MARINE BIODIVERSITY CONSERVATION AND MANAGEMENT

Edited by

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III. CORAL REEFS OF INDIA, THEIR CONSERVATION AND MANAGEMENT

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Coral reefs are natural gift to mankind, and are built in thousands of years by millions of tiny coral polyps. Reefs give food for mankind, material for scientific research, ample opportunities for recreation and past time. We need the reef, reefs need our attention; certainly we should keep them for future generation.

INTRODUCTION

The coral reefs of the mainland coast of India are located chiefly along the southeast coast in Gulf of Mannar and Palk Bay (8° 49'-9° 10'N, 79° 9'-79° 14'E) stretching from Tuticorin to Rameswram Island, and in the Gulf of Kutch in the Gujarat state (22° 15'-23° 14'N, 68° 20'-70° 40'E). Some patchy growths also occur along the west coast of India between Bombay and Malvan stretching to Enayam south of Trivandrum. The coastal reefs of India along the mainland are mostly fringing or patch reefs built on shallow waters around near shore islands. The Andaman and Nicobar Islands in the Bay of Bengal form the major continental island reefs of India. The Lakshadweep is the only atoll formation of our waters. A recent estimate of the reef flat areas of India by Baldev Shai, (1994, Report to Ministry of Environment and Forest, Govt. of India, in press) by remote sensing technology shows the extent of reef flat in Gujarat coast as 148.4 sq km, that of Tamil Nadu coast as 64.9 sq km, Lakshadweep 140.1 sq km and that of Andaman and Nicobar Islands as 813.2 sq km. In addition to that coral knolls and lagoon reefs also form roughly 50 sq. km of reef formations.

PHYSIOGRAPHY AND ECOLOGY OF INDIAN REEFS

Gulf of Kutch

The beaches are sandy or muddy with occasional large sandstone formation. There are about 40 islands with patchy coral forma-

tions of which the largest is Pirotan Island. The Gulf of Kutch is subjected to very high rate of sedimentation with a visibility of more or less 1 m. The climate is semi-arid. Because of high rate of sedimentation the conditions for coral growth is sub optimal. Corals are found on sandstones substrate in patches. Consolidated reefs existed once in Pirotan Island. Most of the islets are submerged at high tide and approach is rather difficult due to extensive mudflat that surrounds. In some islands like Boria and Paga profuse growth of corals are found in the central lagoon like areas which are surrounded by sand bars.

The coral fauna of Gulf of Kutch is comparatively less diverse compared to other parts of India. Ramose corals such as *Acropora, Pocillopora, Stylophora* and *Seriatopora* are not found at present though semi-fossilised specimens of *Acropora* are found on some beaches. Siltation may be one of the reasons for the absence of sensitive genus like *Acropora.*

West coast of India

The west coast of India between Bombay and Goa is reported to have submerged banks with isolated coral formations (Nair and Qasim, 1978). *Porites, Coscinaraea, Turbinaria,* some faviids and *Pseudosiderastrea* are reported. All the genera recorded are massive or encrusting without any representation of ramose forms as in the case of Gulf of Kutch. Siltation is of high rate and salinity may drop to 20 ppt during monsoon in these habitats which might restrict the growth of ecologically sensitive forms of ramose corals (Bakus *et al,* 1994). Down south from Quilon along the Kerala coast to Enayam in Tamil Nadu coast hermatypic corals are reported along the shore. At Enayam, there was profuse growth of corals until recently around a rocky outcrop which was almost totally exploited by local people. *Pocillopora* spp. is the most common genus in this area. *Acropora* is found with representation of at least three species. *Pseudosiderastrea* and *Porites* spp., also found. A recent investigation (Pillai and Jasmine, in press) has shown that 29 species in 17 genera of scleractinians occur in this area. Of this 13 species belonging to 6 genera are hermatypes and the rest 16 species

of 11 genera are ahermatypes mostly deep water forms dredged by Shri Sampson Manickam of CMFRI from the west of Quilon on board FORV *Sagar Sampada*.

Southeast coast of India

The reef formations of S.E. coast of India along the Tamil nadu coast is scattered between 79° to 79°9' E and 8°45' to 9°11' N covering nearly 21 islands from Tuticorin to Adams Bridge. Though, the reefs are mostly of fringing type around the islands, Stoddart and Fosberg (1972) called it a discontinuous Barrier and termed it Mannar Barrier. Of recent, a series of taxonomic and ecological papers on these reef environs have been published (Pillai, 1971, 1971a, 1973, 1977, Mergner and Scheer, 1974) and a review of these results are provided by Bakus, *et al* (1994). The fringing reefs around the islands normally has a lagoon of 100 to 150 m wide and 1 to 2 m deep. In some islands, near Tuticorin (eg. Carachalli *Tive*) there existed well formed flats up to 100 m wide (subsequently quarried and mostly non existent). The coral fauna of Gulf of Mannar and Palk Bay is found to have a total of 96 species divided among 26 genera (Pillai, 1986). The dominant genera include *Acropora, Montipora* and *Pocillopora* among the ramose forms. Massive forms are represented by *Porites, Favia, Favites, Goniastrea, Platygyra* and rarely *Symphyllia*. *Cyphastrea* and *Leptastrea* are very common on all reef habitats of this area. The foliaceous forms are *Echinopora lamellosa* and *Montipora foliosa* in Gulf of Mannar both being now scarce due to quarrying and destruction. Fungiids are very poorly represented in this area.

