds constructed in areas bearing mangroves are proving to be detrimental, especially when the water flow to the mangroves is restricted. This has resulted in mortality or has changed the community structure of mangrove forests in many areas, affecting directly or indirectly livelihoods of local communities and the plant and animal communities dependent on mangroves. According to a notification published on 25 December 2003, there are in all 575 khar land development schemes in four districts of Konkan, aiming to reclaim 49,120 ha (Table 1a).

Out of 575 khar land schemes, 373 (39,607 ha) schemes have been completed. For the remaining 202 schemes, funds are being allocated in a phased manner. Table 1b clearly illustrates that many projects have been stalled in the wake of opposition from local communities. The question thus arises as to why there is such opposition in so many places, if the Khar Land Board aims to work for the people. Some of the prominent examples of the issues of khar land bunds on mangroves, especially from Ratnagiri District, are illustrated below.

Case study 2.2. Khar land bunds affecting mangrove cover: Case studies from Ratnagiri (Apte et al 2013)

(I) Jaigad Creek: Lagvan-Kasari-Satkondi mangrove patch

Total length of the bund: 1 km; total area of mangroves affected: 108 ha

A bund constructed in this area controls the flow of tidal water vital for the survival of approximately 108 ha of mangrove forest along the creek. Historical images of this area reveal that there was a thick mangrove cover over approximately 108 ha during 1989, when the bund construction was initiated. Since then, there has been gradual siltation and disappearance of mangroves from this area. The area under mangroves has now declined from 108 ha to 35 ha. Earlier, a few floodgates of the bund used to be kept open to let the tidal water run into channels, but in recent months, all but one gate have been closed, affecting the mangroves.

(II) Bankot Creek: Shipole-Veswi bund

Total length of the bund: 1.5 km; total area of mangroves affected: 35.5 ha

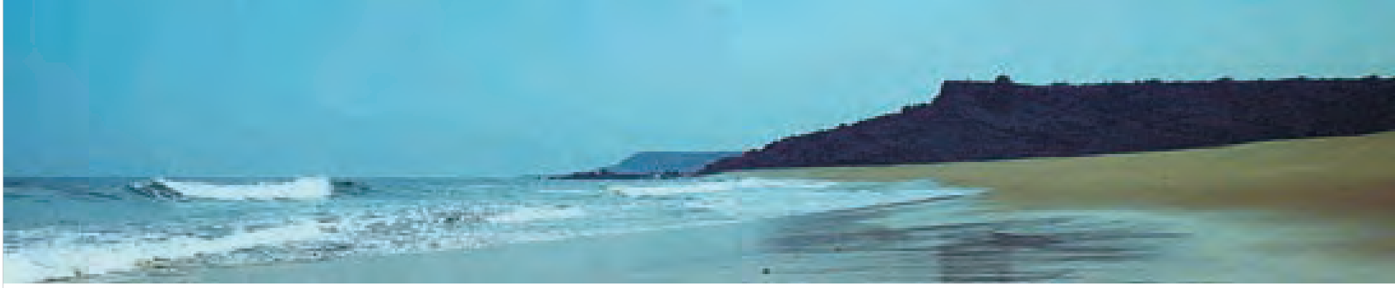
A bund connecting Veswi and Shipole villages passes through an old mangrove patch spread over 48 ha, dividing it into a 12.7 ha patch towards the creek and a 35.3 ha patch landwards. Although two floodgates in the middle of the bund are presently open and supply water to the mangrove area, there is some construction under way, which is likely to divert the floodwater to existing and upcoming aquaculture units. Subsequently, the larger tract of mangrove (35 ha patch) will be at risk due to inadequate tidal water.

(III) Sakhartar Creek: Shirgaon

Total length of the bund: 2.5 km; total area of mangroves affected: 75 ha

A bund of 2.5 km length encircles around 75 ha of mangroves near Shirgaon in Sakhartar Creek. The original mangrove grove was a pure stand of Sonneratia alba. Heavy mortality of mangroves occurred after the bund was erected. Recently, the bund was demolished by the forest department, which resulted in subsequent colonization of mangroves, but with significant changes in composition. The grove is now dominated by Rhizophora mucronata (Apte et al 2013).

This case clearly illustrates the lack of coordination between the Department of Environment and Forests and the Department of Irrigation. While on the one hand mangroves are protected as forests, the Irrigation Department is systematically removing mangroves to make land cultivable.



3. Lack of focus on neglected ecosystems

There are a number of marine and coastal ecosystems that lack national attention. Mudflats, sea grass beds, inter-tidal rocky shores, sandy shores and coral reefs have received little attention in national conservation policies. Large numbers of species that are protected under the Wildlife (Protection) Act, 1972 and are listed in the IUCN Red List depend directly or indirectly on these habitats (Table 2).

