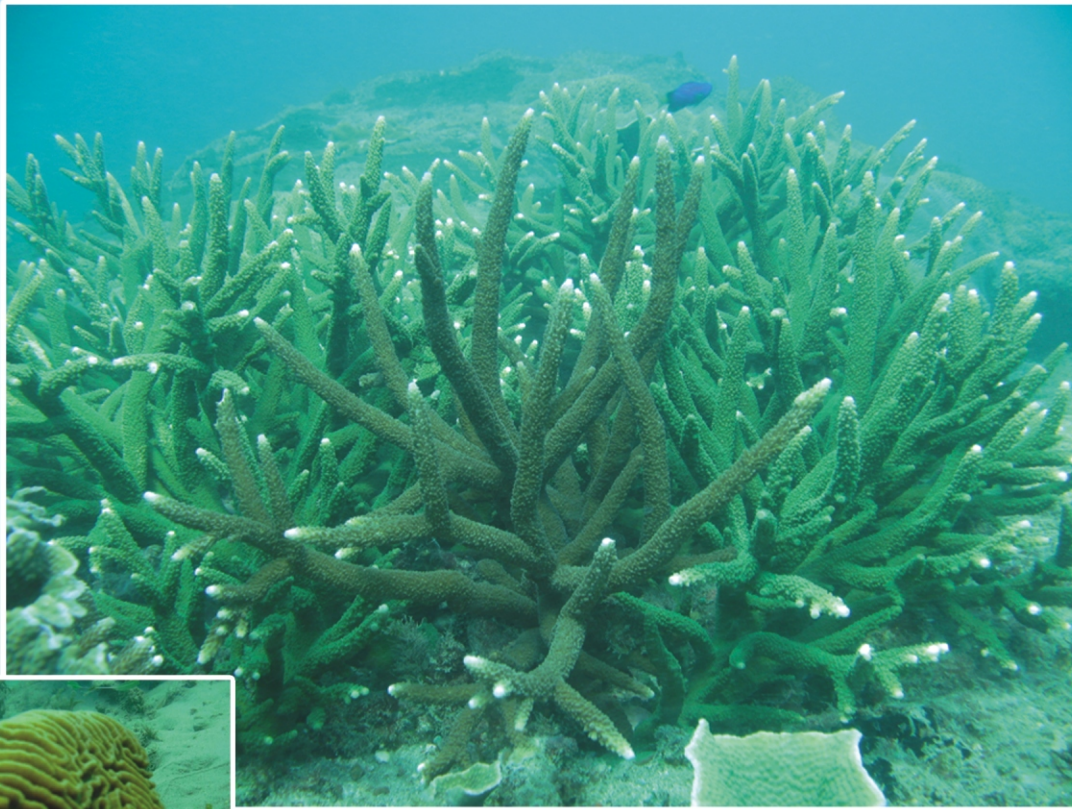




# Status of Coral Reefs in the Gulf of Mannar Region, Tamilnadu, Southeast India



V. K. MELKANI



**Gulf of Mannar Biosphere Reserve Trust**  
Ramanathapuram - 623 504, Tamilnadu

# **Status of Coral Reefs in the Gulf of Mannar Region, Tamil Nadu, Southeast India**

**Project on  
Conservation and Sustainable Use of  
Gulf of Mannar Biosphere Reserve's Coastal Biodiversity**

**V. K. MELKANI**

**December 2008**



**Gulf of Mannar Biosphere Reserve Trust**

Ramanathapuram - 623 504, Tamil Nadu, India

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## **GULF OF MANNAR BIOSPHERE RESERVE TRUST (GOMBRT)**

(A Statutory Trust of the Government of Tamil Nadu)



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### **PRELUDE**

Coral reefs are among one of the most beautiful creations of the nature. They are the repository of marine biodiversity and almost twenty five to thirty percentage marine biodiversity is associated with corals. Coral reefs, Seagrass meadows and Mangroves are associated and interlinked ecosystems providing the vibrant life, color and richness to the marine ecosystem. Gulf of Mannar region is one among the four coral rich areas in India. Though the spread of corals may not be very high (about 100 sq.km) yet the species diversity of reef building corals (117 species reported) is high. Like anywhere else in the world the coral reef of this region are also prone to various threats and serious attempts are being made in reducing those threats in order to ensure that the coral reefs of this region grow as per nature's way and sustain high level of fisheries production in the region.

The year 2008 has been declared as the "International Year of the Reef" in order to focus attention on the status of the coral reef globally and to make efforts to conserve the coral reef for the sustained benefits of marine biodiversity and the human society. This paper was presented in the National Conference on "Coral Reef Conservation" organized by the Fisheries College and Research Institute, Tuticorin on 18 - 19<sup>th</sup> September 2008. In this publication some information along with photographs have been included to make this publication attractive and informative.

