

# **Rapid assessment of status of corals in Gulf of Mannar after tsunami**

## **Report**

**By**

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### INTRODUCTION

The Gulf of Mannar (GoM) (Fig.1), which is the first Marine Biosphere Reserves established in India, lies between India and Sri Lanka, and covers an area of about 10,500 sq.km. It includes 21 coral islands located between 8° 46' and 9° 14' N latitude and 78° 9' and 79° 14' E longitude. Each island has its unique characteristics, surrounded by coral reefs with rich faunal and floral diversity. There 104 coral species recorded in GoM (Patterson *et.al.*, 2004). Coral reefs are the most diversified and complex marine ecosystems, and the reefs of GoM are one of the greatest natural treasures. The islands in the Gulf of Mannar are classified into 4 major groups:-

1. Mandapam Group (7 islands): Musal, Manoli, Manoliputti, and Poomarichan Pullivasal, Krusadai and Shingle.
2. Keezhakkarai group (7 islands): Yaanaipar, Vallimunai, Poovarasanputti, Appa, Thalaiyari, Vaalai and Mulli.
3. Vembar Group (3 islands): Upputhanni, Pulivinichalli and Nallathanni.
4. Tuticorin Group (4 islands): Vaan, Koswari, Kariyachalli and Velanguchalli.

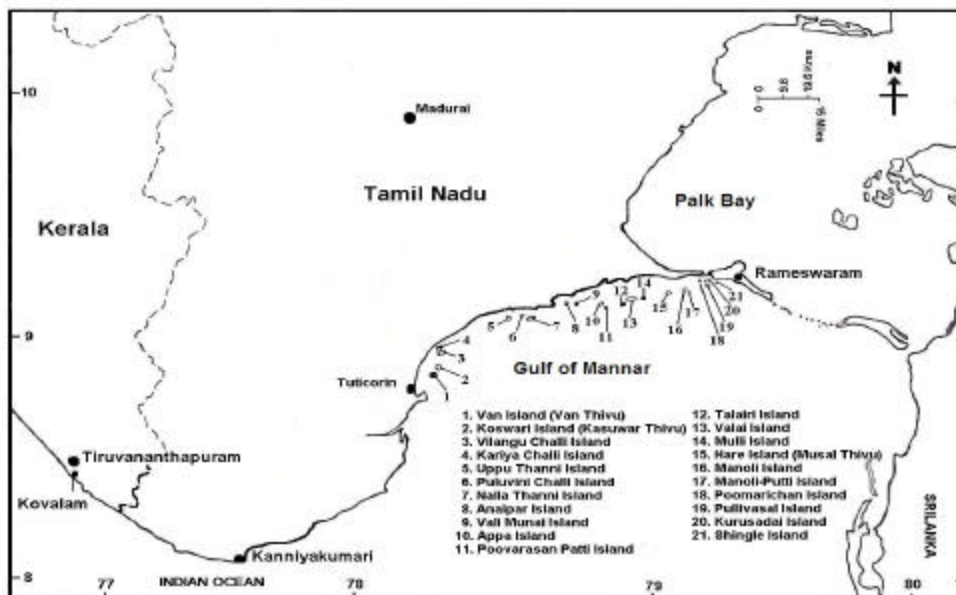


Fig.1. Map showing Gulf of Mannar

## **BACKGROUND**

Tamil Nadu coast in Southeast India was worst affected during the recent tsunami aggression on 26.12.2004. The coastal areas in the districts such as Chennai, Cuddalore, Nagapatinam Kanyakumari were seriously affected, whereas Tuticorin was partially affected. It was feared that the effects of the tsunami would have caused serious short and long term damages to the coral ecosystem in Gulf of Mannar, including loss of habitat and nursery grounds, mechanical damage etc. Therefore a rapid assessment was conducted to assess the environmental consequences of the disaster on the status of corals and associated habitat in Gulf of Mannar. SDMRI has been involved in reef surveys and reef restoration activities in Gulf of Mannar since 2002 and have completed surveys in three island groups (Tuticorin, Vembar and Keezhakkarai), and on the mainland patchy reef near the harbour area. Therefore, the data generated through this rapid assessment has been compared to assess the impacts in this ecosystem due to the tsunami.