3.1. Sea grass beds

Sea grasses are submerged aquatic vegetation (SAV) that have evolved from terrestrial plants to live in the marine environment (Turner & Schwarz 2006). Sea grasses grow from the regularly inundated intertidal zone to a depth of nearly 15 m in sandy sub-tidal zones. The World Atlas of Seagrasses (Green & Short 2003) provides species-specific distributional maps along various coasts. This work provides a compilation of ecosystem services of particular species. They are the main diet of Dugongs (Dugong dugon) and Green Sea Turtles (Chelonia mydas) and provide a habitat for many smaller marine animals, such as shrimps and fish, of commercial importance. They also absorb nutrients from coastal runoff and stabilize sediment, helping to keep the water clear. The major sea grass meadows in India exist along the southeast coast (Gulf of Mannar and Palk Bay) and in the lagoons of islands of Lakshadweep, in the Arabian Sea, and the Andaman and Nicobar Islands, in the Bay of Bengal (Jagtap et al 2003).

3.2. Mudflats3

Also known as tidal flats, mudflats are coastal wetlands that form when mud is deposited by tides or rivers. The sheltered environment and low water currents, which can encourage the deposition of sediment particles carried by water over a period, are fundamental requirements for the formation of complex, muddy shorelines. High-organic detritus material dominated by silt and clay is the textural characteristic of such depositions. Estuarine-creek complexes that are semi-enclosed transitional water systems having both fresh and marine water influxes are the ideal places where such sedimentation can occur naturally (Bush 2009). Many factors are involved in the formation and maintenance of mudflats, but tidal inundation and salinity are the core components that are responsible for their topographic and ecological complexity. The deltas of the Ganges, Mahanadi, Godavari, Krishna and Cauvery supports huge mudflats on the east coast of India.

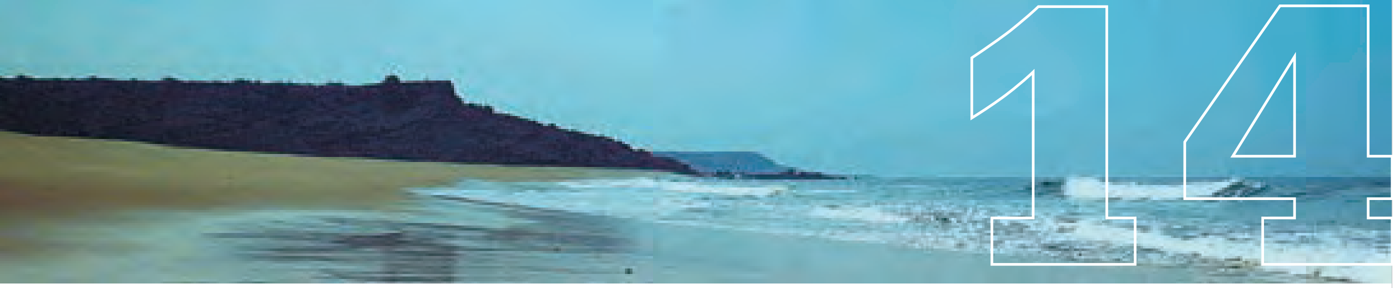
Mudflats play an important role as stopover sites for migratory birds to refuel for the long journey to their wintering or breeding destinations. Mudflats are present in almost all coastal states in India but are often listed as wastelands in revenue records. Destruction of mudflats due to construction of ports, fishing harbours and industries and due to oil exploration and mangrove plantation activities can result in disruption of the foraging and migration of birds.

Fig 1 : *A sandy shore*

Deepak Apte

3.3. Sandy shores and sand dunes

Sandy shores are formed by the accumulation of sand particles driven by wind or water currents. Sandy beaches are classified on the basis of sand structure, wave action, surf zone and sand grain size. The sandy shore fauna are a highly adapted, diverse and ecologically significant group. Their habitats are characterized by the sand particle size and compactness of sediment. High-energy waves tend to change the sandy substrate and hence the fauna.



Sand dunes are hills or mountains formed by accumulation of sand due to the action of tides, waves and wind. The diversity of the sand dune fauna and flora is limited, but these forms are unique to the habitat (McLachlan & Brown 2006). They are highly adapted to the harsh conditions of the shore, such as the strong winds, high salinity, dryness of the sand and temperature fluctuations. Coastal sand dunes form a different habitat along the shore and provide a nesting habitat for some endangered species of bird and sea turtle. Plants on sand dunes are of various types, ranging from small flowering plants to large trees. Sandy beaches are very important economically and socially. Sand or beaches extend over an area of 63,033 ha out of a total coastal wetland area of 37,03,971 ha in India (NWA 2009). Issues such as flattening of sand dunes and sand mining have severe consequences, causing shore erosion.