This publication is dedicated as a contribution towards the "International Year of the Reef" by understanding the present status and state of affairs with regards to coral reefs of Gulf of Mannar region and will help in the reorienting our thoughts and actions to assist the coral reef conservation efforts in future through joint efforts. I hope that this publication will be of use to scholars, students, managers and various other stakeholders.

  
(V.K. MELKANI)

## **STATUS OF CORAL REEFS IN THE GULF OF MANNAR REGION, TAMIL NADU, SOUTHEAST INDIA**

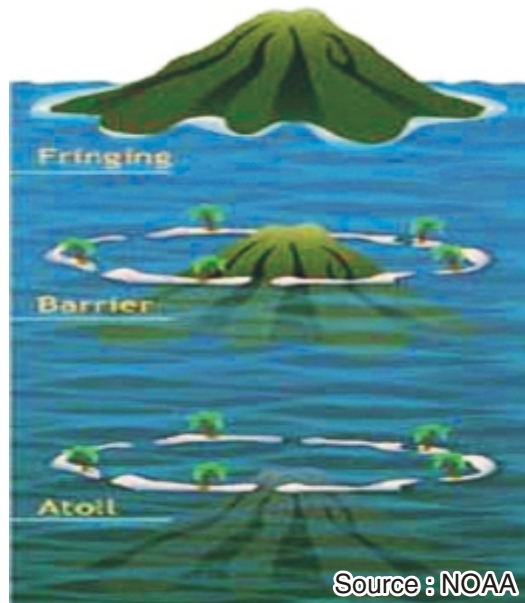
### **Introduction**

Coral reefs are tropical, shallow water habitats largely restricted to the area between the latitude 30 N and 30 S. The exact area and extent of the coral reef in the world is unknown and difficult to clearly estimate. Coral reefs are also referred as the “rain forests” of the oceans because of their biodiversity richness and high level of primary productivity. Reefs are reported to provide shelter, nourishment and breeding grounds to thousands of marine flora and fauna. They have an important role in protecting the coastline. Coral reef in general terms means polyps and the calcareous skeleton. Corals are generally sedentary and are the building blocks of the coral reef. Corals though are the builders of the most massive natural structures, are equally fragile and vulnerable to natural and anthropogenic factors. The conservation of the coral reef in the areas they occur is very important considering the role they play in livelihood, food security, sustaining marine biodiversity and coastal defense.

### **Types of coral reefs**

There are three main types of coral reefs viz

**Fringing reefs** lie near emergent land. They are fairly shallow, narrow and recently formed. They can be separated from the coast by a navigable channel (which is sometimes incorrectly termed a "lagoon").



Types of reef formation

**Barrier reefs** are broader and lie farther away from the coast. They are separated from the coast by a stretch of water which can be up to several miles wide and several tens of metres deep. Sandy islands covered with a characteristic pattern of vegetation have sometimes formed on top of a barrier reef. The coastline of these islands is broken by passes, which have occupied the beds of former rivers.

**Atolls** are large, ring-shaped reefs lying off the coast, with a lagoon in their middle. The emergent part of the reef is often covered with accumulated sediments and the most characteristic vegetation growing on these reefs consists of coconut trees. Atolls develop near the sea surface on underwater islands or on islands that sink, or subside.

### **Status of coral reefs in India**

The total area of coral reef in India is estimated to be 2,375 sq. km. (Pillai, 1994). Coral reefs are found in 4 major areas in India. The mainland coast of India has two widely separated areas having reefs: Gulf of Mannar and Palk Bay; and the Gulf of Kutch (Kachch). Two are the offshore island chains of the Andaman and Nicobars and Lakshadweep Islands. All the three major reef types, atoll, fringing and barrier occur in India. The Gulf of Mannar and Palk Bay are located in the southeast coast (Tamilnadu state). The reef forms in the Gulf of Mannar such as shore, platform, patch and fringing type are observed (Pillai, 1971.) and a total of 117 coral species reported (Patterson *et al.*, 2007). The Gulf of Kachch is located in the northwest (Gujarat state) coast where platform reefs are seen and corals survive through extreme environmental conditions such as high temperature, salinity changes and high-suspended particulate loads (Pillai and Patel, 1988). In addition to these, there are patches of reef growth on the West Coast, for example coral reefs at Malvan. The Andaman and Nicobar Islands have fringing reefs around many islands, and a long barrier reef (329 km) on the west coast. Little is known about these reefs, which may be the most diverse and pristine reefs in India (Wilkinson 2000). The Lakshadweep also has extensive reefs especially atolls, but these are also poorly studied. The coral fauna of Lakshadweep is known to harbor 105 species divided among 37 genera (Pillai, 1996). The islands are flat and scarcely rise more than two meters. They are made up of coral sand and boulders that have been compacted into sandstone. Coral reefs of the islands are mainly atolls except one platform at Andrott. The reef flat occupies 137 km area (Bahuguna and Nayak, 1994)