The Suganthi Devadason Marine Research Institute - Reef Research Team (SDMRI-RRT), comprising five research and two supporting members, had initiated the rapid assessment a week after the tsunami, from 04.01.2005 to 10.01.2005.

## **OBJECTIVES**

- Rapid assessment of status of corals in Gulf of Mannar after the tsunami.
- To compare the data with earlier available baseline information to assess the impacts of tsunami on the degree of cover, and composition of live corals and associated benthic organisms, and selected physico-chemical parameters.

## **METHODS**

### **Study sites:**

The following 11 out of 21 island sites were randomly selected for the assessment. One site in mainland patchy reef was also assessed.

1. Vaan Island (Lat. 8° 49'N, Long. 78° 12'E)
2. Kariyachalli Island (Lat. 8° 56'N, Long. 78° 15'E)
3. Upputhanni Island (Lat. 9° 05'N, Long. 78° 30'E)

4. Pulivinichalli Island (Lat. 9° 06'N, Long. 78° 32'E)
5. Yaanaipar Island (Lat. 9° 09'N, Long. 78° 41'E)
6. Vali Munai Island (Lat. 9° 09'N, Long. 78° 43'E)
7. Thalaiyari Island (Lat. 9° 11'N, Long. 78° 56'E)
8. Mulli Island (Lat. 9° 11'N, Long. 78° 58'E)
9. Poomarichan Island (Lat. 9° 14'N, Long. 79° 13'E)
10. Krusadai Island (Lat. 9° 14'N, Long. 79° 13'E)
11. Shingle Island (Lat. 9° 14'N, Long. 79° 14'E)
12. Mainland Patchy Reef Near Habroure Area (Lat. 8° 43'N, Long. 78° 11'E)

### **Survey methods:**

#### General observations:

In each site, a qualitative visual assessment was conducted in order to estimate the mechanical damage, deposition of debris, sand, silt, rubble, as well as impacts on the diversity of benthic organisms and fish.

#### Line Intercept Transect (LIT):

The benthic composition was assessed using Line Intercept Transect (LIT) techniques following English et al. (1997). At each site, 2-3 transects were laid on the reef parallel to the island shore.

#### Physico-chemical measurements:

Water temperature was measured using thermometer. The transparency of the water was assessed using secchi disc. Salinity and pH were measured using refractometer and pH meter. The dissolved oxygen was measured using Winkler's method. Concentrations of nutrients such as calcium, magnesium, phosphate, nitrate and nitrite were measured following standard methods.

## RESULTS AND DISCUSSION

### Tuticorin Group of Islands:

#### Physico-chemical parameters:

Surface water temperature ranged between 26°C and 28°C; Transparency from 1.2 to 3 metre; Dissolved oxygen content varied between 4.7 and 4.9 ml/l; Salinity between 32 and 33 ppt; pH was 7.5; and the variation in nutrient content was calcium (390-400 mg/l), magnesium (1467-1612 mg/l) phosphate (0.18-0.22 µg/l), nitrate (0.46-0.53 µg/l) and nitrite (0.02 µg/l).

#### General observations:

No significant damage to status of corals;

The water was clear without turbid nature;

No unusual water currents;

Due to strong waves during tsunami few table corals (*Acropora cytherea*) were tilted and few branches of another species (*Acropora intermedia*) broken;

Gravel sand seafloor near the reef area was replaced by about 1 cm thick fine sand.

No sand or other debris deposited on the branching and massive corals; and

No impact on sea grass beds near the reef areas, but due to strong wave action more sea grass fragments were washed ashore.