3.4. Rocky shores

Various forms of rocky shores dominate both the east and west coasts of India. Coastal cliffs are the most commonly observed and characteristic geomorphic feature along the coastline of India (Kumar et al 2009). Rocky shores in the Konkan, for example, are outcrops from the foothills of the Sahyadri. These are formed between sandy shores that have characteristic 'C' shape, forming bays. There are about 32 rocky shores along the Maharashtra coast (Apte et al 2010). Rocky shores are made up of eroded cliffs; wave-cut platforms and rugged sea cliffs. Rock pools are dynamic micro niches, and many organisms may spend their entire life cycles in a single rock pool. The availability of light, frequency of exposure to tidal water, salinity and temperature play very important roles in determining the diversity of life in a rock pool. Compared with sandy shores or rocky shores, the structure of a rock pool is three-dimensional. An abundance of hydroids, sea anemones, echinoderms, sponges, bryozoans, molluscs, algal forms and associated life forms is seen in sheltered rock pools. Comparatively, the east coast has a narrow continental shelf, as in the case of southern Tamil Nadu, where rocky shores with heavy wave actions are found (Sampath 2003).

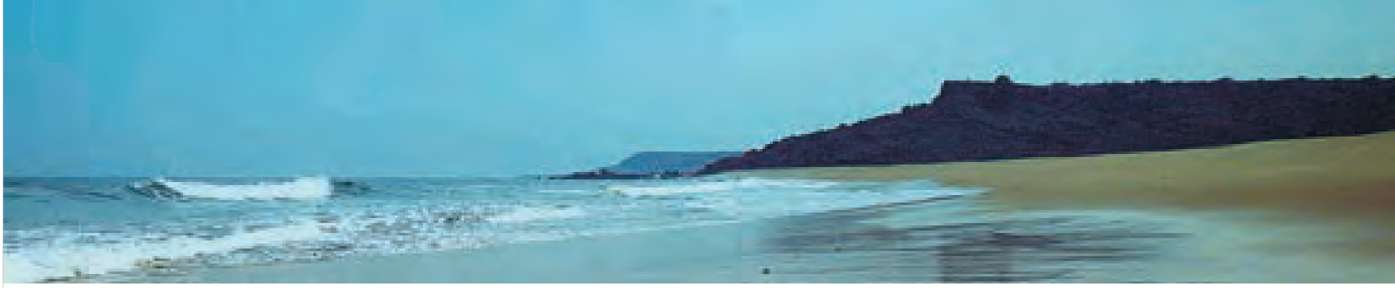
3.5 Coral reef ecosystems

Corals are formed by tiny polyps, whose size varies with species and ranges from less than 1 mm to a few centimetres. Special algae called zooxanthella is harbored by each polyp in its tissues, which uses sunlight and carbon dioxide to conduct photosynthesis. There are several types of coral classified on the basis of their skeletal structure like hard corals, soft or flexible corals, branching and tube corals. Some are sessile (solitary corals) or colonial and they occupy specific zones (the deep sea, for example). Hard corals possess an outer skeleton of calcium carbonate ($CaCO_3$). These corals are also known as reef-building/stony/hermatypic corals. Soft corals are flexible, and they are branched like small trees. Reefs are of three distinct types: fringing reefs, barrier reefs and atolls. The major coral reefs in India are found in the Gulf of Mannar and Palk Bay (fringing reefs), Gulf of Kutch (platform reef), Andaman and Nicobar Islands (fringing and barrier reefs) and Lakshadweep Islands (atoll reefs). Patchy reefs are present near Ratnagiri and the Malvan coast (Maharashtra) (Sampath 2003). Coral reefs are known to be the most diverse among marine ecosystems and harbour an assorted set of communities. The complex physical organization of a reef itself creates heterogeneous micro-habitat structures and influences bio-geographic settings.

4. Coastal armour and afforestation

In 2004, of the 5422 km coastline, an extent of 1214 km (Lakshmi et al 2012) was affected by sea erosion. Now the extent has gone up to 1624 km (increase from 22.4% to 30%) according to the latest information available with the Coastal Protection and Development Advisory Committee (CPDAC). In other words, almost one third of the Indian coast is undergoing erosion. According to the CPDAC, 748 km of the coastline is currently protected, mainly locally, using RCC or rubble mound seawalls, though in recent years attempts have been made to use geo-tubes. Not surprisingly, Kerala, 80% of whose coast comprises sandy beaches and which reportedly experiences the maximum extent of erosion-has 216 km of seawalls, followed by Gujarat, with 118 km. In both cases, sand mining is supposed to be a major cause of coastal erosion. Of the 565 structures in the littoral zone, 204 were groynes and 93 were breakwaters (Lakshmi et al 2012).

