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## STATUS OF CORAL REEFS IN GULF OF MANNAR BIOSPHERE RESERVE

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### INTRODUCTION

The ever-increasing human pressure on the coastal zone to meet the needs of the growing coastal population has resulted in the rapid decline of biodiversity and biomass of the coastal ecosystems worldwide. “Gulf of Mannar Biosphere Reserve” (GoMBR) situated along the southeast coast of India, comprises of a collection of 21 small islands with fringing reefs built on shallow shores of these islands (Fig. 1). They are arranged in the form of a chain between 8°46' and 9°14' N Latitude and 78°9' and 79°14' E Longitude from Mandapam in the north to Tuticorin in the south. This area is remarkable for its faunal and floral wealth, especially the coral reefs and its associates (Thurston, 1890, 1895, Graveley, 1927 and Pillai, 1996).

Typically, coral reefs contain a number of specialized species representing almost all groups of marine animals. The holes and crevices in the reefs provide abundant shelter for fishes and invertebrates and are important for fish nurseries. The reefs of GoMBR have a variety of seaweeds, plenty of sacred chanks (*Turbinella pyrum*), butterfly chanks, pipefishes, sea horses, pearl oysters, corals and gorgonids, the famous sea cow (*Dugong dugon*) and the balanoglossus (*Ptychodera flauva*).

Of the approximate 600,000 km<sup>2</sup> of coral reef worldwide, it is estimated that about 10 percent have already been degraded beyond recovery and another 30 percent are likely to decline significantly within the next 20 years (Wilkinson, 2000). Wilkinson (2000) noted that all Indo-Malayan reefs, except those in Australia are in critical or threatened condition – categories applied to reefs that are likely to collapse within the next 40 years, if conservation and management measures are not properly implemented. Only fringing and patch reefs are present in the intertidal regions of GoMBR.

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KEY WORDS : Coral reefs, status, Gulf of Mannar Biosphere Reserve.