In Palk Bay the reef extends along the shore from Mandapam eastward along the shores of Rameswaram Island, interrupted only at Pampan pass. Corals are found on reef rocks and no consolidated reef flat is seen. Zonation is indistinct. The siltation especially during monsoon along the inshore region is reported to have marked impact on the distribution of corals on this reef (Pillai, 1971). The present day reef growth is very poor. It is not in pristine condition since it was quarried in early sixties.

Oceanic Island Reefs

Lakshadweep Islands are located between 8°-12°30°N and 71°-74°E along the Laccadive -Chagos Ridge. The submarine ridge that supports the islands rises from a depth ranging from 1500 to 4000 m. The Lakshadweep Archipelago consists of 12 atolls and a few (five) submerged reefs. A detailed report on the islands, their coral fauna, reef associated resources and ecological conditions and suggestions of conservation and management are set in a detailed report based on an intensive survey by the scientists of CMFRI (*Bull. Cent. marine Fish Res. Inst.* No.43 1989) The coral fauna of Lakshadweep is known to harbour a total of 105 species divided among 37 genera as listed by Pillai and Jasmine (1989). The lagoon and reef flat faunal elements are dominated by *Acropora* spp., *Pocillopora* spp., *Porites* spp. and massive and encrusting faviids. *Psammocora* spp. is also very common especially in northern islands. The lagoon reefs throughout Lakshadweep have a profusion of blue coral *Heliopra coerulea*. *Millepora* spp. forms dominant element in the lagoon. A sort of latitudinal difference in the coral faunal assemblage from south to north is reflected in the Lakshadweep. Minicoy has some elements such as *Lobophyllia* and *Diploastrea* that are common to adjacent Maldives but rarely found in Kiltan or Chetlat of the northern Lakshadweep. Again the genera *Montipora* and *Echinopora* are recorded from the northern atolls but hitherto not known from Minicoy the southern most atoll in the chain.

The continental island reefs

The Andaman and Nicobar groups of islands in the Bay of Bengal, perhaps form the largest reef formations of Indian continent. These group of nearly 500 islands both large and small, is believed to be part of an emergent mountain chain. Most of the islands are covered by forests, and mangroves form extensive coverage along the shores. Annual rainfall is about 3000 mm and the salinity of the waters is around 33 ppt. The coral reefs are of fringing type and except for stray investigation reports the reefs of this area still largely remain unknown. A total of 135 species of Scleractinia is reported from this area by Pillai (1983) but a few more species have been collected since. The biodiversity

of fauna is still to be ascertained. Because of their location these areas have biotic elements from Polynesian, Indo-Malayan as well as Burmese provinces. The reef flats in general are dominated by massive porites and faviids that form the chief reef frame builders. The shoreward side is generally with luxuriant growth of arborescent genera alike *Acropora, Pocillopora, Seriatopora, Stylophora* etc. The reefs are rich in soft corals. The two reef building genera *Oulastrea* and *Coeloseris* are hitherto recorded form Andaman and Nicobar Islands only from the Indian fauna. Of recent, a survey of the reefs of the Wandoor Marine Park was carried out by the scientists of CMFRI (Gopakumar, *et al, 1990,* James *et al. 1991*). Two ecologically distinct types of reefs in south Andamans could be observed (a) Reefs along the coast of Islands fringed by mangrove forests. The chief reef builders are massive *Porites* and faviids. Alcyonarians form extensive patches. Ramose corals are not conspicuous. The reefs are 50 to 100 m wide on the flat and steeply descent. These facies is mostly seen on the eastern shores of the various islands (b) in between the shores of islands with sandy bottom profuse growth of corals of ramose genera with a percentage cover of about 80% occurs. *Acropora, Seriatopora* and *Pocillopora* constitute the most dominant elements. Fungiids are very common in this situation.

