

# **MARINE BIODIVERSITY CONSERVATION AND MANAGEMENT**

*Edited by*

**N.G. Menon and C.S.G. Pillai**



**ICAR**

**CENTRAL MARINE FISHERIES RESEARCH INSTITUTE**

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

TATAPURAM P.O., COCHIN-682 014

**1996**

## XVII. COASTAL BIODIVERSITY - CONSERVATION AND SUSTAINABLE MANAGEMENT

M. DEVARAJ

Central Marine Fisheries Research Institute, Cochin-682 014

*A management regime based on social acceptance, with the power of moral persuasion from within the group of participants, is the only way to manage widely dispersed resources which are shared by a multitude of small scale fishermen and various other users.*

### INTRODUCTION

The Indian subcontinent is bordered by the tropical seas which include an extensive coastal zone and the deepseas. Within the coastal zone there are a number of sensitive habitats including the estuaries, mangroves, coral reefs, seagrass beds, and oceanic islands. These habitats support a wide spectrum of biota whose abundance varies both spatially and temporally. These habitats have been exploited for food and aesthetic purposes with no apparent ill effects till large scale machanization began to be introduced. Increasing human population coupled with the greater need for cheap protein has led to intensive exploitation of various fisheries resources and has caused considerable stress to many habitats. The more vulnerable species of fish have become endangered in terms of their sustainability or even biological extinction. Often fisheries projects are suggested without fully understanding their long-term consequences on the biological systems and the habitats.

Many fragile coastal ecosystems are facing severe threats of degradation and overexploitation of a few vulnerable target species. Many such threatened or endangered species have been identified. The factors responsible for their plight have been studied and suitable options suggested for their conservation. However, many such options are beset with hindrance owing to social, economic and political reasons. Often the cost of enforcement of legal restrictions is very high,

particularly when there are a large number of resource users. A management regime based on social acceptance, with the power of moral persuasion from within the group of participants, is the only way to manage widely dispersed resources which are shared by a multitude of small scale fishermen and various other users.

#### **A. MARINE BIODIVERSITY MANAGEMENT FOR COASTAL WATERS, CORAL REEFS, MANGROVES AND ESTUARIES.**

Of the several plants and animals inhabiting the coastal ecosystems including the coral reefs, mangroves and estuaries only some species are exploited for human use. However, such species are often irrationally exploited with powerful mechanical harvesting techniques, sometimes leading to the collapse of their population in their respective habitats. It is, therefore, appropriate to deal with the question of biodiversity management from the point of view of "species-habitat" units in the case of the more sensitive and vulnerable ecosystems in the coastal zone.

##### **I. INSHORE (0 TO 50 M DEEP) AND ITS FISH STOCKS STATUS**

This zone is under severe stress due to progressively increasing fishing effort from traditional, motorised and mechanised fishing fleets. Introduction of small meshed harvesting gears and many innovative gears has resulted in the exploitation of juveniles, subadults and spawners of many coastal stocks characterised by a close species stock-area relationship. Stock assessment studies in respect of major exploited stocks have indicated the optimum levels of exploitation for these stocks. Most marine mammals and turtles and many species of fishes such as the catfishes, whale shark, big jawed jumper (*Lactarius lactarius*), flatheads (*Platycephalus maculipinna*), *Protonibea diacanthus*, *Polydactylus indicus*, *Pomadaysis hasta*, rock lobster and sand lobster have become threatened or vulnerable in the Indian seas. Mechanisation and diversification of fishing have slowly extended the fishing activities upto the edge of the continental shelf. As a result, landings of new or little known species of finfishes and shellfishes have increased considerably.

## STRATEGY

1. Regulation of fishing pressure to optimise fleet size and mesh sizes in the coastal zone.
2. Diversification of fishing to the still poorly exploited deeper grounds.
3. Development and popularisation of mariculture practices for crustaceans, finfishes, sea cucumbers, mussels, oysters, pearl and seaweeds as a viable substitute or supplementary for fishing in both small scale and industrial sectors.