### **Coral reefs of the Gulf of Mannar**

Reefs in the Gulf of Mannar are developed around a chain of 21 uninhabited islands that lie along the 140 km stretch between Rameswaram and Tuticorin. The islands are located between Lat. 8° 47' N and 9° 15' N and Long. 78° 12' E 79° 14' E (Fig.1). The islands lie at an average distance of 8-10 km from the mainland and have fringing



Fig. 1: Map showing the 21 islands in the Gulf of Mannar

and patch reefs around them. Narrow fringing reefs are located mostly at a distance of 50 to 400 m from the islands and patch reef rise from depths of 2.5 m to 8 m and extend to 1 - 2 km in length with width as much as 50 meters. Reef flat is extensive in almost all the reef areas in the Gulf of Mannar (Pillai, 1971). Pillai (1986) provided a comprehensive account of the coral fauna of the Gulf of Mannar, 94 species of 37 genera, with most common being *Acropora* sp., *Montipora* sp and *Porites* sp. Patterson *et al.*, (2004) updated the list of corals of Gulf of Mannar from 94 to 104 and further from 104 to 117 (Patterson *et.al.*, 2007). The islands in the Gulf of Mannar are classified into four major groups for management purposes.

1. Mandapam Group (7 islands): Shingle, Krusadai, Pullivasal, Poomarichan, Manoliputti, Manoli, and Hare.
2. Keezhakkarai group (7 islands): Mulli, Valai, Thalaiyari, Appa, Poovarasampatti (submerged), Valaimunai and Anaipar.
3. Vembar Group (3 islands): Nallathanni, Pulivinichalli and Upputhanni.
4. Tuticorin Group (4 islands): Kariyachalli, Vilanguchalli (submerged), Koswari and Vaan.

### **Coral reef management issues in the Gulf of Mannar**

The coastal areas in the Gulf of Mannar are highly populated and therefore stressed due to various human activities such as destructive fishing, rampant coral mining in past, and pollution from the industries along the coastal belt. Coral mining in past several decade for the lime industry, road constructions, and ornamental purposes

Status of Coral Reefs in the Gulf of Mannar Region, Tamilnadu, Southeast India

has depleted the resource base. In the early 1970's, it was estimated that the exploitation of corals was about 60,000 cubic meters (about 25,000 metric tones) per annum from Palk Bay and Gulf of Mannar together (Mahadevan and Nayar, 1972). Many poor fishermen involved in this illegal practice for their daily livelihood. The number of boats involved in mining varied with the fishing season with the highest number involved during the lean fishing season (mid-May to mid-August). However, the 2004 Indian Ocean tsunami added with programmes and projects bringing in awareness, social welfare etc. has changed the situation and coastal people now have voluntarily stopped mining and are supporting the conservation and protection of reefs.

Cyanide fishing was in practice earlier to catch reef fishes, in particular the groupers, which fetch high market prices, and ornamental fishes like clownfish, dottybacks, damsels, and surgeons. Further, a small section of fishermen were also involved in dynamite fishing using gelatin sticks to blow up the reef and kill shoaling fishes. However, strict regulations are implemented to prevent this type of fishing. The Ramanathapuram district administration and the Fisheries Department has taken harsh measures to stop dynamite fishing in the Palk Strait and the Gulf of Mannar and those using explosives to catch fish and announced that those involved in such practice would be booked under the stringent “Goondas Act” (“The Hindu” Newspaper dated 23.06.2002).



Coral mining



Mined corals in past



Shore seine operation



Trap fishing





Industrial development



Sewage disposal

Various types of destructive fishing nets such as beach seine nets, trawl nets, fish traps etc. are matter of concern as they cause big harm to the benthic environment of the Gulf of Mannar and sustainable fisheries.

Industrial pollution is another major problem in the Tuticorin coast due the discharge of untreated and partially treated effluents from industries like Tuticorin Alkali Chemicals and Fertilizers Ltd. (TAC), Southern Petrochemical Industries Corporation Limited (SPIC), Tuticorin Thermal Power Station (TTPS), Heavy Water Plant (HWP), Dharangadhara Chemical Works Limited (DCW), etc. which are bordering the coastal belt. Now the situation is slowly improving due to the strict vigil by the authorities and also adoption of new technology. However, the problems due to the domestic sewage disposal are increasing and have, to be tackled seriously if the ecological and biological health of the Gulf of Mannar is to be protected.

Population growth is also a serious concern as it adds on to the pressure on the marine ecosystem. Low literacy levels and lack of sufficient knowledge on the effects of the unsustainable resource extraction of the coral reefs among the user groups are areas of concern and deserve key focus.