*Reef Fish Diversity:* Common reef fishes such as Snapper (*Lutjanus* sp.), Jacks (*Carangoides malabaricus*), Emperor Breams (*Lethrinus* sp.), Rabbit fishes (*Siganus canaliculatus*), Parrot fishes (*Scarus ghobban*), Groupers (*Epinephelus* sp.), Spiny Lobsters (*Panulirus homarus*), Cuttlefish (*Sepia pharaonis*), Eels, Goat fish (*Parupeneus indicus*) and Soldier fishes (*Sargocentron rubrum*) were found in abundance as usual in reef area.

#### Line Intercept Transect:

Five LITs (Vaan – 2 and Kariyachalli –3) were laid on the coral reef area and the results show that the Tuticorin Group has 40.18% live coral cover, 16.17% DCA (Dead coral with algae), 34.3% Abiotic (sand and rubbles), 3.77% Algae and 5.58% Others (sponges and soft corals).

## ***Vembar Group of Islands:***

### *Physico-chemical parameters*

Surface water temperature ranged between 26°C and 27°C; Transparency from 1.8 to 2.2 metre; Dissolved oxygen content varied between 4.7 and 5.2 ml/l; Salinity between 32.6 and 33 ppt; pH was 7.5-8; and the variation in nutrient content was calcium (640-680 mg/l), magnesium (1164-1299 mg/l) phosphate (3.24-4.05 µg/l), nitrate (0.27-0.38 µg/l) and nitrite (0.03 µg/l).

### *General observations:*

No significant damage to status of corals;

The water was clear without turbid nature;

No unusual water currents;

Due to strong waves few branches of species (*Acropora nobilis*) were broken and seagrasses found to be entangled on some live table and branching corals (*Acropora* sp.);

No sand or other debris deposited on the branching and massive corals; and

No impact on sea grass and seaweed beds near the reef areas, but due to strong wave action more fragments were washed ashore / entangled with branching corals.

*Reef Fish Diversity:* Common reef fishes such as Snapper (*Lutjanus* sp.), Emperor Breams (*Lethrinus nebulosus.*), Butterfly fishes (*Cheatodon* sp.) Groupers (*Epinephelus* sp.), and Bulls eyes (*Pempheris analis*) were found as usual in reef area.

### *Line Intercept Transect:*

Four LITs (Upputhanni – 2 and Pulivinichalli – 2) were laid on the coral reef area and the results show that the Vembar Group has 36.02% live coral cover, 34.55% DCA (Dead coral with algae), 12.81% Abiotic (sand and rubbles), 12.3% Algae and 4.31% Others (sponges and soft corals).

### ***Keezhakkarai Group of Islands:***

#### *Physico-chemical parameters:*

Surface water temperature ranged between 26°C and 27°C; Transparency from 2.2 to 2.4 metre; Dissolved oxygen content varied between 5.2 and 5.7 ml/l; Salinity between 32.7 and 33 ppt; pH was 7.5-8; and the variation in nutrient content was calcium (600-720 mg/l), magnesium (1276-1321 mg/l) phosphate (0.34-1.83 µg/l), nitrate (0.59-0.61 µg/l) and nitrite (0.01-0.02 µg/l).

#### *General observations:*

No significant damage to corals;

The water was in normal condition without turbid nature;

No unusual water currents;

Due to strong waves more seagrasses and seaweeds were found to be entangled on some live table and branching corals (*Acropora* sp.); much seaweed fragments were found scattered on the reef area.

Due to soil erosion in island area (Thalaiyari), the trees were found to be affected and some were uprooted.

No sand or other debris deposited on the branching and massive corals; and

No impact on sea grass and seaweed beds near the reef areas, but due to strong wave action more fragments were washed ashore / entangled with branching corals.

*Reef Fish Diversity:* Common reef fishes such as Parrot fishes (*Scarus ghobban*), Rabbit fishes (*Siganus* Sp.), Surgeon fishes (*Acanthurus* sp.), Snappers (*Lutjanus russelli*), Jacks (*Carangoides malabaricus*), Emperor, Breems (*Lethrinus nebulosus*), and Butterfly fishes (*Chetodon* sp.) were found in abundance as usual in reef area.