SOCIAL AND ECONOMIC VALUE OF CORAL REEFS

Coral reefs rank as the most biologically productive and diverse of all natural ecosystems (Wells, 1988). Reefs are equivalent to tropical rain forests for their rich biological diversity. A large number of reef building and reef dwelling organisms live on reefs, that are objects of beauty and utility. The value of coral reefs to mankind are both extractive and non-extractive. The non-extractive uses of the tropical reefs centres around recreation, tourism, scientific research, shoreline protection and SCUBA diving. The extractive uses are very many, only if judiciously exploited. Coral reefs are huge mounts of Calcium carbonate which forms the raw material for many lime based industries, such as lime, cement, calcium carbide. They are also used as building blocks in many parts of the Indo-Pacific. The fin fish fauna of reefs is extremely rich and varied. The estimated fish production from the

global reef environs varies from 6 to 9 million tonnes per year (Munro, 1985) equivalent to about 10% of the marine fish exploited annually. The potential fish yield from the reefs of India is provisionally estimated to the tune of 0.18-0.27 X 10^6 tonnes yr^{-1} (Wafer, 1986). The diversity of fish fauna on the reefs varies in space and time. The total number of species of fishes from Lakshadweep reefs and surroundings is bout 600 (Jones and Kumaran, 1980). Approximately 600 species of fishes are known from Andaman and Nicobar waters (After Bakus *et al*, 1994). The shellfish resources of the reef is constituted by at-least four species of lobsters and many species of crabs. The common species of lobster on the reef flats of Lakshadweep is *Panulirus versicolar* (Pillai and Mohan, 1985). Among the crabs, *Scylla serrata, Portunus pelagicus, P. sanguinolentus* and *Charribdes* spp. are commercially caught from reef environs. The molluscan resources of our reefs are rich and varied. *Trochus niloticus* and *Turbo marmoratus* are costly gastropods of commercial value from Andaman reefs. Many species of cowries are fished from our reefs. The giant clam *Tridacna* is fairly common in Andaman and Nicobar and Lakshadweep. There exists potential scope of this mollusc in reef mariculture. *Octopus* and cuttle fishes are also fished from the reefs.

There exists vast resources of reef fishes that are of ornamental value on reefs. The surgeon fishes, parrot fishes, damsel fishes, the soldier fishes and cardinal fishes are of great demand as aquarium samples and there is vast scope of their live export. The reef associated fishes of the group clupids and apogonids form the live-bait along with pomacentrids both in Lakshadweep and Andaman Nicorbar Islands. A large resource *Spratelloides delicatulus* was located by the scientist of CMFRI in the marine park of Wandoor (Gopakumar *et al* 1990) especially along the near shore waters fringed by mangroves. The traditional pole and line fishery for tunas in Lakshadweep solely depends on the availability of these fishes on the coral reefs on Lakshadweep.

The echinoderm resources of the reef environs is of significant economic value. The holothurians that inhabit the lagoon and reefs are processed as *beche-de-mer*. Fishery for them exists in S.E. India and Lakshadweep.

The benthic algae of the reefs are rich and varied. Atleast 180 species divided among 99 genera of benthic algae are reported from the southeast coast of India (Varma, 1961). Altogether, 62 genera and 114 species of seaweeds are recorded from the 12 islands from Lakshadweep, of which 18 genera and 43 species belong to chlorophyceae, 14 species divided among 11 genera belong to phaeopaycea and 54 species of 30 genera are of rhodophycea. The total number of sea grass species was estimated to 6 (Kaliaperumal *et al*, 1989.)

In addition to these the reefs harbour a rich marine biological diversity of sponges, coelenterates, worms, molluscs, echinoderms etc. that are of great pharmacological value. The biodiversity of reefs associated flora and fauna of Andaman and Nicobar Islands still remains to be studied.

STRUCTURE AND COMPOSITION OF CORAL FAUNA OF INDIA

Recent studies on the taxonomy of scleractinian corals of our reefs have provided some data on the structure and composition of our reef building corals. Pillai (1993) reported on a total of 199 species of scleractinian corals from the reefs of India that are divided among 37 genera. The list is subject to revision due to taxonomic revision or additional information of other species that may be gained. The coral fauna of Andaman & Nicobar may harbour more species than what is hitherto reported. It is likely that the total species number may be around 225 from the Indian region. The break up list of species and genera is as follows.

	Genera	Species	Sources
Lakshadweep	27	105	(Pillai and Jasmine, 1989)
Gulf of Kutch	24	37	(Pillai and Patel, 1988)
S.E. coast of India	37	94	(Pillai, 1986)
Andaman and Nicobar	59	135	(Pillai, 1983) 20 to 30 species
West coast of Kerala and Tamil nadu	17	29	(Pillai and Jasmine - in press)
Total for India	37	199	

THREATS TO REEFS OF INDIA

There is a world wide regression of coral growth in the recent past due to many natural and anthropogenic reasons. Indiscriminate exploitation of the corals for various purposes, over exploitation of reef associated living resources, dredging and reclamation are some of the major anthropogenic factors for the destruction of reefs in India. Pollution, sea erosion and consequent siltation, construction activities in lagoons are also added to this man made cause for the deterioration of reefs. Cyclones, pests like *Acanthaster planci*, White Band Disease (WBD) are some of the natural factors that has recently affected mortality to corals in the India region. Wells (1988) has given an excellent review of disturbances of reef environs of coastal and island reefs of India.

