

A review of the status of corals and coral reefs of India

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ABSTRACT

Precise estimation of the biodiversity of corals from any area is subject to variation due to uncertainty of synonymy. Corals exhibit very high intraspecific skeletal variation depending on the physiographic and hydrographic condition. The present paper describes overview of coral resources in Indian seas, their biology and taxonomy, anthropogenic stress on coral reefs, conservation and research efforts being put by various organisations.

Key words: Corals, Coral reefs, India, Oceans

Corals belong to the phylum Anthozoa and they are objects of beauty and utility. The hermatypic corals with their symbiotic zooxanthellae build the mighty reefs beneath the waves that are exposed only at low tides. Corals are exclusively marine and taxonomically belong to the order Scleractinia.

They are both solitary and colonial, the solitary forms are called ahermatypes and they do not have symbionts. Reef building corals grow actively in the photic zone of the ocean. Coral reefs are found in the tropical waters as a belt around the globe.

The reefs of seas around India

India has a coast line of nearly 8000 km but the reef formation is restricted to four major centres, viz. Gulf of Kutchh, Gulf of Mannar, Lakshadweep and Andaman and Nicobar Islands. Lakshadweep is exclusively atolls but others have fringing reefs or patch reefs. Barrier reefs are found in Andamans. Additionally the Malvan area and Kanyakumari district of Tamil Nadu have patchy reefs. The vast stretch of Bay of Bengal except for Andaman and Nicobar Islands is devoid of any coral formation. Estimation of reef flats of Indian reefs by remote sensing has shown that the extent of the area in Gulf of Kutchh is 148.4 km² that of Tamil Nadu coast as 64.9 km². Lakshadweep 140.1 km² and that of Andaman and Nicobar Islands 813.2 km². Additionally knolls and lagoon reefs from roughly 50 km². (Pillai, 1996).

Morphology of Indian reefs

Zonation is not distinct in certain areas as in Palk Bay. However, two major morphologically distinct types occur. Reef flats and lagoon shoals dominated by ramose or branching corals. The dominant genera include *Acropora*, *Montipora* and *Lloporora*. Intermittent with these are found massive and encrusting genera like *Porites* and *Favoids*. The

second physiographically demarcated area comprises massive corals that form the chief frame work of the reefs. The dominant genera include *Porites*, *Favia*, *Favites*, *Goniastrea*, *Platygyra* and *Cyphastrea*. In Lakshadweep the lagoon reef flats have extensive coverage of *Heliopora*. Gorgonids are scarce in the shallow waters of our reefs though they are present in deep waters from where they are collected for export. The soft corals or alcyonarians are dominant among the hard corals in Andaman and Nicobar Islands and they do occur in Gulf of Mannar and Gulf of Kutchh.

The coral fauna of India

Precise estimation of the biodiversity of corals from any area is subject to variation due to uncertainty of synonymy. Corals exhibit very high intraspecific skeletal variation depending on the physiographic and hydrographic condition. Estimation of the variation of skeletal morphology is often difficult and this has resulted in the duplication of many species. The studies on the taxonomy of Indian corals have a history of nearly 160 years starting with Link (1847) from Nicobar Islands. Subsequently studied by British scientists on material housed in British Museum Natural History, London and works of Late Prof. George Matthai and C.S.G. Pillai have elucidated the coral fauna to some extent. Pillai estimated the coral fauna of Gulf of Mannar and Palk Bay (1972/1886) Lakshadweep Gulf of Kutchh (Pillai and Patel 1988) Andamans (Pillai 1993) west coast of India *i.e.* the erstwhile Travancore coast including the Kanyakumari coast (Pillai and Jasmin) for details of references the recent work of George and Sandhya (2007) may be referred along with Pillai (1986). Pillai (1996) published a detailed status report on the corals and coral reefs of India which still remains to be the basic document though subsequently status reports were prepared and published by several authors including Wilkinson (2000), Muley *et al.* (2002) and Patterson *et al.*

