

Marine biosphere reserves - Need of the 21st century

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Abstract : Worldwide awareness for the creation of Marine Biosphere Reserves has increased considerably due to the human depredation in many coastal areas and natural changes. Many important and unique plant and animal species have been extinct and whatever remains, needs to be conserved and managed for posterity. Biosphere Reserve conserves and maintains genetic diversity of plant and animal species and helps to manage the natural resources on a sustainable basis. So far five Marine Biosphere Reserves have been declared in India and a few more are under consideration.

The present article gives in brief the status of Marine Biosphere Reserves in India and a few other potential areas for the same reason, along the Indian coast. An action plan has been suggested to manage the Biosphere Reserves and conservation measures to be taken.

Key Words : Marine biosphere - Conservation - Diversity - Ecosystem

INTRODUCTION

There has been a worldwide concern over the damages caused to the coastal areas due to man-made and natural changes. Various activities which are being undertaken in the coastal areas and in surrounding seas have resulted in the degradation of wetlands, floodplains, seagrass beds and coral reefs throughout the world (Carpenter 1983). The industrial and sewage pollution, extensive destruction and modification of the marine habitat for techno- economic development as well as over-exploitation of the marine living resources have endangered and threatened the ocean wealth which will otherwise be a stepping stone for the 21st century.

The enormous degree of marine environmental problems has led to the concept of Biosphere Reserve. This concept was initiated in 1964 during the International Biological Programme (IBP) under the auspices of the International Council of Scientific Union (ICSU). On the basis of this study UNESCO launched the Man and Biosphere Programme (MAB) on global basis in 1974. The concept of Biosphere Reserve encompasses human beings, their needs, problems and development as one of the components which differs from

JEB Decade Commemoration issue

"Bio - indicators"

sanctuaries where priority is given to wild life. Hence it is necessary to take a holistic approach for the identification of Biosphere Reserve. Recently, International Union for Conservation of Nature and Natural Resources (IUCN) set principles, criteria and guidelines for selection, establishment and management of marine and coastal areas (IUCN 1980). Since the initiation of this programme 269 Biosphere Reserves in 74 countries have come into existence. In India, 14 potentially viable Biosphere Reserves have been identified (Govt. of India Publ. 1989).

India with about 7860 km coastline including two groups of islands has tremendous potential for marine living resources. Certain areas such as Malvan (Maharashtra), Okha (Gujarat), Mandapam (Tamil Nadu), Gangetic Sunderbans (West Bengal) as well as Lakshadweep and Andaman group of islands have shown richness with regard to the marine flora and fauna (Untawale *et al.*, 1981, Subbaramaiah *et al.* 1974, Chakrabarty and Sanyal 1985, Chakrabarty and Chaudhary 1973). However, modifications and destruction of marine habitat for development and over exploitation of the renewable resources have dwindled some of the natural reserves.

In order to preserve and protect the unique and ecologically important plant and animal species, attempts are being made to conserve some of the vulnerable areas along the Indian coast line as Biosphere Reserves. In this context the Ministry of Environment and Forest, Govt. of India has declared five areas as Marine Biosphere Reserves along the Indian coastline (Govt. of India, Publ. 1989).

The present paper deals very briefly with the status of the coastal ecosystems in the age of industrialization and development along with the action plan to be implemented to protect these areas under the banner of Biosphere Reserve to manage and maintain ecological balance for the survival and sustenance of the natural resources through socio-economic development in the 21st century.

Objectives of the Marine Biosphere Reserves :

The broad objectives of the Biosphere Reserves are :

1. Conservation of the natural resources and the diversity and integrity of biotic communities for the present and future use.
2. Protection of genetic diversity and assessment of the utilization of living resources and ecosystems on rational and sustainable basis.
3. To carry out ecological and environmental research for maintaining essential ecological processes and life supporting systems in the areas selected as Reserves.