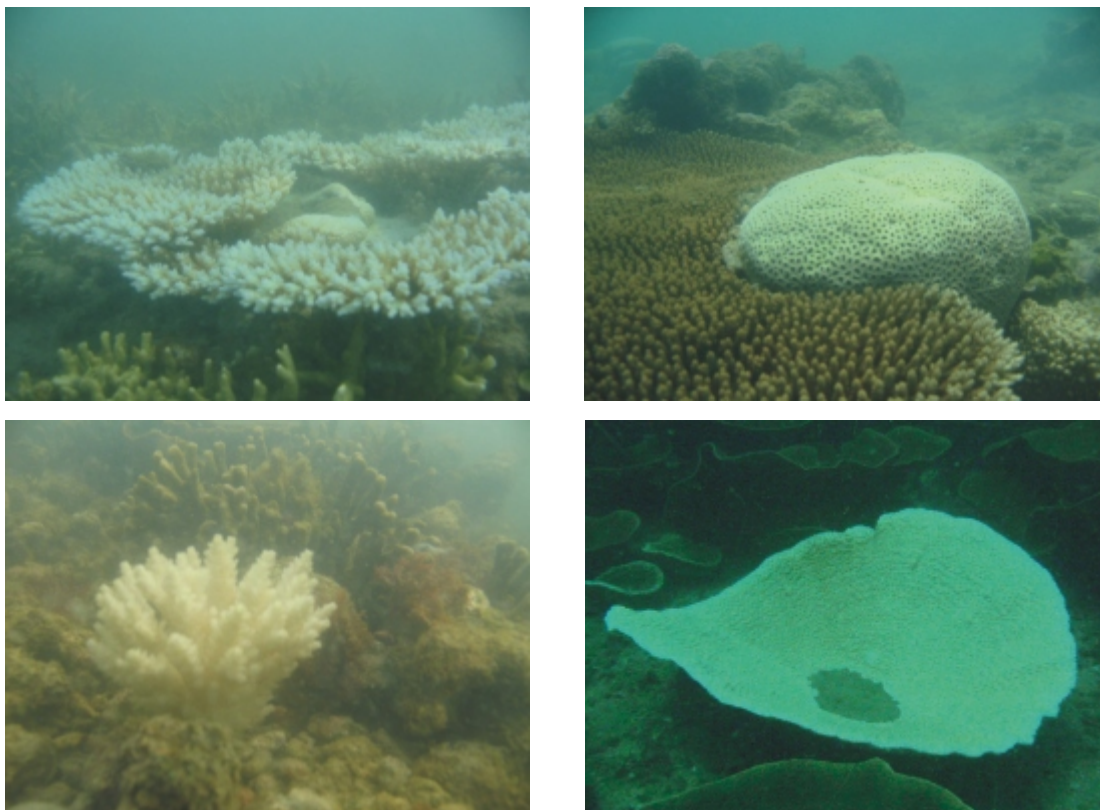
### **Current status of coral reefs of Gulf of Mannar**

The human exploitation of coral reefs for the 3 decades was very high and in addition there are also severe or minimal impacts due to natural effects such as cyclone, climate change and tsunami.

In 1964, the cyclone caused considerable damage to branching corals in Mandapam area (Pillai, 1971). It was observed that branching corals were subjected to considerable damage followed by foliose corals due to mechanical force of high waves during cyclone.

A significant rise on the surface water temperature in the Indian Ocean and elsewhere was observed during 1998, as a result of the 1997/98 El Niño Southern Oscillation (ENSO) (Wilkinson *et al.* 1999). Coral reefs over the entire Indian Ocean,

## Status of Coral Reefs in the Gulf of Mannar Region, Tamilnadu, Southeast India



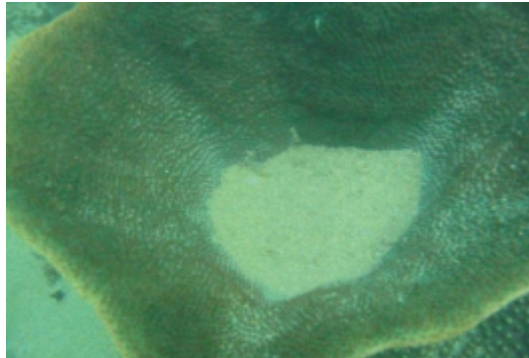
Coral bleaching

including reefs in near pristine areas were affected by bleaching as a result of the elevated temperatures. The 1998 bleaching event destroyed most shallow water corals and live coral cover was reduced by over two thirds, such that about 25% of live corals remain. The most affected were branching *Acropora* and *Pocillopora*. Massive corals now dominate on all island groups. Though bleaching impact was experienced in Gulf of Mannar (Venkataraman, 2000), subsequent studies in Tuticorin in the southern part of Gulf of Mannar, showed densely populated coral reefs and no sign of impact of the ENSO event of 1997/98 (Patterson *et al.*, 2003). There has been a further reduction in the live coral cover with more bleaching in early 2002 in shallow areas.