## II CORAL REEF AREAS

### STATUS

The coral reefs of the southeast coast of India, Gulf of Mannar, Palk Bay, Lakshadweep and Andaman & Nicobar Islands are rich in their biodiversity. The catalogued coral species are around 199 under 71 genera in the reefs besides several species of sponges, polychaetes, crabs, gastropods, bivalves, echinoderms, ascidians, etc. Large scale exploitation of coral reefs for industrial purposes, their fauna and flora for multiple uses, the effects of dredging, and the consequential mass mortality of corals pose grave threats to these habitats, their species diversity and also the fisheries resources.

### STRATEGY

1. Implementation of an integrated coastal zone management plan for coral reefs and atolls.
2. Imposing a ban on quarrying of massive corals.
3. Establishment, protection and development of National Marine Parks at different strategic reef areas.
4. Establishment of suitable mariculture farms in the reef areas as well as onshore for mussels, clams, edible oysters, pearl, ornamental fishes and seaweeds through active community participation.

### **III MANGROVES**

#### **STATUS**

The mangrove ecosystem of a diverse assemblage of salt tolerant intertidal flora and fauna is a major nursery ground for the larvae and juveniles of many commercially important species of prawns and fishes. Surveys of mangroves of the Gulf of Kutch, Andaman & Nicobar, Killai (Tamilnadu), Cochin and Kakinada have revealed mass scale denudation of mangrove wood, heavy siltation, and conversion into prawn farms.

#### **STRATEGY**

1. Catalogueing the species diversity in the mangrove ecosystem and establishment of gene banks for mangrove vegetation.
2. Ensuring a strong ecofriendly base (with minimum destruction to mangrove trees) in all aquaculture proposals in the mangrove sites.
3. Development of mangrove sanctuaries in vulnerable sites along the Indian coast.
4. Popularisation of proven techniques of mariculture of clams, oysters, prawns, finfishes and seaweeds in suitable sites, without impairing the mangrove ecosystems.
5. Undertaking massive plantation of mangroves along the dykes of existing coastal shrimp farms.

### **IV ESTUARIES**

#### **STATUS**

Several of the Indian estuaries have become danger-prone zones. Stress due to damming the rivers, fishing pressure and pollution is the principle cause of biodiversity degradation and ecosystem deterioration. Estuaries are veritable nurseries for many marine animals, but their fisheries have declined considerably due to overexploitation of juvenile shrimps and anadromous stocks.

## STRATEGY

1. Assessment of the estuarine biota and their communities is fundamental to biodiversity conservation.
2. Quantification of destruction of juvenile populations of finfishes and shrimps by various fishing gears.
3. Transfer of oyster and clam culture technologies to the estuarine and backwater fishermen and mapping cultivable areas within these ecosystems.
4. Development of hatcheries for mass production of finfish and shellfish seed for ranching the affected habitats.
5. Providing fishways in barrages for facilitating migration of fishes.

### **B. MARINE BIODIVERSITY MANAGEMENT BASED ON THE IMPACT OF COMMERCIAL FISHERIES**

Heavy fishing pressure in the coastal habitats has led to the decline in production in many regions along the Indian coast. The estimated fish harvest per hectare of Indian continental shelf has reached 53 kg in 1993 and any further increase may not be very economic. The ecosystem impact of fishing is outlined here briefly.

#### **I TRADITIONAL FISHING**

Artisanal fishing gears like the boatseines and ringseines with meshes of 6 to 8 mm cause heavy juvenile mortality in the nearshore fishing grounds. Heavy landings of juvenile bombayduck (45 to 60 mm) are reported frequently from dolnets operated in Maharashtra and Gujarat. Indigenous hand trawling along the seagrass beds (0 to 4 m depth) in Palk Bay not only destroys the biomass of seagrass, but also harvests the juvenile *Penaeus semisulcatus* (45 to 70 mm) at the rate of 2 to 10 kg per unit effort with an average annual effort of 2500 units, yielding an annual total of about 4800 t. If allowed to reach marketable size the juvenile stock would have contributed 72,000 t.