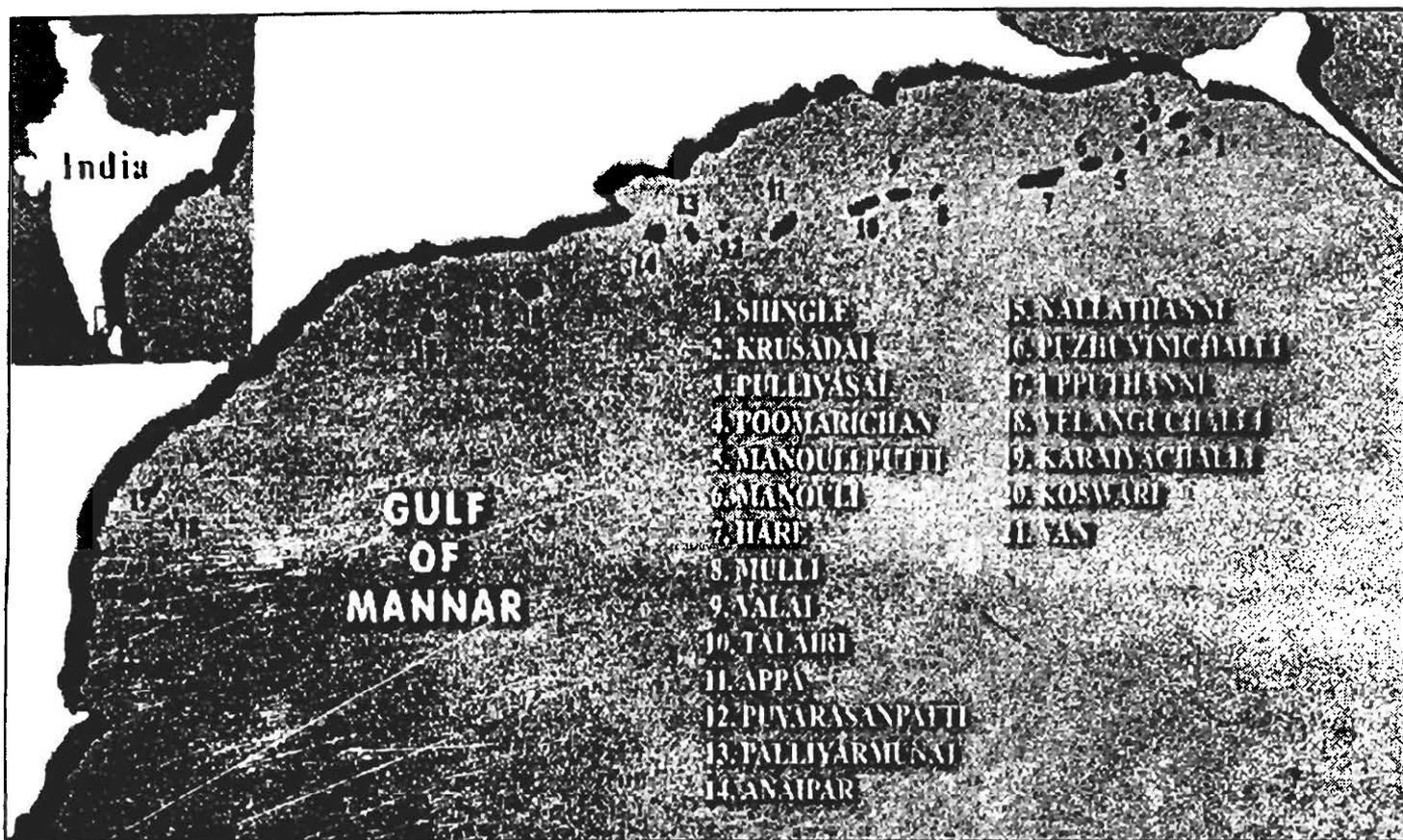


Fig. 1. : Map showing the location of 21 islands of Gulf of Mannar Biosphere Reserve.

The lagoon (the area between the coral reef and the shore) in these islands is shallow, and can be waded during low tides. The intertidal region of Gulf of Mannar islands is sandy and muddy.

Although many have documented the richness of this area qualitatively, the quantitative data on fauna and flora of this region, which is very much needed for effective management of this unique ecosystem, is lacking. Therefore, the present study on the status of the coral reefs was conducted in all the 21 islands of GoMBR.

### MATERIAL AND METHODS

Depending upon the proximity to a major town, the 21 islands of GoMBR were divided into three groups (Mandapam, Keelakarai and Tuticorin) (Fig. 1). The present study was carried out in three different phases. In the first phase seven islands of Mandapam group of GoMBR starting from Shingle Island in the north to Hare Island in the south were surveyed in June 1998 initially keeping Mandapam as base camp. In the second phase another seven islands belonging to Keelakarai group from Mulli Island in the north to Anaipar Island in the south were surveyed in October to November 1998 keeping Mandapam and Ramanathapuram as base camps. The remaining seven islands belonging to Tuticorin group starting from Nallathanni Island in the north to Van Island in the south were surveyed in May 1999 keeping Ramanathapuram and Tuticorin as base camps.

Each Island was surveyed using “Manta tow” study method before laying the 50 m Line Intercept Transect (LIT) to find out the location of the coral reef, sea grass bed and general nature of the intertidal region. After confirming the location of the reef area, a 50 m transect (LIT) was laid using a 50 m plastic tape using iron nails as hold. Underwater slates were used to collect data using snorkeling equipment, the intercepts were noted down. The same procedure was repeated in all the 21 islands of GoMBR.

### **LINE INTERCEPT TRANSECT (LIT)**

Line Intercept Transect is used to collect data on the Coelenterata, Mollusca, Crustacea, Echinodermata and other corals and coral reef associated organisms (English *et al.*, 1997). This method is used mainly wherever coral reefs are present and are more than 50 m away from the shore. Coral reefs and the associated fauna are part of the intertidal community, other than the fauna present in the sandy bottom. These communities are characterised by life form categories, which will provide a clear description of the reef community of the intertidal coral reefs and other associated fauna mentioned above.

The LIT is used to estimate the life form cover of the coral reef (present status) and also the reef associated organisms within a specified area by calculating the length of the line that is intercepted by the object (different coral species, Mollusca, Echinodermata and others). This measure of cover is expressed as a percentage, which is considered to be an unbiased estimate of the proportion of the total area covered by that coral reef and associated organisms provided the size of the coral reef fauna is relative to the length of the line and that length of the line is small relative to the area of interest.

### **LIFE FORM CATEGORIES**

The following are the different life form categories used in the present study. These categories and the symbols were much useful in conducting the under water studies. The method used in calculating the life form categories are following English *et al.*, (1997).