Need for Marine Biosphere Reserves :

1. Biosphere Reserves need to be established in the representative biogeographic zones to preserve biota of the globe.
2. Coastal marine areas having endangered and rare plant as well as animal species should be conserved to maintain genetic diversity/gene pool.

3. Study of the ecology of endangered or threatened plant and animal species, can be carried out effectively in Biosphere Reserve as it can provide necessary uninterrupted data.
4. Maintenance of genetic diversity of species on which the continuing evolution depends and to provide raw material for scientific and industrial innovation.
5. Biosphere Reserves are important to study long term changes in the biosphere as a whole and can be used as important sites for environmental monitoring.
6. Reserves can provide excellent facilities for education, training and recreation.

Present status of Marine Biosphere Reserves in India :

On the basis of the above objectives, the Indian National Man and Biosphere Reserves Committee constituted a core committee in 1974 to identify areas for Biosphere Reserves. As per the guidelines the committee identified fourteen sites as potential Biosphere Reserves out of which five are Marine Biosphere Reserves. They are :

- (1) Gulf of Mannar Biosphere Reserve (Tamil Nadu)
- (2) Sunderbans Biosphere Reserve (West Bengal)
- (3) Great Nicobar Biosphere Reserve (Andaman and Nicobar Islands)
- (4) North Andaman Biosphere Reserve (Andaman and Nicobar Islands), and
- (5) Little Rann of Kutch Biosphere Reserve (Gujarat)

1. Gulf of Mannar Biosphere Reserve :

a. **Location :** The shallow protected sea between India and Sri Lanka ($8^{\circ}49' - 9^{\circ}15' N$ latitude and $78^{\circ}11' - 79^{\circ}15' E$ longitude) is rich in marine life of molluscs, pearl oysters and marine algae. There is a line of 22 islands parallel to the Indian mainland from Tuticorin to Mandapam Peninsula. These islands are formed of accumulated sand and coastal debris over dead coral core and are surrounded by live fringing coral reef, harbouring variety of fauna and flora.

b. **Significance for conservation :** About 90 species of corals have been reported from this area (Silas *et al.*, 1985). The branching corals *Acropora* and *Mantiprora* spp. as well as molluscan shells *Conus* and *Murex* spp which thrive luxuriently, form the targets of over exploitation. So also economically important seaweeds such as *Sargassum* sp., *Turbinaria* sp., *Gracilaria* spp. and *Gelidiella* spp. are being harvested at the rate of 5000-7000 tonnes (dry wt.) every year. The extensive seagrass beds and sandy beaches are the feeding grounds for the endangered species of *Dugong* and breeding grounds of marine turtles.

The mangrove vegetation along the swampy islets and creeks between the islands, are ideal feeding grounds for mullets, prawns, marine reptiles and nesting grounds of several species of terns.

2. Sunderbans Biosphere Reserve :

a. **Location :** It covers Ganges and Brahmaputra Delta ($21^{\circ}30' - 22^{\circ}45' N$ latitude

and $88^{\circ}60' - 89^{\circ}5'$ E longitude) of 9630 km^2 area of which about 4264 km^2 is of mangrove forests accounting for 60% of the total mangrove area in India.

b. Significance for conservation : The mangrove forests of Sunderbans hosts a Tiger Reserve, a National Park and three Wildlife Sanctuaries. This is the only mangrove tiger land in the world where tiger shares aquatic and terrestrial food web.

Of the six geographic mangrove provinces in the world, the Asian Province shows the highest diversity of flora and fauna. In this province there are 64 mangrove species while in others, there are only 20 species. Sunderban mangroves is the home of a number of endangered and globally threatened species of animals and plants. The Royal Bengal tiger, estuarine crocodiles, saltwater lizard and grey water monitor (*Varanus flubiscence*) inhabit this area. It is also a nesting ground for marine turtles and marine mammals such as Gangetic Dolphins and Black Finless Porpoise (*Neomeris focinoides*). Horse-shoe crabs are the living fossils, much older than the '*Limulus*' horse-shoe crab of Florida, and prefer to breed in these mudflats. The area is rich in tiger, prawns and mullet fishery.