#### **II TRAWLING**

The rate of catch of target species to the bycatch in trawls is about 1:4, and 1 to 30% of the bycatch is discarded resulting in avoidable

economic loss to the country. In this postharvest loss, about 12% (in the trawl catch) is composed of a heterogeneous species mix belonging to the bottom fauna. The gear invariably catches large quantities of juveniles and subadults of a variety of demersals like the sciaenids, catfishes, flatfishes, flatheads, silverbellies, perches, whitefish and pomfrets, which are often discarded. This has often led to recruitment overfishing of a few vulnerable species. Destructive fishing by minitrawls along the Kerala coast on the juveniles of *Parapenaeopsis stylifera* is a glaring example of recruitment overfishing and consequential conservation problems. Of late, the trawlers operating in the midshelf waters land substantial quantities of juveniles and subadults of nemipterids, saurids and flatheads, which may lead to problems of recruitment.

The landings of the monotypic whitefish (*Lactarius lactarius*) declined progressively (the catch declined from 25354 t in 1985 to 4189 t in 1993), obviously due to its vulnerability to increasing fishing pressure from trawlers. The catches of the sand lobster (*Thenus orientalis*) and the rock lobster (*Panulirus sp*) declined significantly from 4082 t in 1985 to 1862 t in 1993. The stocks of deepsea lobster (*Puerulus sewelli*) in the Quilon Bank was completely depleted in three successive fishing seasons. The horseshoe crab (*Limulus sp*) has become endangered along the Orissa coast due to overexploitation. These species are being proposed to be brought under the CITES.

### III PURSESEINING

Purseseining along the coast of Karnataka during 1979-86 landed large quantities of incubating parents of *Tachysurus tenuispinis*, *T. dussumieri* and *T. serratus* during September to March, which is the peak breeding season for these species of catfishes. It was estimated that about 8 million eggs and embryos of *T. tenuispinis* were destroyed during September - October every year by purseseiners during 1979-86. Gestating male *T. tenuispinis* formed about 50% of the catfishes caught in purseseines in Karnataka. Similarly about 2 million eggs of *T. dussumieri* were destroyed annually; about 14% of *T. dussumieri* landings by purseseines consisted of gestating males. Destruction of

this magnitude has led to the collapse of the fishery after the late eighties.

#### IV SEA TURTLES

All species of marine turtles are in the endangered category, and are therefore, protected under the Indian Wildlife Act, 1972. Five species of sea turtles, *Dermochelys coriacea*, *Eretmochelys imbricata*, *Chelonia mydas*, *Lepidochelys olivacea* and *Caretta caretta* are listed in Schedule I of the above Act. The nesting sites of Orissa, West Bengal and Tamilnadu need to be declared as protected areas. In view of their endangered status and total ban on the trade of sea turtles and their products under CITES, proper identification of the species and information on their biology are essential for monitoring the resource. Field surveys for nesting sites and tagging of hatchery reared turtles before ranching and their recovery are essential for obtaining clues regarding their migration and growth. The arribada or mass nesting, a phenomenal behavior of sea turtles, occurs in December-January and March-April at Gahirmatha beach, Orissa. With the objective of protecting the marine turtles the Tamilnadu government has developed eight turtle hatcheries in different locations where the eggs are collected, incubated and hatched for ranching.

#### V MARINE MAMMALS

All marine mammals belonging to the whales, dolphins, porpoises and dugong are rare and endangered, and are listed under CITES. They migrate to the tropical seas for feeding and breeding and often get entrapped in the tide and washed ashore or entangled in the fishing gears. All such reported strandings or accidental landings data are stored in the National Marine Living Resources Data Centre (NMLRDC) of the CMFRI for careful monitoring of their areawise, regionwise, seasonwise occurrence and abundance and for deriving their biological data for the purpose of their conservation and management. Dugongs get entangled in fishing gears while feeding on the seagrass beds along the Gulf of Mannar. Often there has been clandestine fishing for the dugongs along the Gulf of Mannar. The meat is highly relished by the local people and hence the dugongs are often



exploited. This has led to a drastic decline in their population. The destruction of seagrass beds due to trawling has further aggravated the situation. As the dugong inhabits the narrow Palk Strait and the contiguous Gulf of Mannar between India and Sri Lanka, conservation requires international understanding and cooperation.