Andaman and Nicobar Islands

Today, among the Indian reefs, only some sites in Andamans and Nicobar still remain in the pristine condition without human interference.

Siltation: In a recent survey of the Wandoor Marine Park area in South Andamans, it was observed that siltation has caused mass mortality to ramose corals at Wandoor. Sea erosion was rampant and vast areas in May 1989 was found covered by silt along the shore, killing mostly ramose corals. Mass mortality to corals was also observed in and around Port Blair and Labrynthene Islands; probably due to siltation. Along the Wandoor coast the reef flat is basically composed of massive species. Opposite to the Helipad, sea erosion was very rampant and large scale death to ramose corals such as *Acropora, Montipora, Pocillopora* and *Seriatopora* was observed. Similar mortality to *Acropora* thickets were observed at the northern side of Chester Island. The reefs around Malay Island, Tarmugil Island are found to be healthy mostly dominated by massive *Porites*. At Jolly Buoy which is a tourist centre, the outer reefs are found to be dead. The near shore shows patchy growth of corals.

In Burmanella the exposed reef flat is found to harbour few live coral colonies. The reef of Chideathope is also mostly dead. The reasons

are not ascertained. Quarrying of sand from the nearshore area was reported to be the reason for sea erosion and subsequent siltation. Dorairaj *et al* (1987) reported on an incidence of large scale mortality to corals due to the construction of an approach road to Pongi Balu Jetty.

Coral mining: Dorairaj *et al* (1987) also cite instances of large scale destruction of corals due to mining of the reefs and coastal sand for construction work in the various parts of the island.

The effluents from timber factories around Port Blair and in middle Andamans is reported to have caused damages to coral growth (Arif, *et al*, 1987)

Shell collection and dynamiting for fishing are also causing damage. Invasion of *Acathaster planci* was studied by James, *et al* (1989) from the Wandoor Marine Park. *A.planci* was recorded from Grub Island, Alexandra Island, Red Skin Island and Twin Island. In several places *Acropora* spp. were found to be grazed by this star fish. Average intensity of the starfish population in Grub Island at some sites was to the tune of 124 individuals per 1000 sq.m. No follow up studies have been made and the present situation is not known. Tourism is being encouraged in the Labrynthine Islands enclosing the Marine Park. Though collection of marine animals from the Park area is strictly disallowed other implecations of the extended tourism needs assessment.

A case of White Band Disease prevalence is also reported form Andamans.

Gulf of Kutch

Siltation: The Gulf is heavily silted especially in the nearshore areas as a result of great tidal fluctuation and wind driven terregenous material that get deposited. The ecological condition for coral growth must be subnormal. This heavy siltation has remarkable effect on the faunal composition. Dredging of sand for cement industry in Salaya is reported to have caused substantial damage to corals (Patel, 1985). In Pirotan Island large quantities of massive corals have been mined from the reef flat thus effecting damage to reefs (Pillai, personal observation).

Over collection of many marine animals is effecting depletion of fauna. Extensive destruction to mangrove along the coast has already been done. Threat from oil pollution in the Gulf is also suggested (Rashid, 1985).

Lakshadweep

The environmental damages and its consequences on the terrestrial and aquatic habitats of the Lakshadweep have been elucidated recently in a series of papers by the scientists of CMFRI (James *et al*, 1989, Pillai, 1985, Pillai, 1990, Pillai and Madan Mohan, 1986, Pillai, 1986). The available data on the ecological stress and deficiencies as well as importance for research in this Archpelago is summarised by Wells (1988). The land and the shores of the habitated islands have been subjected to intensive construction activities as well as semi-intensive agricultural operations in the post Independent period. The natural vegetation in almost all islands are cleared for settlement. The introduction of cattle and goats have added grazing pressure on the land vegetation. The introduction of large mechanised fishing vessels and added demand for cargo transport has resulted in the dredging of lagoons in Minicoy, Kavaratti, Amini and Kiltan islands. The lagoon corals in these islands are almost dead. The extensive growth of corals in Minicoy and Kiltan found in seventies are no more there. Introduction of mechanised boats in tuna fishery has also effected increased fishing pressure on resident live-bait fishes. Breaking of corals to capture small food fishes has also caused damage to coral fauna and associated organisms in northern Lakshadweep. The shell collection, especially from the northern islands is of high magnitude. On the whole, the human interference and exploitation of the resources have created significant loss to the reef building and reef associated organism of Lakshadweep. Perhaps no island in the Archipelago remains in the pristine condition. Sea erosion is rampant at sites mainly because of cutting of reef flats to widen and deepen the channel and dredging of the lagoon. Tourism is being encouraged. The siltation rate has gone up thus killing corals. W.B. Disease in *Acropora* is reported from Kavaratti atoll. (Annual Report CMFRI, 1992-93).