The post tsunami reef assessments in the Gulf of Mannar revealed that there were no significant impacts on coral reefs, associated habitats and resources apart from some minor transitional damages. Due to strong waves, a few table corals (*Acropora cytherea*) were tilted and branching corals (*Acropora intermedia* and *Acropora nobilis*) were broken. The damage was estimated to about 1-2% of the total live table corals and branching corals. Fine sand had been deposited (layers of 4-6 cm) in almost all cup corals (*Turbinaria* sp.) in patch reefs after the Tsunami. Generally 25-30% of the cup corals in



Tilted table coral due to tsunami in 2004



Deposition of sand in cup corals due to tsunami in 2004

this area were filled with fine sand (layers of 1-2 cm). In the Keezhakkarai group of islands, fragments of seaweed and seagrass were entangled with branching corals. Beach erosion had increased in two islands (Thalayari Island in Keezhakkarai group and Krusadai Island in Mandapam group) and a few trees were uprooted. However, no deposition of sand and debris on table, branching and massive corals nor on seaweed and seagrass beds could be observed here (Patterson *et.al.*, 2006).

Coral disease is another raising problem in the Gulf of Mannar. The recorded common diseases were white band, white plaque, white spot, pink spot, block spot, block band, yellow spot, yellow band and tumors. The overall disease prevalence in the



Tumor in *Acropora digitata*



White band disease in *Montipora digitata*



White plaque disease in *Porites* spp.



Pink spot disease in *Porites* spp.

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Mandapam Group of island was 8.9% (Thinesh *et al.*, 2008, in press).

The Suganthi Devadason Marine Research Institute (SDMRI), Tuticorin conducted assessment in the Gulf of Mannar during 2003-05 to collect comprehensive baseline data on the distribution, diversity and status of coral reefs and the average live coral cover during 2005 was about 36.98% (Patterson *et al.*, 2007) and it increased to 41.99% during 2008 (Patterson *et al.*, 2008). The increase of live coral cover is mainly due to various conservation and management measures, in particular the complete halt of the coral mining, reduction in the human disturbances to reef areas, increased coral recruitment, various GOMBRT initiatives and enforcement mechanism. Figs 2, 3 and 4

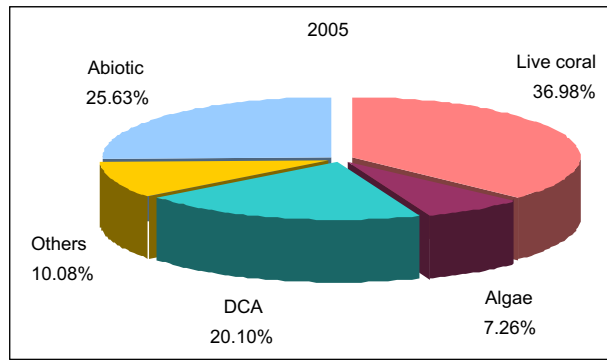


Fig 2 : Percentage of benthic assemblages in the reef areas of the Gulf of Mannar in 2005 (Source: Patterson *et al.*, 2007)

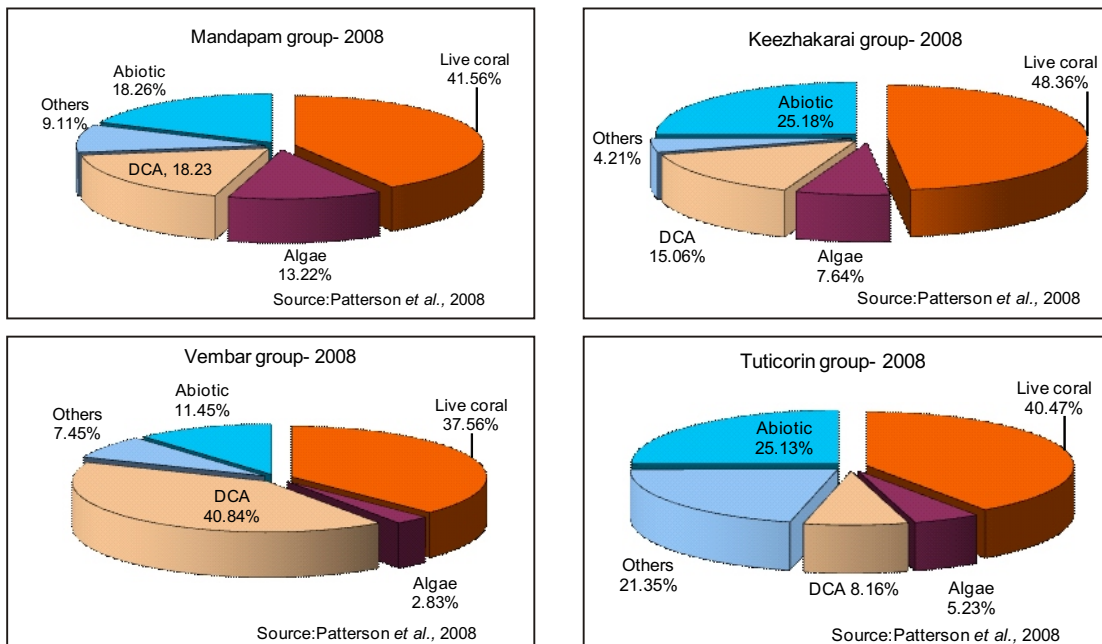


Fig. 3 : Percentage of benthic assemblages in the reef areas in four groups of islands of the Gulf of Mannar (Source: Patterson *et al.*, 2008)