## VI SEA CUCUMBERS

The sea cucumbers, *Holothuria atra*, *H. nobilis*, *Actinopyga* sp, *Bohadschia argus* and *Stichopus chloronotus* are exploited from the Gulf of Mannar, Palk Bay and the Lakshadweep waters for the *beche-de-mer* industry. Increasing demand has led to massive exploitation of sea cucumbers often resulting in the removal of undersized animals. Therefore, the minimum allowable legal size for exploitation has been fixed at 250 mm (75 mm for processed *beche-de-mer*). As a conservation measure, the peak breeding months of April and November should be considered as closed season for fishing in Palk Bay and the Gulf of Mannar.

## VII GORGONIDS

The biomedical versatility of the gorgonids, popularly known as the seafans, attracted great attention to this resource. Large quantities of seafans have been exported from India to the USA, France, Germany and Netherlands. Many drugs (e.g. prostaglandins) have been separated from the seafans for treatment of various ailments. Owing to very attractive prices in the export markets, there has been indiscriminate exploitation of the seafans from the Indian seas, particularly the Gulf of Mannar. Based on colour, the gorgonids are named in trade as 'black', 'red', 'monkey tail' and 'flower'. The four species which have already shown symptoms of depletion include *Echinomuricea indica*, *Heterogorgia flabellum*, *Echinogorgia complexa* and *Gorgonella umbraculum*. A total ban on their export is suggested as an immediate conservation measure. Some of the less exploited grounds off Vizhinjam, Cape Comorin, Visakhapatnam, Okha, Dwarka, Gulf of Kutch, Ratnagiri, Malwan, Andaman Islands, Rameswaram, Tondi and Point Calimer offer limited scope of gorgonid exploitation through pruning, where the basal stalk is left undisturbed for regeneration, which takes place at the rate of about 2 cm per year.

## STRATEGY

1. All the threatened and endangered species should be listed under CITES and monitored for their abundance and production.
2. Popular opinion and support for conservation should be sought through awareness creation. NGOs should be actively involved in all conservation measures. Legal intervention for fleet and mesh regulation may not be fruitful without the active participation and cooperation of the community.
3. National sanctuaries may be created for marine turtles, dugongs, coral reefs, sea cucumbers and gorgonids in vulnerable areas with active support from the community and the NGOs.
4. There should be a legal ban on: (a) exploitation of coral reefs, (b) reclamation of mangrove swamps, (c) export of live marine flora and fauna which are used for the extraction of biomedical substances, and (d) bottom trawling upto a depth of 30 m.
5. Development of capabilities for mariculture of seaweeds, seacucumbers, mussel, clams, oysters, pearl, crabs, lobsters and finfishes in selected sea sites along the Indian coast and in on-shore farms and captive flowthrough systems. These mariculture technologies should be transferred to coastal communities as alternative or supplementary employment, and thereby help reduce fishing pressure on overexploited stocks.
6. Development of hatcheries at appropriate sites for endangered stocks for ranching the habitats to reinforce the wild stocks.
7. Creating genebanks and genetic gardens for all important marine flora and fauna in phases.
8. Strengthening institutions for their infrastructure of hatcheries and growouts for training and demonstration of technologies to the coastal communities to help them adopt ecofriendly mariculture practices.