3. Great Nicobar Biosphere Reserve :

a. Location : It is the southernmost island of the archipelago & lies in between $6^{\circ}45' - 7^{\circ}15'$ N latitude and $93^{\circ}38' - 93^{\circ}55'$ E longitude. It is about 55 km long and 30 km wide and covers about 1045 km^2 area. The coastline is indented with several creeks and a number of bays. Prominent among them are Galathea, Casuarina, Ganges harbour, Valdora and Trinkat Champlong. The area has coralline substrate with coral reef extending far away from shore lines enclosing lagoons. The tip of this island, Pygmalion Point (Indira Point), is the southernmost point of India.

b. Significance for conservation : Mangrove vegetation of this coast plays a critical role in the coastal ecosystem with high level of carrying capacity, thus protecting shores from erosion. The economically important mangrove trees are *Rhizophora apiculata*, *R. mucronata*, *Bruguiera gymnorhiza*, *Excoecaria agallocha* and *Nypa fruticans*. Several bird species are endemic to this region. Marine turtles, estuarine crocodiles and dugong sanctuaries could be established in the vicinity of the island. Its southern part borders a major oil tanker route from the Gulf countries to Far East and Japan. Visible damage to the luxuriant Coral beds by oil pollution has been observed. Proper and detailed information on the marine flora and fauna of this area is lacking.

4. North Andaman Biosphere Reserve :

a. Location : It lies in between the latitudes $13^{\circ}00'$ and $13^{\circ}45'$ N and longitude $92^{\circ}45'$ and 94° E. It is about 122 km long and 26 km wide. The climate is tropical and is influenced by both southwest and northeast monsoons.

b. Significance for conservation : The mangrove vegetation occupies 25000 hectares of land and plays an important role in the protection of the coast from erosion. The dominant

mangrove species are *Rhizophora mucronata*, *R. apiculata*, *Bruguiera gymnorhiza*, *Avicennia officinalis*, *Ceriops tagal*, *Kandelia candel*, *Xylocarpus moluensis*, *Sonneratia caseolaris* etc., which provide ideal nesting sites for a number of birds.

The animal species at this locality are varied and diverse. About 2,900 species of marine animals have been reported from this area (Subba Rao 1984). Avifauna is represented by 50 species belonging to 10 families. Four species of turtles and one species of crocodile (*Crocodilus porosus*) inhabit this area. There are 750 species of fish fauna, of which 11 marine species are commercially important e.g. sardines, perches, silver bellies, mackerel, seer fish, pomfret etc. The total annual exploitable fish resources of this biosphere reserve range from 50,000 to 100,000 tonnes. *Dugong* has been reported from this area.

5. Little Rann of Kuchchh Biosphere Reserve :

a. Location : This lies in between 22° 45'–23° 55' N latitude and 70° 10'–71° 58' E longitude and is about 260 km long and 70 km wide. It has extensive salt pans which are connected to the sea by Surajbari Creek at the head of the Gulf of Kuchchh. During the high tide and particularly the south-west monsoons, seawater passes through the creek and spreads into the little Rann of Kutch.

b. Significance for conservation : This reserve has a breeding colony of Lesser Flamingo. The most important aspect is that this is the habitat of wild asses. The area between Kuchchh and Saurashtra adjoining the Little Rann of Kuchchh are some of the nesting places of the endangered Great Indian Bustard, *Choriotis nigriceps* and wintering area for waders and ducks. At the north of Banas River, thousands of Pintail *Anus acuta* breed.

Potential sites for some more Marine Biosphere Reserves :

Apart from the above five declared Marine Biosphere Reserves some more areas along the Indian coast line have been identified. These are as follows :—

1. Malvan Biosphere Reserve :

It is situated along the Maharashtra coast and lies between 16°15' to 16°50' N latitude and 73°27' to 73°31' E longitude. The coastline is indented with creeks and bays. Prominent creeks are Kolamb, Kalavati and Karli. These creeks show good growth of mangroves and seagrasses. Sand dune vegetation is found to be very rich.