(2007). Pillai (1996) listed 199 species of corals from Indian waters of 71 genera of which 55 were hermatypes and the rest ahermatypes. The Colonial or hermatypes comprised 155 species and the rest deep sea or shallow water ahermatypes. Since that publication taxonomic work on Andaman and Nicobar Islands by Venkataraman *et. al.* (2002) Zoological Survey of India, Gulf of Mannar from George and Sandhya and Patterson yielded a few more species. Venkataraman *et.al.* 2002 lists 208 hermatypes from India. Additional information based on recent works from Marine biosphere in Gulf of Mannar accounts for nearly 8 more species, thus totalling to about 220 species (subject to further taxonomic) of colonial corals plus nearly 45 species of deep water and shallow water ahermatypes. This total accounts for about 265 species of stony corals from our waters there to known. However, Venkataraman and other states that another 111 species of hermatypes are reported from Anadamins by underwater diving and this should be added to the list. The species listed by SCUBA diving on more sights, the records are unreliable since identification of corals *in-situ* underwater with any certainty is difficult. Wells as early as 1954 stated that approximately 700 species of corals occur in the whole of Indo-Pacific. However, this is also is not final, for several authors since have, especially the Australian workers added many more species so also the scientists of Philippines to the biodiversity of Indo-Pacific corals. If one takes John Wells 1954 estimate of 700 species along with additional information provided by recent workers the total will be about 775 species. This indicates that circa 35% of the Indopacific corals occur in our waters since Pillai's work on Lakshadweep and Gulf of Kutchh no intensive survey in those areas has been done especially the deep waters facies. In essence to get a realistic picture of our coral resources we have to do more collection, collation literature survey settling of the synonymy and the like. This is to be done by a team of expert scientists, SCUBA divers and technical persons who are dedicated to their assigned task.

The living resources of reefs of india

The waters around the reefs are reported to be nutritionally poor. Despite this reefs harbour a rich fauna and flora. Out of the 34 marine genera 32 are reported to occur in reef as parabion, crypobion, borers and free living. The exact number of species living on a reef from any area is yet to be precisely estimated. The determination of biodiversity on a reef depends on the exact number occurring, the area covered, the time spent on collection and seasonal variation. The biodiversity of reef associated organisms in Indian reefs is still to be critically assessed.

The dominant flora comprises, *Gracilaria*, *Gelidiella*, *Hypnea*, *Sarconema*, *Hydrodathrus*, *Cauleropa*, *Sargassum* and *Turbinaria*. The marior sea grasses include *Thalassia hemprichi*, *Halodule univervis cymodocea serrulata*, *Syringodium sp.* and *Enhalus acroroides*. These are found

on the reef flats and lagoon shoals.

The reef associated fauna constitute, sponges both boring and free living, other coelenterates, such as hydroids, alcyonarians gorgonids and sea anemones. Many areas on Indo-Pacific reefs are rich in hydroid corals such as *millepore*, *Heliopora* and *Distichopora* and black or thorny corals. The crustacean fauna is immensely rich. The global estimate of crustaceans is about 150,000. It is reported that Indian waters harbour nearly 3000 species. The exact number of reef dwelling crustaceans that are important and are exported from India is yet to be determined.

The molluscs are a dominant component of reef dwelling animals. The global estimate of molluscan species is around one lakh fifty thousand. About 5000 species occur in our waters. Several bivalves cause bio-erosion to dead and living corals. Several gastropods such as *Trochus*, *Turbo*, cowries and many others are exploited from the reef for various proposes. A cottage industry in south India exists on mulluscan shells.

The echinoderm fauna of India is estimated to the tune of 760 species and many are found on reef. Some like *Acanthaster planci* are predators of corals and occasionally in many parts of the Indo-Pacific this species increase in large numbers causing sever damage to the living corals.

The bryozoans are tiny colonial coelomates encrusting on corals and about 200 species occur in our waters. The exact numbers of reef dwelling species are yet to be known.

Reef fishes are rich in number and species. Lakshadweep is reported to have about 600 species of reef fishes and Andaman and Nicobar Islands also have nearly 600 species. Reef fishes are both resident and migrant. Seasonal variation in species composition is often seen in a reef track. Reef ichthyofauna is highly colourful and form valuable aquarium samples. They are often highly priced.

The reptilian fauna is essentially constituted by turtles. They are a protected class of animals.