#### **DEAD CORALS**

DC – recently dead, white or yellow, no algae

DCA – dead coral covered with algae

#### **ACROPORA CORALS**

ACB – Secondary branching, axial polyp

ACE – Encrusting with distinct polyp

ACS – Columnar, distinct polyps, sub massive

ACD – finger like, axial polyp, no secondary branching

ACT – looks like a table, flat profile

**NON-ACROPORA CORALS**

- CB – secondary branching, no axial polyp
- CE – attached to substrate at various points; margin very thin, encrusting
- CF – vertical and/or horizontal plates, foliose
- CM – boulder or mound shape; margin thick, massive
- CSM – with knobs, thickened branches or columns, sub massive
- CMR – free-living solitary, mushroom corals
- CHL – deep brown, smooth, blue colour, blue coral
- CME – mustard yellow, smooth, fuzzy appearance, fire coral
- CTU – polyps look like daisies, stacked pipe skeleton, Organ pipe coral

**ALGAE**

- AA – a non-distinct mass of algae
- CA – encrusting, red or pink, sometimes like leaves
- HA – hard, green, triangle-shaped, stacked, halimeda
- MA – >5 cm, brown, green, red, macro algae
- TA – <5 cm, >1 cm, forms carpet on substrate, turf algae

**OTHER FAUNA**

- SC – soft or leathery, brown or colourful, soft coral
- SP – varied shapes, colour and sizes, look out for ostiole, sponges
- ZO – looks like a clump of small anemones with 2 rings of tentacles, Zoanthids
- OT – any other fauna like gorgonians, anemones, octopus, Holothuria, seagrass

**ABIOTIC**

- S – settles immediately when stirred, sand
- R – broken pieces of coral, <15 cm rubble
- SI – forms a cloud when stirred, silt
- WA – crevice, cracks >50 cm, water
- RCK – non-coral origin like stones, granites

**DATA ANALYSIS**

Summary of data showing percentage cover and number of occurrences of each life form is calculated using the Line Intercept Transect data. After calculating intercept (length) from the

transition points recorded along the transect, percentage cover of a life form category is calculated as follows.

$$\text{Percent cover} = \frac{\text{Length of category} \times 100}{\text{Length of Transect}}$$

This analysis will provide quantitative information on the community structure of the sample sites. Successive samples can also be compared from different areas of the coral reef.

## RESULTS

### MANDAPAM GROUP OF ISLANDS

(Figs. 1–3)

The following seven islands, which are located close to Mandapam town, were categorised as Mandapam group of islands *viz.* 1. Shingle, 2. Krusadai, 3. Pullivasal, 4. Poomarichan, 5. Manāliputti, 6. Manāuli and 7. Muyal or Hare Island.

1. **Shingle Island** : The Shingle Island is situated near Pamban (9°15' N Lat. and 79°14' E Long.) and has an area of 13 ha. This island was composed of coral rubbles on the reef patch. Extensive coral reefs were found on the northeastern side as well as on the eastern side of the island. Two 50 m LIT were laid parallel to the shore, one on the eastern side and other on the northeastern side of the island. The results showed that, the eastern side of the reef contained 19% ACB, 4% CB, 16% CF, 32% CSM and 29% DC. The northeastern side of the reef contained 0.4% CM, 97.6% DC and 2% CSM.

2. **Krusadai Island** : Krusadai Island (9°14' N Lat. and 79°13' E Long.) is situated near the Mandapam and Pamban of Rameswaram Island. The coral reefs in the island and the shallow lagoon between the reef and the shore formed excellent sites for collection of various kinds of flora and fauna. The southeast side of the Krusadai Island is called "Galaxea Reef" This reef was composed of dead corals with holes and crevices covered with seaweeds and algal growth. The coral reefs on the western part of the southern side contained luxuriant growth of corals and during the study period it was in critical condition. LIT was laid on the southern side of the island reef and the results showed that the reef contained 4% ACB, 1% CF, 23% CM, 17% CSM, 3% R and 52% DC.

3. **Pullivasal Island** : This Island (9°14' N Lat. and 79°11' E Long.) spreads over an area of 30 ha. The coral reefs were found only in southern shore and it extended to about 300 m from the shore. During low tide, the coral reefs were exposed and the most dominant coral species present was *Montipora* sp. Most of the exposed reefs were dead. The present observation revealed that all the *Montipora* sp. were found to be bleached, and the reef contained mostly dead corals.