Surveys conducted by NIO revealed that Malvan is an ideal locality for the development of Marine Park along the central west coast of India. This area is free of pollution and harbours a variety of flora and fauna. There are 94 species of marine algae of which *Hypnea musciformis*, *Gracilaria corticata*, *Sargassum* sp, 7 species of *Caulerpa* are dominant (Untawale et al. 1980). Mangrove species such as *Rhizophora mucronata*, *Avicennia officinalis*, *Exocoecaria* etc. flourish well in the creeks.

Faunal composition comprises of 198 species representing sponges, seafans, soft corals, sea anemones, hard corals (8 species) etc. which thrive well in the intertidal area. Live pearl

oyster and red coral are also found in this area. Marine turtles have been reported on the beaches occasionally. Fishing activity is very high and about 500 trawlers are engaged in fishing.

2. Gulf of Khambhat Biosphere Reserve :

It is situated to the east of the Saurashtra Peninsula separating it from the mainland ($22^{\circ}15'$ – $20^{\circ}30'$ N latitude and $71^{\circ}50'$ – 73° longitude). It extends from south to north narrowing into the estuary of river Mahe. River Narmada and Sabarmati flow into the Gulf. The characteristic feature of this bay is the large tidal range (9 m) and extensive mudflats on either side of the Gulf.

The extensive mudflats of this area attract numerous waders and is the winter home of two species of flamingos. Common and domicile cranes also assemble on these mudflats to roost. Large assemblage of cranes in winter is the characteristic feature of the estuary of River Shetrunji. A very small patch of mangroves is seen near Bhavnagar Port.

3. Chilka Lake Biosphere Reserve :

It is the largest lagoon in Asia and is located south of the Mahanadi delta ($19^{\circ}30'$ N and $85^{\circ}30'$ E), separated by a large sand bar which steeply slopes down into the open sea at the northern end. The main body of the lagoon is 50 km long and 20 km wide. The island in the middle of the lake gets inundated during the south-west monsoon. Fresh water from the surrounding areas and from one of the tributaries of the Mahanadi considerably reduces the salinity of water, turning it brackish.

This lake has important prawn, mullet and crab fisheries. It is a major wintering spot for water fowl, pintails and other species of wintering ducks and geese. With regard to the bird life, this lake is on par with the Bharatpur Sanctuary. Besides the water fowl, the shoreline is densely thronged by the two species of flamingos and concourses of shore birds. Sand dunes facing the sea may provide hatching sites for marine turtles. Breeding of *Dugong* can also be tried in the lagoons. Marine algae like *Gelidiella* grow luxuriantly in the lake.

4. Lakshadweep Biosphere Reserve :

Lakshadweep group of islands lie about 300 kms to the west of Kerala (72° E 11° N). These islands are typical of coral atolls. Several of the large islands are inhabited while the smaller ones are uninhabited except for fishermen's brief visits.

These groups of islands are of considerable importance for active conservation programmes as they are rich in marine life. Several atolls house breeding colonies of tropical oceanic birds and marine turtles. Mangrove vegetation is found only at the Minicoy island in a small patch. About 21 species of marine algae are found growing luxuriantly in the coastal waters (Subbaramaiah 1979), dominant ones are the species of *Gracilaria*, *Gelidium*, *Gelidiella*, *Turbinaria*, and *Sargassum*.

5. Bhitarkanika Biosphere Reserve :

It is situated to the north of the Mahanadi delta 20° N and $86^{\circ}59'$ E, having tidal creeks. There is also the Bhitarkanika Island and few other smaller islands. This was the reserve of the former Rajas of Kanika. Considerable mangrove forests still cover many of the tidal islands.