Sandy beaches are the dominant feature of most of the world's ice-free coastlines and are increasingly being threatened by coastal squeeze. Sandy beaches are relatively poorly understood, and this aggravates the threats faced by them (Schoeman et al 2009). With the increasing extent of coastal armouring, there are now concerns about the cumulative impact on the coastline. There are various effects, ranging from disturbing the long shore transport of sediment and restricting access to the beach to disturbing the aesthetic effect of the landscape (Stancheva et al 2011) and having an impact on the ecology of the area. Of course, such effects are based on the type of coastline as well as the spatial and temporal scales of the interventions. The most significant impact of coastal structures on coastal habitats, particularly along sandy beaches that have a significant net littoral drift, is the aggravation, increase and acceleration of coastal erosion down-drift (or down-current) of the structures-commonly known as the terminal groyne syndrome in the case of groyne fields-which leads first and foremost to destruction and loss of habitat. Recent studies on low-crested coastal defence structures (Bulleri & Chapman 2010) have found them to have severe ecological impacts such as erosion of



beaches and sand dunes, resulting in direct loss of habitat; removing barriers that would normally isolate species; favouring the spread of non-native species; increasing habitat heterogeneity; shrinking of habitats; and disproportionate loss of dry upper intertidal zones.

Animals such as sea turtles find it difficult to nest in areas with coastal armouring (Dugan et al. 2008). Rizkalla and Savage (2011) studied the impact of seawalls on the Loggerhead Sea Turtle (Caretta caretta) and concluded that nesting patterns indicated that passive erosion at seawalls likely caused fewer turtles to attempt to nest on armoured beaches compared with unarmoured beaches. Witherington et al (2011) concluded that barriers such as exposed seawalls and other types of coastal armouring can prevent use of the upper beach by nesting sea turtles. One important impact of the restriction of beach access is a change in the spatial distribution of nests on the beach. Witherington et al (2011) concluded that rather than abandoning nesting attempts, the turtles made nests seaward of the barrier; however, nests in this seaward zone have the greatest risk of egg mortality from erosion and inundation, especially in seasons when tropical storms occur. Feagin et al (2005) concluded that the effects of armouring are greatest and felt earliest on the landward-most coastal strand and supra-littoral dry sand zones.

Few studies have been carried out on this subject in India. Comparing the biodiversity of artificial and natural seawalls on the Kerala coast, Biju Kumar and Ravinesh (2011) found that many species occurring in natural rocky shores are either absent or found in differing compositions on artificial seawalls. There were also variations in the regeneration of communities in artificial systems. The authors pointed out that protective armour may serve as a shelters for coastal biodiversity and called for habitat-enhancing marine structures (HEMS). Although this may be true for some subtidal taxa, which settle in similar numbers on natural and artificial structures (Glasby 1999; Chapman & Clynick 2006), it is not necessarily true for intertidal (Chapman 2003) or supratidal (Attrill et al 1999) habitats. Seawalls and revetments have the most significant impact on livelihoods because they block and restrict access to the sea and fully occupy the beach-space.

5. Lack of dedicated marine policy and cadre for the management of MPAs

Considering the vast extent of coastal areas, it is significant that we do not have a dedicated cadre of MPA managers. Management of oceans is very different from management of forests or other terrestrial habitats. Thus, there is an urgent need to have a dedicated marine conservation policy supported by dedicated cadre of MPA managers.

6. Poor enforcement infrastructure

Whereas there is an intent of protecting MPAs, the facilities that exist with managers are simply inadequate to manage such vast seascapes. Monitoring boundaries in the seascape poses special challenges compared with terrestrial protected areas. This makes fishing communities one of the major partners in marine biodiversity conservation.

7. Lack of integration of scientific inputs in policy promulgation

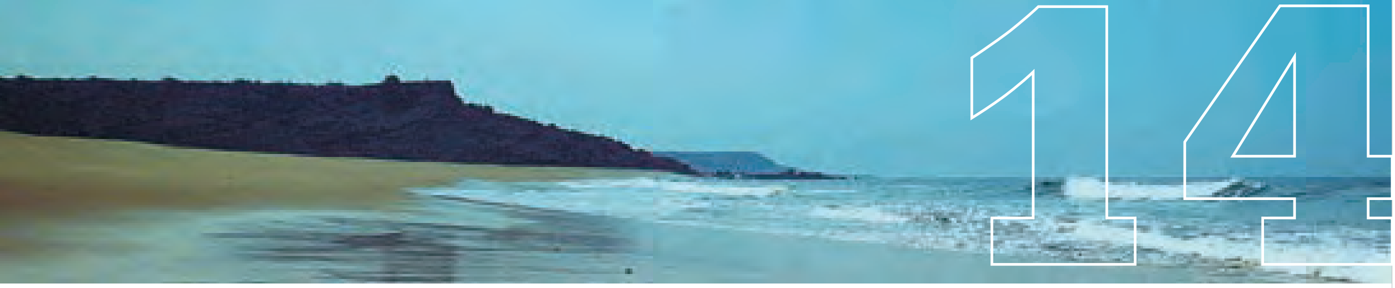
It is important that conservation interventions be based on sound science. For example, promotion of longline tuna fishing instead of pole-and-line fishing in Lakshadweep is against the very spirit of sustainable development. Pillai and Satheeshkumar (2013) stated that the Indian Ocean stock of tuna is currently overfished and that there are no proper management regulations aimed at sustaining the stock. The authors also state that in the Indian EEZ, while the near-shore waters up to a depth of 50 m are fully exploited, the waters beyond this depth are still believed to be relatively unexploited. Of the various methods used to catch tuna in India, only 29% use the pole and line method. Among all gears, it is considered the most eco-friendly due to its by-catch-free nature. Thus, instead of providing incentives for using eco-friendly fishing gear, the Government of India is promoting longline fishing in Lakshadweep along with collector vessels for servicing longline fleets (GOI 2004; MOFPI 2013), defeating the purpose of sustainable development.