#### *Line Intercept Transect:*

Twelve LITs (Yaanaipar – 3, Vali Munai – 3, Thalaiyari – 3 and Mulli – 3) were laid on the coral reef area and the results show that the Keezhakkarai Group has 48.63% live coral cover, 34.52% DCA (Dead coral with algae), 7.62% Abiotic (sand and rubbles), 7.05% Algae and 2.17% Others (sponges and soft corals).

### ***Mandapam Group of Islands:***

#### *Physico-chemical parameters:*

Surface water temperature ranged between 26°C and 27°C; Transparency from 0.8 to 1.2 metre; Dissolved oxygen content varied between 4.2 and 5.3 ml/l; Salinity between 32.6 and 33 ppt; pH was 7.5-8; and the variation in nutrient content was calcium (640-720 mg/l), magnesium (1232-1388 mg/l) phosphate (3.24-4.05 µg/l), nitrate (0.43-0.73 µg/l) and nitrite (0.01-0.03 µg/l).

#### *General observations:*

No significant damage to corals;

The water is normal as usual without turbid nature;

No unusual water currents;

Soil erosion noticed between the mainland and Krusadai Island;

No sand or other debris deposited on the branching and massive corals; and

No impact on sea grass and seaweed beds near the reef areas.

*Reef Fish Diversity:* Common reef fishes such as Parrot fishes (*Scarus* sp.), Snappers (*Lutjanus russelli*, *L. lunulatus*), Jacks (*Carangoides malabaricus*), Emperor, Breams (*Lethrinus* sp.), Rabbit fishes (*Siganus canaliculatus*), Groupers (*Epinephelus* sp.), and Soldier fishes (*Sargocentron rubun*) were found in abundance as usual in reef area.

#### *Line Intercept Transect:*

Five LITs (Poomarichan – 2, Krusadai – 1 and Shingle – 2) were laid on the coral reef area and the results show that the Mandapam Group has 32.33% live coral cover, 42.55% DCA (Dead coral with algae), 9% Abiotic (sand and rubbles), 9.07% Algae and 7.04% Others (sponges and soft corals).

### ***Mainland Patchy Reef:***

#### *Physico-chemical parameters:*

Surface water temperature was recorded as 27°C; Transparency 2.4 metre; Dissolved oxygen content 5.9 ml/l; Salinity 34 ppt; pH 8; and nutrient content was

calcium (440 mg/l), magnesium (1612 mg/l) phosphate (1.43 µg/l), nitrate (0.84 µg/l) and nitrite (0.04 µg/l).

General observations:

No significant damage to corals;

The water is clear without turbid nature;

No unusual water currents;

Due to strong waves during tsunami few branches of branching coral (*Acropora intermedia*) broken;

The mainland patchy reef is dominated by cup corals (*Turbinaria* sp.);

Normally 25-30% *Turbinaria* sp. are filled with fine sand about 1-2 cm depth depends on the cup shape;

After tsunami, almost all *Turbinaria* corals are filled with fine sand about 4-5 cm depth;

No impact on sea grass beds near the reef areas, but due to strong wave action more sea grass fragments were washed ashore.

*Reef Fish Diversity:* Common reef fishes such as Snapper (*Lutjanus* sp.), Jacks (*Carangoides malabaricus*), Emperor (*Lethrinus nebulosus*), Parrot fishes (*Scarus ghobban*), Groupers (*Epinephelus* sp.), Soldier fishes (*Sargocentron rubrum*) and Butterfly fishes (*Chetodon* sp.) were found as usual in reef area.

Line Intercept Transect:

Three LITs were laid on the coral reef area and the results show that the mainland patchy reef has 75.92% live coral cover, 9.77% DCA (Dead coral with algae), 13.4% Abiotic (sand and rubbles), Algae (nil) and 0.92% Others (sponges and soft corals).