### **C. PROTECTED AREAS**

The first Marine National Park in India came into existence in the Gulf of Kutch (Pirotan area) in 1980 followed by the Gulf of Mannar and Wandoor Marine National Park in the South Andamans. A marine park is a reserve and should be managed along several ecological principles and should serve many relevant purposes such as habitat and species preservation, scientific research, recreation and financial gains. Though these three marine habitats have been declared as protected areas, delineation of the core areas and the park limits and the regulations on various human activities in the protected areas remain to be implemented. Proposals have been initiated to establish marine parks and preserves in Malvan - Vengurla (coast of Maharashtra), Minicoy, Kavaratti, Chetlat, Kadamat and Kalpeni (in Lakshadweep).

### **D. MADRAS WORKSHOP RECOMMENDATIONS**

A one day Workshop on "Conservation and sustainable Management of Coastal Biodiversity" held on the 31st May 1995 at the M.S. Swaminathan Research Foundation, Madras has recommended that any proposals on conservation and management of coastal biodiversity should be human-centered. Based on the discussions three projects have been identified for GEF funding:

- Strengthening and networking the existing marine protected areas (MPAs)
- Identifying new areas for the establishment of MPAs and preparing and implementing management plans for them.
- Developing and implementing integrated coastal zone management plan for areas rich in biodiversity.

These projects would seek:

1. to upgrade the baseline information on the habitat availability and distribution, species diversity, genetic wealth and exploitable living resources of the existing and proposed marine protected areas.
2. to develop and implement an integrated coastal zone management plan and policies that ensure conservation of coastal

biodiversity and sustainable utilisation of biological resources in the existing and proposed marine protected areas.

3. to strengthen the capacity of the institutions and organisations involved in the conservation of coastal biodiversity and implementation of policies and plans that link the ecological security of the coastal zone and the enhancement of the livelihood of coastal human communities.
4. to establish institutional, organisational, legal, financial and policy frameworks for the expansion and future maintenance of the marine protected area network,

In order to achieve the above objects this Workshop recommended the following activities:

1. Mapping the coastal zone, delineating and demarcating different geomorphological features influencing the coastal biodiversity using remote sensing data and GIS.
2. Analysing the land use pattern in the coastal zones and its impact of the coastal biodiversity and resources.
3. Monitoring changes in the physical setting of the coastal zone and coastal ecosystems and analysing the impact of such changes on the biodiversity.
4. A detailed study on the current status of biodiversity and management of the threatened coastal ecosystems such as the coral reefs, seagrass meadows, mangroves, molluscan beds etc.
5. A detailed study on the current status and habitat availability for endangered species like dugong, sea turtles, saltwater crocodiles, king crabs etc.
6. A detailed study on the status and management on the wetlands that support migratory birds.
7. Developing and implementing innovative techniques like creating artificial reefs to protect the coastal biodiversity and enhance the fishery productivity.
8. Eco-redevelopment of the degraded coastal ecosystems.

9. Exploring and providing alternative livelihood for the local populations which overexploit the coastal resources.
10. Developing and implementing coastal land and water use policies and plans.
11. A detailed study on the impact and feasibility of eco tourism.
12. Involving local people in the preparation and implementation of conservation and management plans.
13. Improving the infrastructure facilities of organisations and institutions involved in the conservation and sustainable management of the coastal biodiversity and resources.
14. Improving the human-resources of the above organisations and institutions through training.
15. Education and training of the local populations in conserving and managing coastal resources.
16. Reviewing the existing legislations and regulations relating to:
  - (a) protection and management of the marine protected areas, and
  - (b) utilisation and development of coastal regions.
17. Preparing and implementing new plans and policies for the conservation and sustainable management of coastal biodiversity and resources.

#### **E. NATIONAL ACTION PLAN BRIEF**

1. Sustainable Coastal Resource Management.
  - a. Documentation of the status of exploited finfish and shellfish stocks for the identification of region/area specific problems and transfer of the relevant management models.
  - b. Awareness creation among the members of participating and user societies, especially the youth on the needs of ecological security for their own livelihood security.
  - c. Selection of socially acceptable management regimes and assessment of socio-economic impact of interventions.