8. Lack of cumulative impact assessment

In recent times, there has been construction of a large number of power plants and ports close to each other in many coastal states such as Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh and Orissa. For example, in a small area between Vijaydurg and Jaigad Creek, in Ratnagiri District (a 100 km stretch), five power plants (total capacity 17 GW), five minor ports, landing jetties and numerous aquaculture units are being commissioned (some are already operational). Such large-scale coastal development is bound to have social and ecological impacts. However, under the Environmental Protection Act (EPA) it is not mandatory to carry out cumulative impact assessment. This is a major gap in the policy. For such cluster development, it is necessary to have cumulative assessment of social and environmental impacts (Apte & Bhave 2010).

9. Lack of attention to marine species conservation

The Wildlife Institute of India, under a mandate from the MoEF, has had three national consultations (22 July 2008, 6



November 2008 and 6 March 2009) to identify marine species requiring species recovery plans. After intensive consultations, eight species (the Dugong, Whale Shark, Leatherback Sea Turtle, Hawksbill Sea Turtle, giant clams, holothurians, horseshoe crabs and Balanoglossus) were identified as priority species for developing species recovery plans. Species recovery plans were developed for at least four species. Since 2009, however, none of the marine species except the Dugong has received any kind of support from the MoEF for implementing recovery plans.

Recommendations

1. Policy-level intervention
   a) It is important to have a National Policy on Coastal and Marine Biodiversity supported by a dedicated cadre of MPA managers.
   b) The efficacy of international, national and state policies and legal instruments in resource management in the coastal and marine environment needs to be assessed.
2. Cumulative impact assessment: Under the EPA, and as a part of EIA, cumulative impact assessment must be made mandatory, especially for projects that are being planned in close vicinity to other projects.
3. A coastal development blueprint should be prepared for each coastal state and district instead of having an ad hoc approach.
4. Conflicts between policies at the union and state levels need to be identified for conservation and development.
5. Gaps in the policy-making process need to be identified and documented. Methods need to be recommended to support a participatory policy-making process.
6. Institutional models (government, non-government and community-led organizations) that can be given responsibility for managing and conserving resources must be studied and identified.

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Fig 2 : *Giant clam*

Deepak Apte

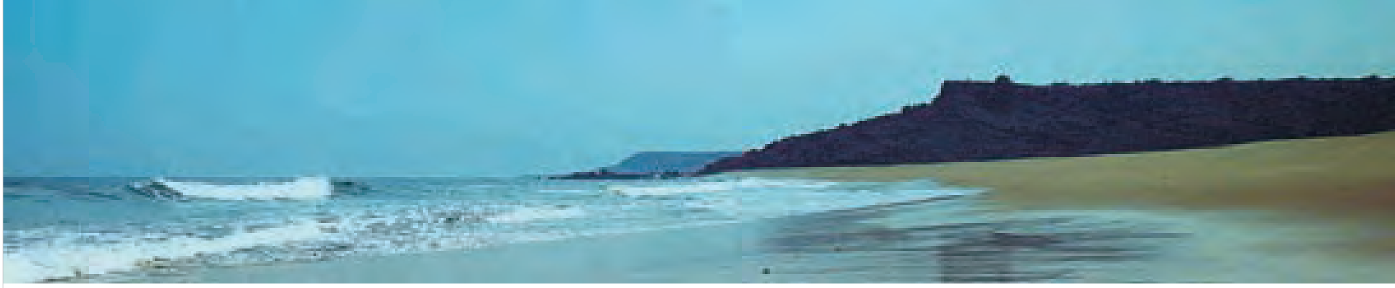


Table 1a : Kharland development schemes in four districts of Konkan

District	Total No. of schemes	Reclaimable area (ha)
Thane	108	13,631
Raigad	165	22,559
Ratnagiri	170	6794
Sindhudurg	132	6136
Total	**575**	**49,120**

(**Source:** *http://www.mahaKharlanddevelopment.org/*)

Table 1b : Ongoing schemes under State Fund (data up to 2008-2009. Khar Land Board website data not updated)