Southeast coast of India

The destruction to the reefs and reef associated organisms in the Gulf of Mannar and Palk Bay is perhaps unparalleled in the history of environmental damage to nature and natural resources in the recent past. Pillai (1975) in a detailed report has drawn attention to this. The coral reefs on Palk Bay and Gulf of Mannar was quarried for industrial purpose from early sixties form Mandapam to Tuticorin. The estimate of corals quarried varies. At Tuticorin the estimation was 80,0000 t per year. Pillai (1973) estimated the exploitation to corals from Mandapam area during sixties and early seventies to the tune of 250m^3 per day. The massive genera like *Porites, Favia, Favites, Platygyra* and *Goniastrea* are all destroyed. A fringing reef that existed in Manauli (Nair and Pillai, 1972) is no more there. It is reported that some of the islands near Tuticorin is almost vanished as a result of quarrying. A recent survey in Palk Bay and Krusadi Island has revealed that damage to reef due to human interferences is still rampant. Over exploitation of algae, and shells by fisherman (clandestine) from krusadi is of extensive scale. Corals are broken for collection of fishes and algae. Several boats were found collecting in the lagoon of the "Paradise of Marine Biologist" during September 1994. The huge colonies of *Montipora foliosa* and *Echinopora lamellosa* that occupied large areas in the lagoon is no more there. They were mostly broken by fishermen during collection of algae to negotiate their boat. The live export of crabs from this area in the recent years is also causing damage to live corals. Fishermen set crab nets and traps among the what ever available corals of Palk Bay and Gulf of Mannar Islands to catch *Scylla serrata*. The setting and retrieving of cages is observed to cause breakage to live corals. The corals that grow in Enayam was also extracted and virtually few colonies are found there at present.

Recent investigations from the Manauli Island (Chandrika and Pillai, 1992) has revealed the presence of *Escherichia coli* Type 1 from *Acropora formosa* and also from reef sediments collected from a depth of nearly 0.5 m at low tide indicating faecal contamination. Presence of *E. coli* in all reef organisms in reef flats of Lakshadweep islands, is

bound to occur due to open defecation on reef flats, by the residents.

CONSERVATION OF REEFS AND REEF RESOURCES

As already stated the coral reefs and their resources are fast dwindling in our waters. Except for, perhaps, some islands in the Andaman and Nicobar Islands, no pristine reefs exist today in our country. Over exploitation, and unwanted interference and lack of effective management in the past may be the major reasons for this sad state of affairs. The value of coral reefs is all the more important to the island territories of our country. In Lakshadweep the reefs form a major life supporting resource to the locals as important as the coconuts.

Existing legislation to conserve reefs and reef resources

The Wild Life (Protection) Act of India (1972) provides legal protection to many marine animals including reef associated organisms. Chapter IV of this act dealing with Sanctuaries, National Park Game reserves and closed areas is equally applicable to marine reserves and marine parks and biospheres. Some of the reef area inhabiting mammals, such as *Dugong dugon* and turtles like *Chelonia mydas, Eretmochelys imbricata* are included in Schedule I as fully protected species. The chank and pearl fishing from the Tamil Nadu coast is regulated by the respective regulations made by the Tamil Nadu Govt.

As early as 1985 a National Committee on coral reefs was set up by the Govt. of India, Department of Science and Technology with a mandate to suggest means for conserving coral reefs of India. However nothing much seems to have emerged by this well thought out action.

Proposals were made from various scientific institutes such as National Institute of Oceanography and C.M.F.R.I to have national Parks and biosphere reserves in various coral growing areas of our country (See Silas, *et al* 1985 for a detailed report and constructive suggestions). Dugong reserves, Turtle reserves and echinoderm reserves etc are also proposed. James *et al.*, (1989) examined the credentials of various islands in the Lakshadweep to establish a Marine Park with suggestions for management. Qasim (1980) suggested Malvan and adjacent areas along the west coast of India as Marine park. All

these proposals pleaded for judicious exploitation of the resources as well as halting unnecessary human interference on the ecosystem.