**Reef Restoration and Artificial Reef Sites:**

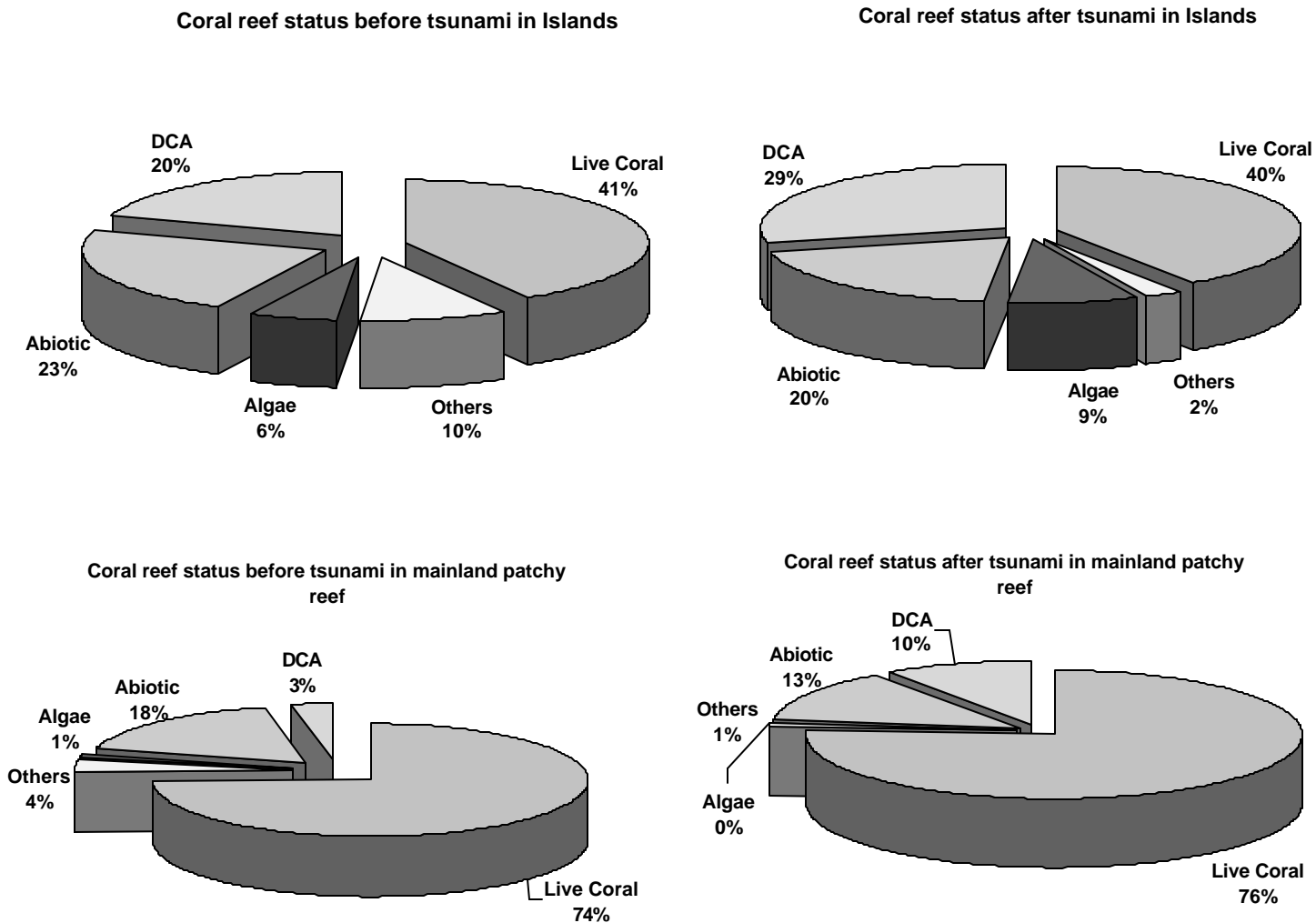
In 2001, SDMRI, as the first institution in India, initiated reef restoration efforts through coral transplantation. The concrete frames and fish houses (made of waste building debris) were used as substrates for transplantation. No tsunami impact on corals was noticed at the reef restoration sites except for a few transplanted coral colonies that had fallen from the base of concrete frames due to strong waves. There is no sand deposition on these sites and the faunal assemblages in these areas are as

usual. As before the tsunami event, reef fishes such as Butterfly fishes (*Chetodon* sp.), Groupers (*Epinephelus* sp.), Emperors (*Lethrinus nebulosus*), Snappers (*Lutjanus* sp) and Wrasses (*Bodianus* sp.) were recorded in the restoration site.