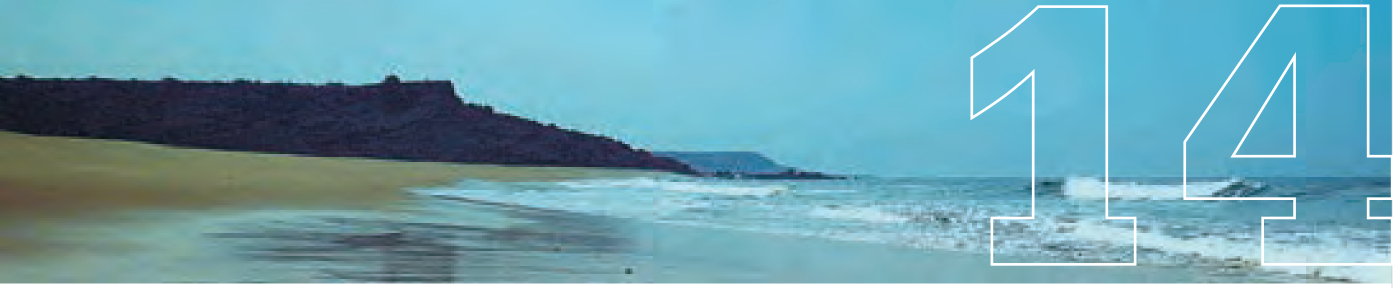
S. No.	Name of khar land scheme	Taluka	Creek/ Sub-creek	R.A. (ha)	L.B. (m)	Total cost (in lakhs of rupees)	Cost per hectare [in lakhs of rupees]	Present status	Remarks
1	Shirgaon	Ratnagiri	Mirya	74	2485	64.38	0.87	Work stopped	Villagers' opposition
2	Juve-Jaitapur	Rajapur	Jaitapur	168	1890	188.81	1.12	Ongoing	
3	Sadye	Ratnagiri	Are	24	750	27.66	1.15	Ongoing	Villagers' opposition
4	Nevare-Chichavane	Ratnagiri	Navare	26	845	29.75	1.14	Ongoing	
5	Arwali Tak	Vengurla	Mochemad	75	80	54.50	0.51	Ongoing	Work stopped due to local cultivators' objection
6	Phansewadi	Deogad	Vijaydurg	71	1440	35.34	0.40	Ongoing	

R.A. = reclaimed area, L.B. = length of bund.

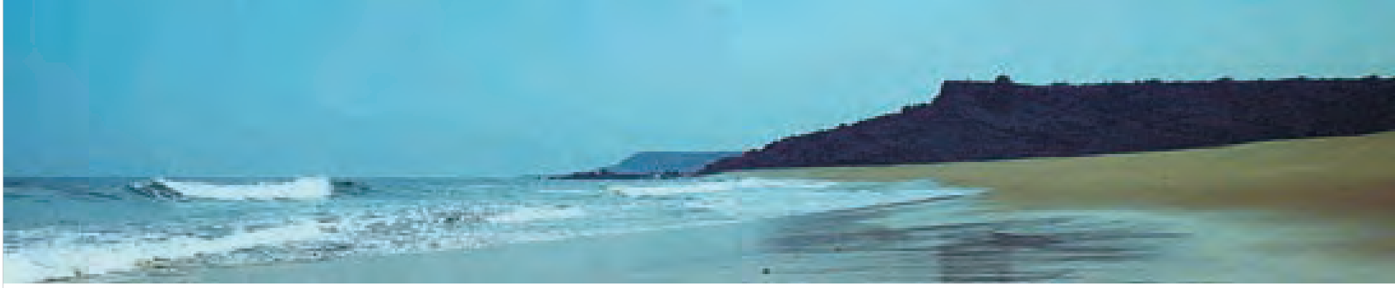
(**Source:** *http://www.mahaKharlanddevelopment.org/*)

Table 2 : List of species that use neglected ecosystems and that are protected under the Wildlife (Protection)