Anthropogenic and natural threats to indian reefs

Corals and coral reefs all over the tropical waters are under stress due to various anthropogenic and natural intervention. The interference of these factors on Indian reefs has been reported by several workers (Wells, 1988, Pillai, 1996; Venkataraman, 2002, Wilkimson, 2000, Patterson, *et.al*, 2007). The major natural causes for the destruction of corals include siltation, cyclone, local tectonic upheavals, tsunami, pests and predators and El Nino. During 1988 a notable rise in surface water temperature was observed and large scale mortality to corals was reported as a result of 1997/98 El Nino southern oscillation. Venkateraman (2000) reports that this has affected reefs in Gulf of Mannar and many species of corals were bleached. However subsequent studies by Patterson (loc. cit.) show that the southern part of Gulf of Mannar has densely populated reefs and there is no sign of impact of El Nino event.

Coral diseases

Corals are also affected by various fungal and bacterial diseases. In Gulf of manner and Lakshadweep three types of disease have been recorded in the recent past, viz. white band diseases, black band disease and bacterial/fungal infection. The exact cause of this being studied by various institution. Venkataraman (2000) states that it is stress related.

Silt and sedimentation cause asfixia on polyps and corals die. Sea erosion, dredging the reef environs, deforestation and construction activities stir up silt and sediment. Pests and predators also cause death of corals. Among the predators the echinoderm *acanthaster planci* is the most disastrous. This is reported from Lakshadweep and Andamans. The population of the starfish in Lakshadweep is normal and is doing little harm. There was a great increase of the starfish in Andamans but the damage was minimum. The star fish feed on coral polyps leaving the skeleton white.

Bio-closion is the reef go hand in hand with reef building molluscs, polychaetes and echiuroid are the major bioeroding agents on a reef.

Blasting of the reef is a human activity that cause destruction to reefs. In the post independent years introduction of mechanized fishing crafts resulted in the blasting of the reefs to deepen the boat channel in Lakshadweep. Quarring of corals for various industrial purposes and construction work in Gulf of Mannar resulted in the total lose of fringing reefs in some islands. Dredging the lagoon for navigational purposes degraded the atoll reefs of Lakshadweep. Only in some part of Nicobar Islands and Andamans undisturbed reefs remain.

Management issues

As already indicated, our reefs are under severe ressure from many reasons. This valuable natural gift is almost irreparably exploited. Coral reefs and corals protect the coast from wave action. The value of reefs is both extractive and non extractive. The extractive values include many food organisms including fishes, molluscs and crustaceans. Pearl oysters are normally found in the reef environs. Corals are traditionally used for medicine. The reef associated organisms provide raw material for many life saving drugs and reefs are potential areas for pharmacological research. The genetic structure of reef corals is little investigated and it is of great value in the determination of species. They have decorative value. They provide raw material for lime, cement and calcium carbonate since the skeleton of corals contain 98.5% pure calcium carbonate. They are building blocks for houses in atolls and coastal areas. The non-extractive use of coral reefs is chiefly tourism. They are excellent sites for scientific research. Tourists are mainly attracted to the reef for skin and SCUBA diving and sport fishing. Though, the tourism is yet to fully develop. Due to the above mentioned value of the reefs they have to be protected and conserved for the future generation. Development and conservation rarely go hand in

hand. Hence we have to utilise reefs on a sustainable level and as such management strategies have to be taken up.

Action taken for conservation of reefs in india

Need for conservation of coral reefs is evident from the value of this marine benthic, tropical community. Though reefs were present and mankind utilized their resources from time immemorial a greater awareness for the conservation and protection emerged only in the later half of the last century. Early workers in the 19th century did not much argue for protection to reefs, for reefs survived in healthy condition. But indiscriminate exploitation and unhealthy interference on reefs by man made them threatened ecosystem and ecologists and naturalists started pointed out to the necessity for reef conservation. India had the privilege to hoist the first International symposium on corals under the auspices of the Marine Biological association of India in January 1969 where in reef scientists from 11 countries participated. An international committee for the conduct of further symposia in every 4 years was also constituted. And to date 10 symposia were conducted in various tropical countries. However, our involvement in the series of meetings later was virtually nill.