- d. Implementation of regulations with willful involvement and participation of the society.
  - e. Recognition of the traditional rights of coastal communities to use the natural resources in their surrounding natural habitats for their livelihood, while formulating and implementing regulations and conservation measures.
  - f. Generating a willful, total commitment by all levels of government and participating communities in the sustainable management programme.
  - g. Conservation of vulnerable edible and bio-medically important species with the involvement of local communities in *in situ* preservation of germplasm through national parks and protected areas.
2. Integrated Coastal Ecosystem Management
- a. Survey of coastal ecosystems like coral reefs, estuaries, wetlands including mangroves, seagrass beds and other spawning and nursery grounds for any possible alteration, shrinkage, biodiversity degradation and pollution.
  - b. Preparation of inventories of fauna and flora in each of the region/area specific life supporting systems. Protection and restoration of endangered species in the various ecologically fragile, but biologically rich habitats.
  - c. Establishment of community - owned systems of marine protected areas that are consistent with the social, economic, political and cultural characteristics of the region, with active community involvement supported by local NGOs and government agencies.
  - d. Development and implementation of suitable integrated island ecosystem management package to meet the essential needs of the island communities and to improve their quality of life without compromising the geographic, environmental, cultural and socioeconomic characteristics of the islanders.

- e. Introducing tested coastal mariculture technologies at selected centres, but replicable elsewhere, for offering ecological and economic security to the communities taking into confidence the traditional knowledge and interest of local communities.
  - f. Implementation of an integrated national conservation strategy involving *in situ* and *ex situ* and *in vitro* and *in vivo* methods, to be developed for all marine endangered, vulnerable and rare species.
3. Recognition of marine biodiversity as an essentiality for human survival
- a. Recognition of biodiversity preservation, protection and monitoring as a national obligation.
  - b. Preparation of inventories of biological resources and categorising their status of abundance and rarity.
  - c. Formulation of socially relevant conservation strategies for all such rare, endangered and vulnerable species.
  - d. Catalogueing the deepwater biodiversity in the EEZ.
  - e. Development of nature preserves, gene banks and gene gardens for threatened and vulnerable species.
4. Development of appropriate mariculture technologies for alternative employment and livelihood.
- a. Identification and location testing for mariculture of region/area specific candidate species.
  - b. Transfer of mariculture technologies to small scale traditional fishermen who have been displaced due to conservation or management measures.
  - c. Capability building among fisherwomen for income generation through mariculture practices.

- d. Development of hatcheries for seed production for mariculture as well as sea ranching by user agencies as well as NGOs connected with environment.
5. Research, education, training and extension.
- a. Research priorities should be identified, reoriented and restructured to meet the immediate requirements of:
    - 1. Sustainable coastal resource harvest.
    - 2. Deepwater resources survey, exploitation and utilisation.
    - 3. Integration of mariculture with capture fisheries.
    - 4. Development, upgradation, propagation and testing of mariculture technologies.
  - b. Development of infrastructure and human resource capabilities at institutional level for imparting education and training for mariculture.
  - c. Development of centers of excellence for:
    - 1. Taxonomy of marine organisms
    - 2. Mariculture.
    - 3. Biotechnology.
6. Providing strategic plans, projects and financing mechanisms.
- a) Involvement of the participating agencies like the fishermen, fish farmer, entrepreneur, NGOs and governmental, national and international agencies in the formulation of research project design, implementation and funding. Such research programmes should have a broad base and be participatory in nature, with active involvement of inhabitants at planning and implementing phases.
  - b) Through collaborative agreement funds could be generated from IFC, GEF etc. for projects on biodiversity protection, conservation, catalogueing coastal preserves, ex-



panding ecosystems network, integrated ecosystems management, technology development and upgradation to supplement and complement livelihood support and employment generation, gene bank and gene gardens development, and promotion of environmentally sound technology centres for biotechnology.

- c) Strengthening interdisciplinary research on coastal ecosystems as a whole for integrating capture fisheries, culture fisheries, and agroforestry, for ensuring sustainable development, and for upgrading socioeconomic capabilities of target groups, in the context of growing urbanisation, pollution and industrial growth.