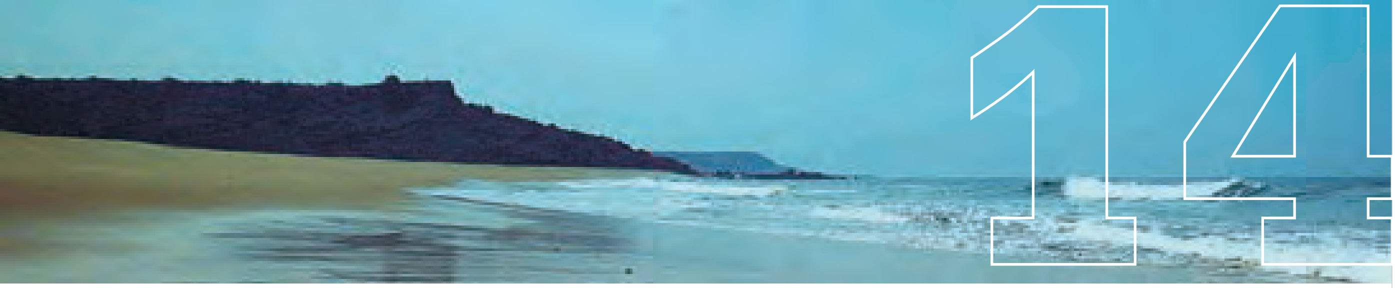
Common name	Scientific name	WPA schedule	IUCN	Habitat
Porifera				
Sponges	All sponges	III	NA	Inter-tidal-sub-tidal rocky habitat, reef areas
Cnidaria				
Corals	All scelarctinians	I	-	Reef builders
	Antipatharians	I	-	Reef builders
Orange Pipe Coral	*Tubipora musica*	I	-	Reef builders
	All Millipora species	I	-	Coral reefs
	All gorgonians	I	-	Coral reefs and rocky shores
Arthropoda				
Horseshoe Crab	*Tachypleus gigas*	IV	NA	Sandy shores for nesting
	Carcinoscopius rotundicauda	IV	NA	Sandy shores for nesting
Mollusca (Pelecypoda, Gastropoda and Cephalopoda)				
Small Giant Clam	*Tridacna maxima*	I	Lower Risk/ Conservation Dependent	Coral reefs



Common name	Scientific name	WPA schedule	IUCN	Habitat
Fluted Giant Clam	*Tridacna squamosa*	I	Lower Risk/ Conservation Dependent	Coral reefs
Giant Clam	*Tridacna gigas*	-	VU	Coral reefs
Horseshoe Giant Clam	*Hippopus hippopus*	I	VU	Coral reefs
Giant Helmet Shell	*Cassis cornuta*	I	NA	Sandy bottom in coral reefs
Queen's Conch	*Cypraecassis rufa*	I	NA	Sandy bottom in coral reefs
Triton's Trumpet	*Charonia tritonis*	I	NA	Sandy bottom in coral reefs
Glory of India	*Conus milneedwardsi*	I	LC	Sandy bottom
Nautilus	*Nautilus pompilius*	I	NA	Pelagic
Spiral Tudicla	*Tudicla spirillus*	I	NA	Sandy bottom in coral reefs
Window-pane Oyster	*Placenta placenta*	IV	NA	Mangroves, sandy-muddy substrates
Chiragra Spiderconch	*Harpago chiragra*	IV	NA	Sandy bottom in coral reefs
Crocus Spiderconch	*Lambis crocata*	IV	NA	Sandy bottom in coral reefs
Arthritic Spiderconch	*Harpago arthritica*	IV	NA	Sandy bottom in coral reefs
Orange Spiderconch	*Lambis crocea*	IV	NA	Sandy bottom in coral reefs
Milleped Spiderconch	*Lambis millepeda*	IV	NA	Sandy bottom in coral reefs
Scorpius Spiderconch	*Lambis scorpius*	IV	NA	Sandy bottom in coral reefs
Truncate Spiderconch	*Lambis truncata*	IV	NA	Sandy bottom in coral reefs
Pigeon Conch	*Dolomena plicata*	IV	NA	Sandy bottom in coral reefs
Lamacine Cowry	*Staphylaea limacina*	IV	NA	Coral reefs
Map Cowry	*Leporicypraea mappa*	IV	NA	Coral reefs
Chocolate Banded Cowry	*Talparia talpa*	IV	NA	Coral reefs in intertidal areas
Trapezium Horse Conch	*Pleuroploca trapezium*	IV	NA	Prefers sea grass areas
Gold-Banded Volute	*Harpulina arausiaca*	IV	NA	Sandy bottoms
Top Shell	*Tectus niloticus*	IV	NA	Coral and rocky reefs
Great Green Turban	*Turbo marmoratus*	IV	NA	Coral reef areas
Echinodermatac				
Sea cucumbers	*All holothurians*	I		Sandy bottom in coral and rocky reefs
Pisces				
Whale Shark	*Rhincodon typus*	I	NA	Near-shore/offshore
Sharks and rays	*Anoxypristis cuspidata*	I	EN	Sub-tidal
	Carcharhinus hemiodon	I	CR	Sub-tidal
	Pristis microdon	I	CR	Sub-tidal
	Pristis zijsron	I	CR	Sub-tidal
	Rhynchobatus djiddensis	I	VU	Sub-tidal
	Urogymus asperrimus	I	NA	Sub-tidal
Sea horses	*Family Sygnathidae*	I	-	Coral reefs, inter-tidal rocky shores
Giant Grouper	*Epinephelus larceolatus*	I	NA	Coral reefs, near-shore areas