The Ministry of Environment and Forests, Govt, of India has constituted a National Committee on mangroves, wetlands and coral reefs with representation of scientific experts and forest officials of all states. The committee examines action plans prepared by various state Governments for conservation of the above ecosystems and provide financial support. A special committee assesses the research needs and recommends proposals for research funding. The committee has identified, Gulf of Kutch, Gulf of Mannar, Lakshadweep and Andaman and Nicobar Islands for conservation and management of coral reefs and the respective state governments or Union Territories are requested to prepare action plan in this regard. The Andaman and Nicobar administration has drawn up an action plan for the conservation of the reefs of this area.

Actions already implemented

Establishment of marine parks: National Marine Parks were established in three areas already.

1. The Gulf of Kutch Marine Park:

A detailed report on the Gulf of Kutch National Marine Park is found in Rashid (1988) The area from Okha to Jodia along the Gujarat coast was notified as Marine Park in 1980 under the provisions of the Wild Life Protection Act 1972. An original area of 270 sq.km. was brought under this which was subsequently enlarged to 400 sq. km. The Park is administered by the Forest Department of the state.

2. The Wandoor National Marine Park in South Andamans

The Wandoor National Marine Park covers an area of 281.5 sq.km. within the Labrythine Islands of S. Andamans. It covers the coast of Wandoor, the Chester Island, Grub Island, Snob Island, Red Skin Island, Alexandra Island, Jolly Bouy, Malaya Island, Tarmugili Island and the Twin Islands. The high islands are all covered with rich forests, the shores fringed by extensive mangroves. Human interfer-

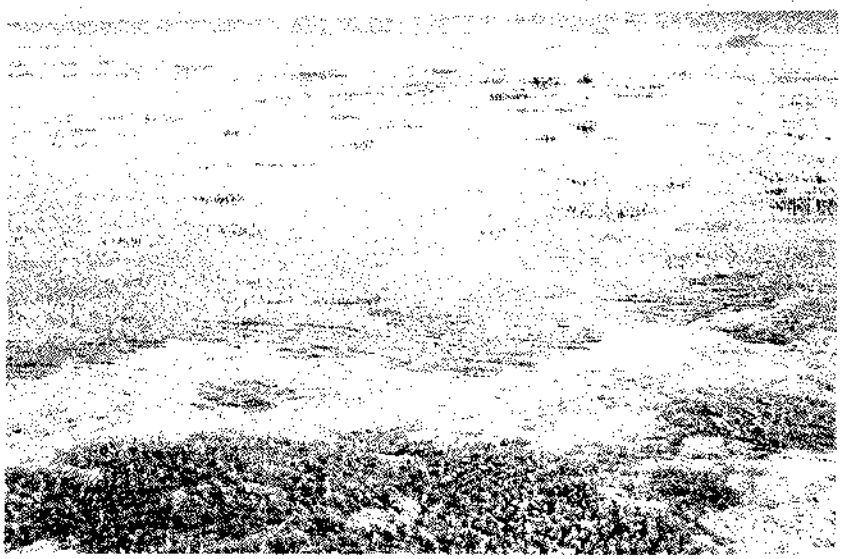
ences on the reef ecosystem is minimum. Tourism, is permitted to Jolly Bouy and Twin Islands. The Park is managed by the wild life wing of the Andaman forest department. Collection of all organisms including turtle fishing is effectively checked. Proposals for scientific research is on the way.

3. The Gulf of Mannar Marine Park.

This is the Third National Marine Park of this country. It embraces 22 islands in the Gulf of Manner from Rameswaram to Tuticorin. The area was subjected to marine biological studies for a long time by the C.M.F.R.I. and have fairly good knowledge of the fauna and flora. Perhaps this area was also subjected to severe exploitation of its resources in the last few years. The coral reefs are mostly destroyed. Pearl and chanks as well as crustaceans are intensively fished. The exploitation of marine algae is on large scale. The Park is administered by the park authority of the wild life wing of the forest department of Tamil Nadu. However, till Sept. 1994 the Krusadai Island which should form the heart and sole of the park is not yet brought under the preview of the park. It is said, after the declaration of the marine park, the paradise of Marine Biologists- Krusadai is almost depleted of its corals and other organisms by intensive collection. The implementation of regulation is still in a poor state. Clandestine exploitation of the resources is still in vogue. Large quantities of economically important seaweeds are collected daily by fishermen. Infrastructure for effective management as well as identification of personnel for running of the park is yet to be realised. Various research programmes funded by national agencies and central ministries are in operation. Fishing of turtle, though prohibited by law is going on. Corals collection and mining is still taking place in Tuticorin area.