Rediscovery of reptiles which formerly inhabited the coastal mangroves all along the east coast has led to the conservation of this area. A 5 m long estuarine crocodile *Crocodilus porosus* is the largest living reptile found in India and calls for immediate conservation measures. The most significant character of this area is that it is the only nesting site in India of the Pacific Ridley Turtle *Lepidochelys olivacea*, which grows to the largest size among all the turtles in the world. Establishment of breeding population of the estuarine crocodile would ensure survival of the reptiles.

Action Plan and Management of Biosphere Reserves

1. Careful management procedures must be drawn to conserve species stocks so that the breeding potentials of the population is not destroyed by overexploitation. It should be ensured that destruction of critical habitat of the species stock is not attempted.
2. Two zone system to be adopted for effective implementation of the regulations in the Biosphere Reserve.
3. Management must be prepared to meet the present and future needs of the people through conservation.
4. To conserve natural resources, to optimise current uses and value as well as to integrate the traditional uses, management should identify the areas within the Biosphere Reserves for different and systematic use of the resources.
5. Planning should encompass developmental activities throughout the coastal zone so that the protected areas are not victims of pollution, flooding, siltation or uncontrolled landuse practices.
6. Development that would jeopardise coastal and marine habitats should not be entertained until proper management measures are developed to minimise the impact.
7. Consideration should be given to certain areas that benefit other nations in safeguarding critical habitat of migratory species.
8. Detailed inventory and mapping of the proposed Biosphere Reserve may be carried out giving significance of the different areas.
9. Adequate manpower is required to be trained to undertake proper management of the protected areas.
10. It should function to achieve inter-agency coordination and cooperation among different government departments.
11. Planning should encompass legal, educational and administrative concerns.
12. Public awareness should be created through Audio-Visuals camps, lectures and through publications.

Conservation Measures

The basic aim of the biosphere reserve is the conservation of biotic community as a whole. Some of the coastal areas are very rich and unique in flora and fauna. These areas are required to be conserved for germplasm of all the economically important floral and faunal species. Various river banks and coasts have flourishing mangroves which are being deforested for fuel and reclamation. Strict measures are required to be taken not to disturb the mangrove zone and should be left as it is for maintaining coastal ecosystem. Human greed for food has resulted in the hunting and poaching of the marine mammals, reptiles and birds on a large scale which requires to be stopped with strict legislation.

Depletion of various unique and economically important species is the result of overexploitation. Hence emphasis should be given to harvest the resources on sustainable basis. Industrial revolution has resulted in coastal pollution endangering flora and fauna. To avoid further damage due to industrial and sewage pollution, monitoring of impact together with strict measures to control pollution, should be adopted.

It has often been noticed that various coastal areas are reclaimed for development, by destroying the marine habitat. So also various recreational activities are planned in the coastal areas. It should be ascertained that no such activities which prove detrimental to ecological balance be allowed within the biosphere reserves.

CONCLUSIONS

Biosphere Reserves will help to maintain and carry genetic diversity of various plant and animal species to the 21st century. The dawn of the 21st century could see a bright future through Biosphere Reserves, as far as utilization of marine living resources is concerned and it will also help to maintain and manage natural resources on sustainable yield basis. Continuous uninterrupted research on the marine flora and fauna in relation to the environment could be carried out in the Biosphere Reserve. This will help to gain understanding of the various economically important species which could be exploited during the 21st century. It will also help to safeguard the endangered marine plant and animal species like turtles, crocodiles and birds so that propagation and multiplication can be undertaken in 21st century on a large scale. Mankind will be able to know and understand the sea and life in it at close quarters. Biosphere Reserve can create awareness in the future generations which will help to maintain the ecological balance of the various marine ecosystems in the 21st century. Taking into consideration various environmental pressures, it is necessary to identify Biosphere Reserves. Apart from functioning as gene pools, the diverse biota from such areas can play an important role as indicators of complex environmental changes.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, National Institute of Oceanography, Goa for encouragement.

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