Common name	Scientific name	WPA schedule	IUCN	Habitat
Reptiles				
Sea Snakes	*Family Hydrophidae*	IV		Pelagic-near-shore-occasionally in inter-tidal reef areas
	Cerberus rynchops	IV	LC	Mangrove, mudflats
Saltwater Crocodile	*Crocodilus porosus*	I	LC	Riverine and deltaic areas; prefers mangrove forests for nesting
Green Sea Turtle	*Chelonia mydas*	I	EN	Sandy shores and sand dunes for nesting/sea grass for feeding
Hawksbill Sea Turtle	*Eretmochelys imbricata*	I	CR	Sandy shores and sand dunes for nesting/coral reefs for feeding
Leatherback Sea Turtle	*Dermochelys coriacea*	I	CR	Sandy shores and sand dunes for nesting
Loggerhead Sea Turtle	*Caretta caretta*	I	EN	Sandy shores and sand dunes for nesting/coral reefs for feeding
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	I	VU	Sandy shores and sand dunes for nesting
Aves				
Eurasian Spoonbill	*Platalea leucorodia*	I	LC	Mudflats-mangroves or fine sandy beds
Brown-Headed Gull	*Larus brunnicephalus*	IV	LC	Marshy areas for breeding
Black-Headed Gull	*Larus ridibundus*	IV	LC	-
Slender-Billed Gull	*Larus genei*	IV	LC	Salt pans, sand spits, shallow inshore waters
Gull-Billed Tern	*Gelochelidon nilotica*	IV	NA	-
Caspian Tern	*Sterna caspia*	IV	LC	Coastal lagoons, salt marshes, estuaries, inshore waters
Common Tern	*Sterna hirundo*	IV	LC	Sheltered coastal waters, estuaries, mangroves
Great Cormorant	*Phalacrocorax carbo*	IV	LC	Nests on rocky ledges along the coastal region
Black-Tailed Godwit	*Limosa limosa*	IV	NT	Occasionally some subspecies use sandy beaches and mudflats for breeding
Eurasian Curlew	*Numenius arquata*	IV	NT	Rocky-sandy beaches, mudflats, mangroves for feeding
Common Redshank	*Tringa tetanus*	IV	LC	Coastal salt marshes for breeding and feeding
Common Greenshank	*Tringa nebularia*	IV	LC	Estuaries, swamps, salt marshes, mangroves for feeding
Wood Sandpiper	*Tringa glareola*	IV	LC	Mudflats for feeding
Common Sandpiper	*Actitis hypoleucos*	IV	LC	Mudflats, estuaries and sheltered coasts for feeding
Spoonbill Sandpiper	*Eurynorhynchus pygmeus*	IV	CR	Mudflats
Ruddy Turnstone	*Arenaria interpres*	IV	LC	Rocky-sandy shores, mudflats for feeding



Common name	Scientific name	WPA schedule	IUCN	Habitat
Curlew Sandpiper	*Calidris ferruginea*	IV	LC	Mudflats, sand flats, salt marshes for feeding
Greater Flamingo	*Phoenicopterus ruber*	IV	LC	Saline lakes, mudflats, sand flats for feeding
Lesser Flamingo	*Phoenicopterus minor*	IV	NT	Saline lakes, mudflats, sand flats for feeding
Mammals Dugong	*Dugong dugong*	I	LC	Offshore/sea grass habitats for feeding
Finless Porpoise	*Neophocaena phocaenoides*	VU		Pelagic
Otter	*Lutrogale perspicillata*	-	VU	Mudflats-creeks-estuaries for feeding
Flora				
Sea grass	*Halophila beccarii*	-	VU	Mudflats-sandy substrates

Act, 1972 or appear in the IUCN Red List

NA Not yet been accessed
LC Least concern
NT Near Threatened
VU Vulnerable
EN Endangered
CR Critically Endangered
WPA Wildlife (Protection) Act, 1972

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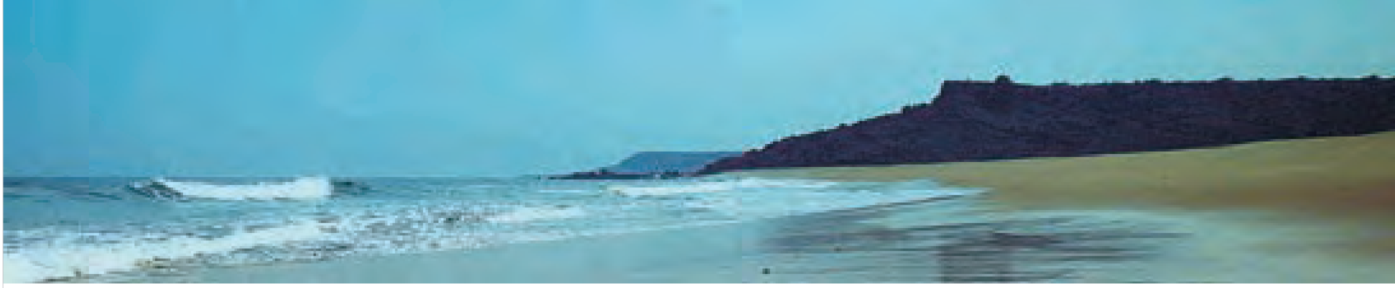

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