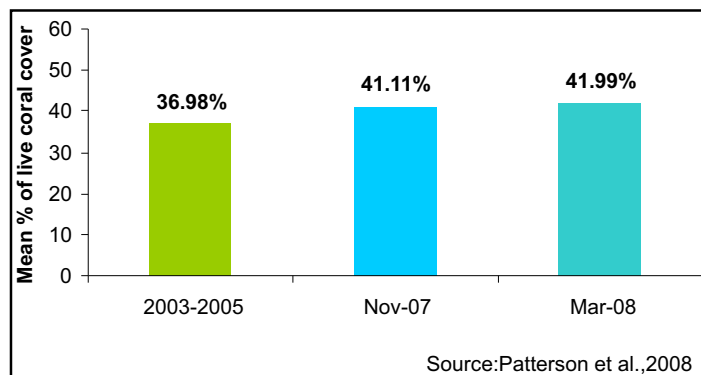


Fig. 4 : Coral status of the Gulf of Mannar during 2005 to 2008

and Table 1 explain the increase of live coral cover in the Gulf of Mannar Table 2 reveals the reef type, live coral status, coral cover direction and major coral genus in the 4 group of islands.

Table 1 : Percentage of increase of live coral cover in the Gulf of Mannar in 2008

Benthic assemblages	% in 2005	% in 2008	% of increase of live coral in 2008
Live coral	36.98	41.99	5.01
Algae	7.26	7.23	
DCA	20.1	20.57	
Abiotic	25.63	20.00	
Others	10.08	10.53	

Table 2 : Reef type, live coral status, coral cover direction and major coral genus in the 4 group of islands

	Mandapam group of islands	Keezhakarai group of islands	Vembar group of islands	Tuticorin group of islands
Reef type	Fringing and patch reef	Fringing and patch reef	Fringing and patch reef	Fringing and patch reef
Live coral status	Fair	Fair	Fair	Fair
Coral cover (direction at island groups)	Northeast & Southeastern direction	Northeast & Southeastern direction	Southeastern direction	South and southeastern direction
Major coral genus	<i>Acropora</i> , <i>Montipora</i> and <i>Porites</i>	<i>Acropora</i> and <i>Montipora</i>	<i>Acropora</i> and <i>Porites</i>	<i>Acropora</i> and <i>Porites</i>

### **Present management interventions in the Gulf of Mannar**

Of the 4 major coral reef areas in the country, the Gulf of Mannar is of the highly protective coral ecosystem in the country. The coral reefs in the Gulf of Mannar are found around the 21 islands in the Gulf of Mannar Marine National Park which extends to an area of 560 sq.km and is protected under the provisions of the Wildlife Protection Act, 1972. The total extent of reef area in the Gulf of Mannar is about 100 sq.km. The scientific studies carried out in the area have confirmed that 40% of the organisms survive in the area are dependent on the coral reef ecosystem.

India is signatory in convention on biodiversity with the mushrooming multifacility threats to the endangered marine resources. The GEF-UNDP in collaboration with Government of Tamil Nadu (GOTN), and Government of India (GOI) initiated a project on “*Conservation and sustainable use of Gulf of Mannar Biosphere Reserve's coastal bio-diversity*” in 2002. The project being a pioneering initiative in the South east Asia in involving people participation in marine resource management. The project fund supported for 7 years by GEF UNDP with parallel contribution from GOI, GOTN and other project partners. The Gulf of Mannar Biosphere Reserve Trust (GOMBRT), a registered Trust of the Government of Tamilnadu is the project implementing agency (vide GO.Ms.No.263/ E & F FR (V) Dated: 18.12.2000). The Trust is registered under Tamilnadu Society Registration Act 1975. The Trust has been established as a project implementing agency to coordinate project implementation in order to ensure effective inter-sectoral co-ordination and facilitate main streaming of bio-diversity conservation issues into the productive sector and policy development.

The overall objective of this project is to conserve the Gulf of Mannar Biosphere Reserve's globally significant assemblage of coastal biodiversity and to demonstrate in a large Biosphere Reserve with various multiple uses, how to integrate biodiversity conservation and sustainable coastal zone management and livelihood development. The focus of the project is on empowering local communities to manage the coastal ecosystem and wild resources in partnership with Government and other stakeholders and making all accountable for the quality of the resulting stewardship. Specific Government and village-level institutional capacities will be strengthened, stakeholders will apply sustainable livelihoods, and the independent, statutory Trust will ensure effective inter-sectoral co-operation in the sustainable conservation and utilization of the GOMBR's biodiversity resources. The project is attempting to evolve suitable strategies to establish an implementable design for participatory marine biodiversity conservation and sustainable aid in marine resource management in the Gulf of Mannar as a model which can later be adopted in many other parts in the country and across the globe. The four important thrust areas of the project are as follows:

- Strengthening the capacity and infrastructure of the Gulf of Mannar Marine National Park for its enhanced conservation and management.
- Base line research and monitoring on key ecological, biological, environmental and managerial aspect of Gulf of Mannar Biosphere Reserve.
- Building capacity of various groups of stakeholders
- Eliciting local communities participation in conservation and sustainable marine resource use through use through building awareness, capacity & skill, organizing local communities at the grass route level, empowering the communities to take judicious decisions for adopting alternate / enhanced livelihood options and to bring down the pressure on the fisheries resources.