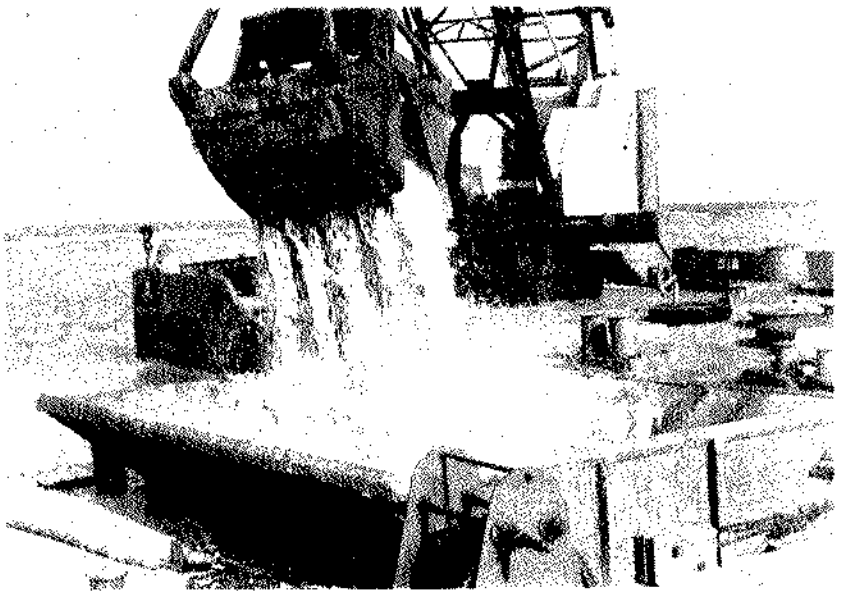
A NATIONAL POLICY FOR REEF CONSERVATION

The coral reefs of India are under the jurisdiction of the respective state or Union administration. A national policy to bring all coral reefs under one central authority is the need of the hour. The management of marine parks needs trained marine biologists. Management of terrestrial forest ecosystem may be technically different from

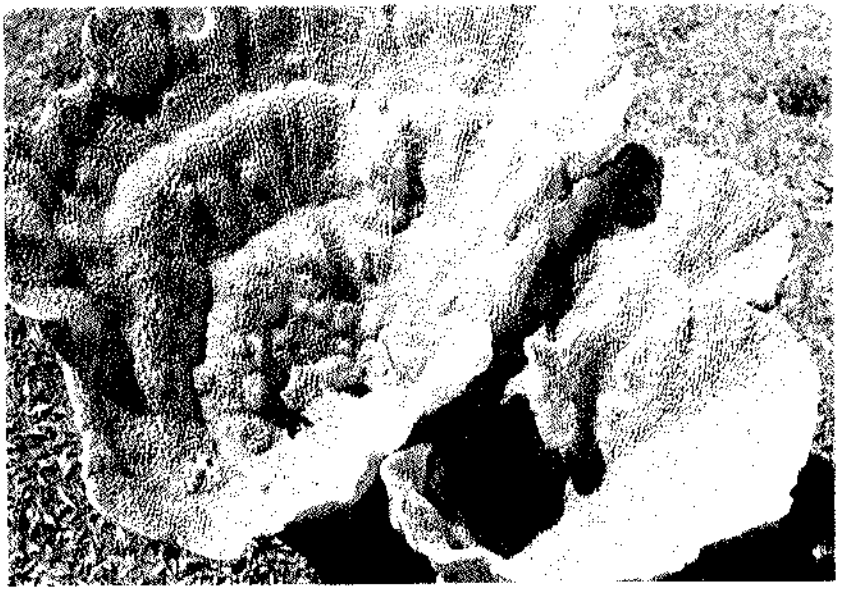


Coral reef flat at Kadamat, Lakshadweep

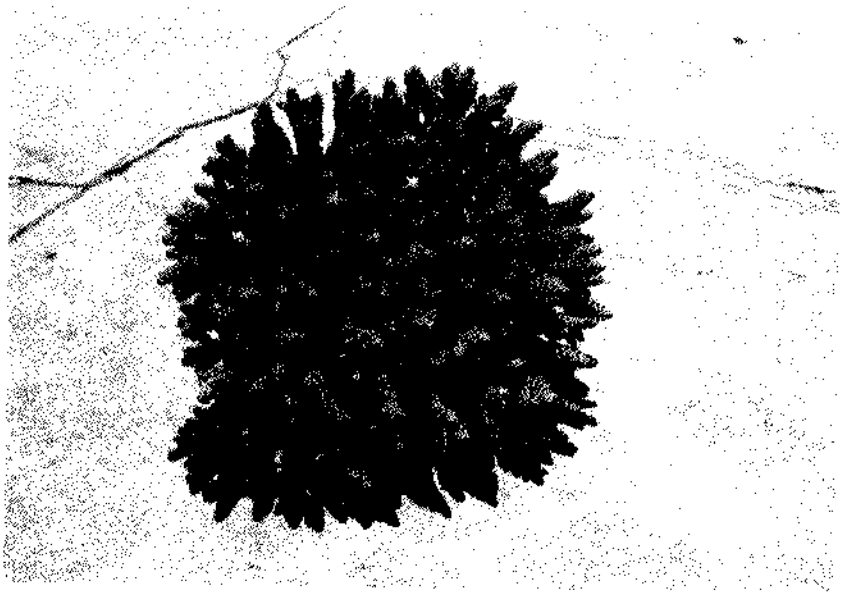
Coral exploitation at Mandapam, Tamil Nadu