Efforts in India for conservation of reefs

Realising the needs for the protection of this valuable marine resource the Government of India has taken steps to conserve and manage the reefs from early 1986. A national committee on corals and mangrove was constituted by the Ministry of Evironment and forests and expert scientists, administrative staff and state govt. officials were incorporated. The mandate of this committee was to advise the govt. on strategies of protection and conservation of the reefs, in addition to eco-development and awareness creation on island population and coastal dwelling people on the need for conservation. A research committee was also constituted with a view to recommending need based research projects to scientific institutions and non-governmental agencies. State level steering committees were also constituted to over see the progress of implementation of management action plans. Thrust areas were identified. Marine parks and biosphere reserves were established. The Gulf of Kutchh Marine Park, in Gujarat, Mahatma Ghandi Marine Park in Wandoor S. Andamans, Gulf of Mannar Biosphere and Jhansi Rani Marine Park in Andaman and Nicobar were established Nodal institutions in these areas were indentified to carry out research and monitoring. Research projects were funded Non-governmental organisations of repute were encouraged to persue research and to ensure awareness creation on the protection of reefs.

Legislation

The Govt. of India has promulgated various legislations covering coral reef conservation. The wild life protection act 1972 provides protection to certain marine species. Efforts

are being made to bring corals under this act. The Government of India issued a Coastal Regulation Zone notification in 1991 and amendments in subsequent years. The collection of corals either dead or live is strictly prohibited except for scientific research by identified institutions. All scleractinians and gorgonids are brought under wild Life Protection Act. 1972 from July 2001.

Thought India gave a fillip to reef research by organising the first International symposium on coral reefs, in 1969, subsequent involvement of our country in furthering research in this field is limited. However, to supplement national efforts related to conservation and management of coral reefs and associated living resources the Ministry and environment and Forests, Government of India has been collaborating through some international initiatives in this country. Under the UNDP/GEF programme studies have been undertaken in Gulf of Mannar through MS Swaminathan Research Foundation. Another project in Andaman and Nicobar Islands has been completed. The ultimate aim of these studies is to evolve a viable Management action plan on Indian coral reefs. The management of coral reefs is currently vested with the forest officials. Marine biodiversity management and eco-development needs trained persons other than forest officials. With the collaboration of Australia India has trained three scientists in Australia on coral taxonomy with a view to capacity building to strengthen reef research the Ministry of Environment has initiated action for the establishment of a National Institute of Coral Reef research at Port Blair. This is currently associated with the Zoological Survey of India and a small laboratory with limited staff is established.

On going research activities

Zoological Survey of India, National Institute of Oceanography and Central Marine Fisheries Research Institute are the major national centres of current reef research. The Suganthi Devadason Marine Research Institute at Tuticorin Tamil Nadu is a private organization that is very actively engaged in reef research in Gulf of Mannar. The major ongoing research activities at various centres are mainly on various aspects covering Biodiversity of coral fauna; Biophysical monitoring of reefs; Reef restoration and coral transplantation; Reproductive biology of corals; Studies on the physical and biological impact on reefs GIS based mapping of reefs; Livelihood programmes on coastal population to reduce anthropogenic pressure; Awareness creation on the value of reefs and need for conservation; Capacity building in the taxonomy of corals and reef dwelling organisms to assess biodiversity.

Current reef research and achievements

The knowledge of scleractinian corals has considerably

increased. All the major reefs are reasonably studied. Formulation and partial implementation of conservation laws have considerably reduced the destruction of reefs. An attempt is made to capacity building in various sectors including training to coral taxonomists.

Tourism is restricted to selected areas. Effluent discharge to reefs has been considerably controlled. Continuous monitoring of the reefs in Gulf of Mannar and some parts of A&N Islands and Lakshadweep enabled us to understand present status of reefs so also recolonisation of scleractinians after mortality. Awareness to the value of reefs and need for conservation of this ecosystem has increased particularly among the coastal people and Island inhabitants. Some attempts are being made to transplant corals for eco-development Marine Parks and biosphere established.

Suggestions for future research

Taxonomic studies on reefs should be carried out. Maritime universities and research institutes should be encouraged to take up further reef research for which infrastructure is to be developed. Pharmacological research of marine organisms may be taken up on a priority ground. Eco tourism and eco development should receive attention. Continuous monitoring of the reefs may be made to assess various impacts thus to implement remedial measures.

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