Coral reefs being important ecologically sensitive ecosystems of the Gulf of Mannar, efforts of the Trust and its initiative are equally focused on coral reef conservation through the process of stakeholder participation, understanding the need of conservation and imbibing a sense of ownership of the Gulf of Mannar and its resources among the stakeholders. 252 grassroot level organizations Village Marine Conservation and Eco Development Committees (VMC & EDC's) have been established within the 10 km landward zone from Rameswaram in Ramanathapuram district to Periyathalai in Tuticorin district. A foundation has been laid for a vibrant start of participatory marine biodiversity conservation in the Gulf of Mannar under the project (Sreedharan and Melkani, 2006).

The capacity building of line department officials and field staff of the Gulf of Mannar area marine biodiversity and the enforcement officials and field staff in the identification of scheduled marine animals proved to be very effective in the ongoing conservation and management process of the coral reef ecosystem.

The year 2008 is declared as the International Year of the reef (IYOR) and awareness creation among the coastal community and school children through various activities such as workshops, television media campaign, posters, brochures etc. in enhancing the awareness level about the coral reefs among all stakeholders which will help the conservation management efforts.

A project to monitor the coral reef areas in the Gulf of Mannar Marine National Park and comparing information as are already available to understand the changing trends has been initiated by the Trust. The SDMRI, Tuticorin, has undertaken this task of coral reef monitoring in all islands, wherein GOMBRT is supporting the monitoring activity in the 10 islands (Pullivasal, Manoliputtui, Valai, Poovarasampatti, Vallimunai, Nallathani, Puluvinichalli, Upputhani, Vilanguchalli and Koswari) and the monitoring is ongoing.

### **Coral reef restoration a viable management tool**

Coral reef restoration is considered as one of the viable management tool in rehabilitating degraded reef areas to the near original state and also to support the natural coral recovery process. The coral restoration efforts were first initiated in the Tuticorin coast of the Gulf of Mannar by SDMRI in 2002 with the support from the Ministry of Environment and Forests, GOI and Coral Reef Degradation in the Indian Ocean (CORDIO), Sweden. The feasibility of coral restoration was studied and techniques were standardized by SDMRI (Patterson, 2005; Mathews and Patterson, 2005; Patterson *et al.*, 2005, 2006; Patterson *et al.*, 2008)

Patterson *et al.*, (2008) described in detail that various native coral species were successfully restored on artificial substrates such as concrete frames and fish houses with high survival and growth. Over 1 sq.km of coral reefs has been restored through coral transplantation in the Tuticorin coast of the Gulf of Mannar since 2002. The overall survival of the restored corals is 85-90% and the annual growth varied between 9.0 13.5 cm for branching corals (*Acropora intermedia*, *A. cytherea*, *A. nobilis*, *A. formosa*,



Coral restoration on concrete frame



Coral restoration on Fish house



*Montipora foliosa*) and 1.5-2.0 cm for non-branching corals (*Favia* sp., *Turbinaria* sp. *Porites* sp.) The experiences from the SDMRI's ongoing coral restoration study since 2002 support that the coral restoration with comparatively low cost transplantation method using suitable artificial substrates, fragments of native species, precise standardized techniques and regular monitoring would help to restore larger degraded reef areas and further to support the natural recovery process in the Gulf of Mannar. The study also reveals that the observation of matured gametes in some restored corals is a good sign for the successful reproduction and subsequently new recruitment. It is also important to note that the contribution of fragments from the restored corals after 2 years would help to reduce / avoid dependence on donor natural reefs.

### **Conclusion**

Occupying less than 0.2% of the ocean floor, coral reefs support around 25% of ocean's floral and faunal diversity. Reefs are highly complex, diverse, beautiful but equally fragile and sensitive ecosystem. The present and future role and values of coral reef for sustained fisheries, coastal protection, conservation of marine biodiversity and global biochemical cycles need to be respected and acknowledged by all stakeholders. We have to sincerely try and bring out ways and means to contain and curb the plethora of unsustainable and unhealthy practices which are equally prevalent in the Gulf of Mannar region and impose greater threats to coral reef in order to bring a fresh lease of life to this wonderful creation of nature. The future health of coral reefs will ultimately affect not only the ecological process, biological assemblages but also the socio-economics of coastal communities and their welfare