SDMRI has also involved in Artificial Reef (AR) research since 2002. AR modules (constructed using Ferro cement and Fly Ash) have been deployed in Tuticorin coast and there is no tsunami impact noticed in these sites. There is no sand or debris deposited on these modules and the faunal assemblages in these AR sites are as usual. Usual associated reef fishes such as Butterfly fishes (*Chetodon* sp.), Groupers (*Epinephelus* sp.), Jacks (*Carangoides malabaricus*), Parrot fishes (*Scarus ghobban*), Puffer fishes (*Arothron mappa*, *Canthigaster* sp.), Soldier fishes (*Sargocentron rubrum*), Rabbit fishes (*Siganus* sp.) Goat fishes (*Parupeneus* sp.), Bulls eyes (*Pempheris* sp.), Emperors (*Lethrinus nebulosus*), Snappers (*Lutjanus russelli*, *L. lunulatus*) and Wrasses (*Bodianus* sp.) were recorded in the restoration site.

### **All sites**

SDMRI conducted reef surveys in Tuticorin, Vembar, Keezhakkarai Group of Islands and Mainland patchy reef in Tuticorin during 2002-2004. Comparisons between pre and post tsunami data show no significant differences in amount of average live coral cover. Average degrees of coverage of the different benthic categories before and after the tsunami, including all investigated sites, are provided in Figure 2. In case of Mandapam Group of Islands, SDMRI has no data to compare, but the present assessment suggests that the tsunami has not affected the reef ecosystem to any significant degree. Also, SDMRI's reef restoration and artificial reef sites were not affected.



**Fig.2: Percentage coverage of main benthic categories before and after the tsunami**

**SALIENT OBSERVATIONS**

- Tsunami impact has been observed in the coastal region in Gulf of Mannar.
- In general, there is no significant impact on corals, associated habitat and resources due to tsunami.
- No impact on reef associated fishes.
- Soil erosion has been noticed in two islands (Thalaiyari Island in Keezhakkarai Group and Krusadai Island in Mandapam Group).

- No unusual currents were noticed.
- Due to strong waves few table corals (*Acropora cytherea*) were tilted and branching corals (*Acropora intermedia*, *Acropora nobilis*) were broken. The damage was estimated to about 1-2% of the total live table and branching corals.
- Fine sand deposited (4-6 cm) in almost all cup corals (*Turbinaria* sp.) in mainland patchy reef after tsunami. Generally, 25-30% of cup corals in this area are filled with fine sand (layers of 1-2 cm).
- Fragments of seaweed and seagrass had been washed ashore due to strong waves, and in some areas (Keezhakkarai group) the fragments were entangled with branching corals (*Acropora* sp.).
- No deposition of sand and debris on table, branching and massive corals nor on the seaweed and seagrass beds.
- Water visibility was normal.
- No impact was recorded at reef restoration and artificial reef sites.

## REMARKS

In general, Tsunami impact has been observed in the coastal region in Gulf of Mannar. However, no significant impact was noticed on reefs, associated habitat and resources in Gulf of Mannar except minor transitional damages.

## REFERENCES

1. English. S, Wilkinson. C, Baker. V (eds). 1997. Survey manual for Tropical Marine Resources. Published by Australian Institute of Marine Science: 390 pp.
2. J.K. Patterson Edward, Jamila Patterson, M. Venkatesh, G. Mathews, C. Chellaram and Dan Wilhelmsson (2004). A field guide to stony corals (Scleractinia) of Tuticorin in Gulf of Mannar, Southeast India, 80 pp.

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