Dredging the lagoon, Lakshadweep



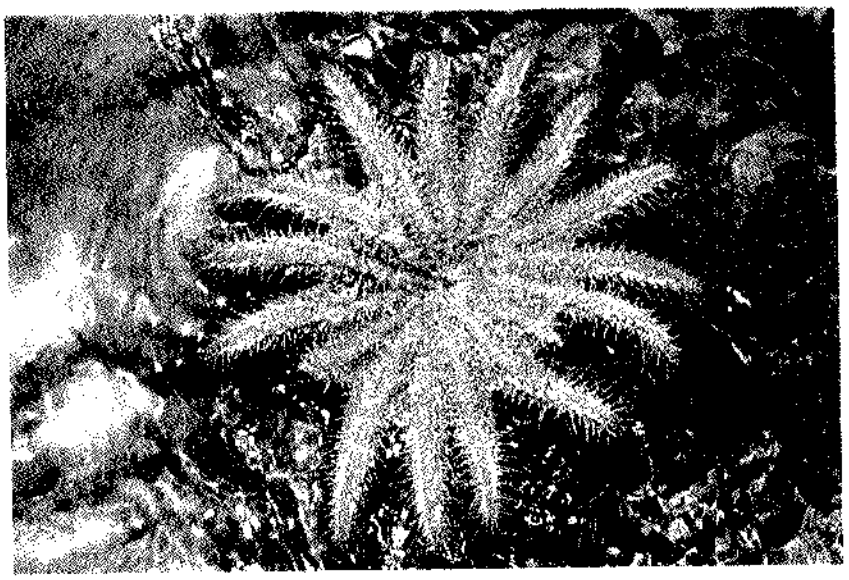
Montipora foliosa



Acropora humilis

Fungia scutaria - A solitary coral

Gastropod shells collected from the coral reef at Lakshadweep



Acanthaster planci. Predator starfish on coral reefs from Wandoor

marine habitat management. Silas *et al* (1988) have given some guidelines for the effective management of Marine Parks. Exploitation of corals should be effectively halted except for scientific research. Further interference on reef ecosystems should be avoided. Dredging and blasting of reefs resulting in sedimentation of reefs and lagoons may be restricted. Many of the reef organisms of our country could be brought under CITES regulations. This will control the exploitation of pharmacologically valuable gorgonids, sponges and alcyonarians from our reefs. Live export of marine organisms such as lobsters and crabs from S.E. India needs careful watching and their fishing needs to be regulated.

The administration of the U.T. of Lakshadweep has already banned the collection of corals for any construction work. However, there is an imperative urgency for the establishment of a National Marine Park in some parts of the Archipelago to protect the biodiversity of our only atoll environment. Already, the pristine nature of the atolls is lost. As an initial step, zones should be marked on every atoll where no interference, whatever so is allowed. This is best done with the co-operation of the local people without much affecting their traditional rights of using the living resources. Tourism now allowed in Lakshadweep in a significant scale must be strictly made as ecotourism. Though legal protection to coral reefs of Lakshadweep, S.E. India, Gulf of Kutch and some parts of South Andamans are provided, effective implementation of the law with the participation of the beneficiaries is still awaited. The reefs of our waters are a very valuable marine, benthic ecosystem of high biological diversity and at any cost they need to be preserved and protected.

Establishment of a Marine Park Authority in a national level, with sufficient expertise and infrastructure is advisable. All the coral growing areas of this country may be brought under the Authority which should effectively implement conservation measures. Research and monitoring aspects also may be entrusted with it. In all the work the participation of the beneficiaries of our reef resources has to be enlisted. Coral reefs are natural gift to mankind and are built in

thousands of years by millions of tiny coral polyps. Destruction of a reef can be done in a short while. We have done it and we have lost this heritage and valuable resources in many parts of our waters. Reefs give food for mankind, material for scientific research, ample opportunities for recreation and past time. We need the reef, reefs need our attention, certainly we should keep them for future generation. Our approach towards the exploitation of reefs, should be based on a "sustainable" development.

Foot Note : This article is dedicated to the fond memory of Dr. Reymond F. Fosberg U.S. National Museum, Washington; demised on 25th September, 1993. As a great atol scientist and champion of nature conservation, he will be remembered by both botanist and reef scientists all over the world.