### **Acknowledgement**

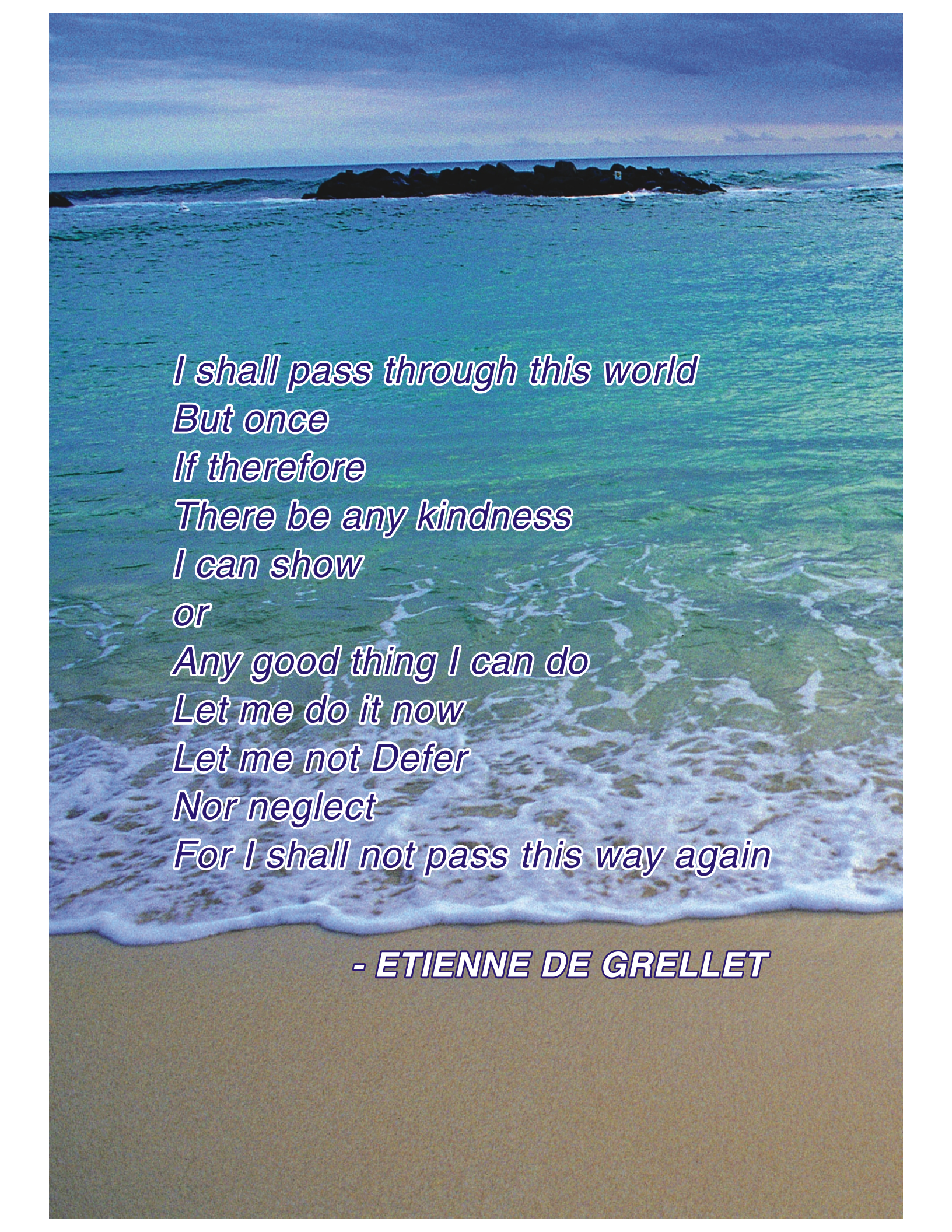
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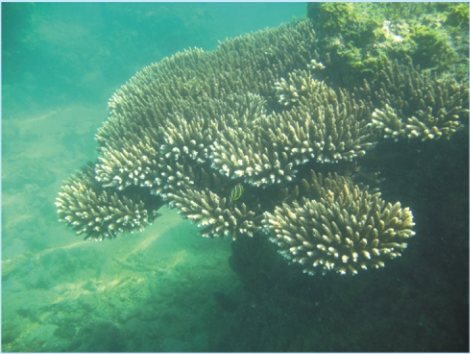
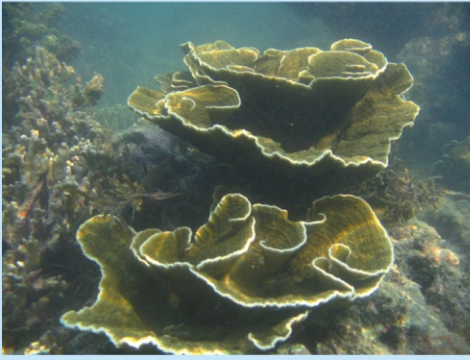
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*I shall pass through this world  
But once  
If therefore  
There be any kindness  
I can show  
or  
Any good thing I can do  
Let me do it now  
Let me not Defer  
Nor neglect  
For I shall not pass this way again*

***- ETIENNE DE GRELLET***



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