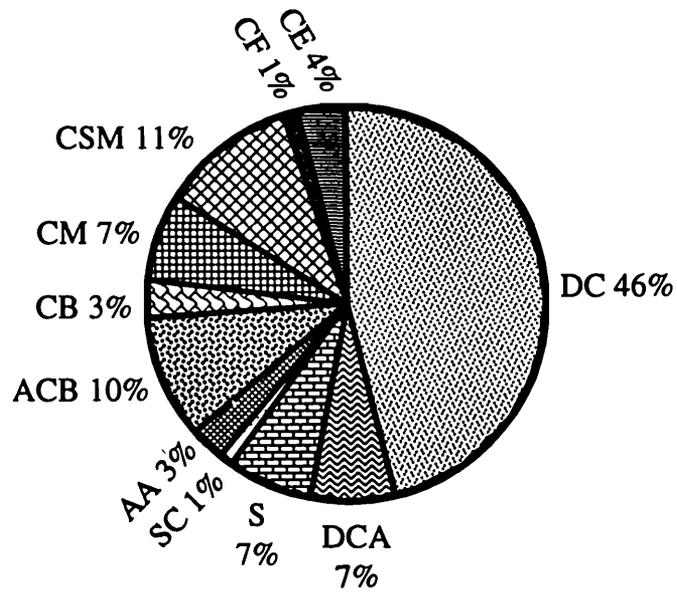
4. **Poomarichan Island** : The Poomarichan Island is also called as Pulli Island (9°14' N Lat. and 79°11' E Long.) and it covers an area of 17 ha. Coral reefs were found only on the southern, western and northern side of the island. In the southern side dead coral beds were observed and in the northern part of western side different types of live corals were present. The coral reef in the western part of northern side appeared to be good in live coral cover when compared to the other parts of the island.

Three LIT were laid, one on the southern part and the other on the northern part of the island as well as on the western side of the island. The results of the first LIT showed the occurrence of corals in the following percentage; dead coral with algae 53%, CM 16%, DC 1% and CSM 40%. The second LIT showed that the reef contain 33% Dead Coral with Algae, 10% CM, 9% CSM, 17% DC and 31% CB. The western part of northern side of the Poomarichan Island showed the following type of coral distribution 16% ACB, 3% CB, 7% CE, 12% CM, 3% CSM, 18% S and 41% DC. However, these corals were also in stressed condition.

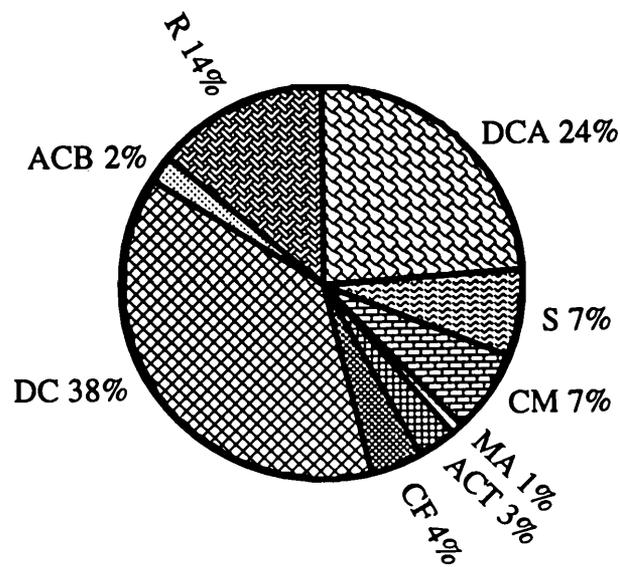
5. **Manauliputti Island (New Islets)** : This island (9°13' N Lat. and 79°7' E Long.) covers an area of 0.34 ha (Fig. 1). The coral reefs were observed on the eastern side of the island 650 m from the shore to the sea and covered an area of 6 sq km. Two LIT surveys were made on this island. The first LIT showed the 17% CM, 6% CSM, 5% S and 72% DC of coral reef. The second LIT showed the occurrence of 5% ACB, 3% CB, 24% CE, 2% CSM, 5% R, 33% S and 28% DC.

6. **Manauli Island** : Among all the islands, Manauli Island exhibited maximum diversity among the corals. This island (9°14' N Lat. and 79°7' E Long.) covers an area of 26 ha. Extensive reefs occurred on the northern side of the Manauli Island. It was exposed during low tide and a small stretch of sandy shore formed in between the Manauli Island and Manauliputti Island. Two LIT were laid on northern side of the island. The results showed the presence of 9% ACB, 3% CE, 6% CM, 8% SC, 10% S and 64% DC in the western part of the reef. The LIT on the eastern part of the reef showed the presence of 18% ACB, 1% CE, 4% CM, 73% DC and 4% SC. One more transect was laid on the northern side of the island during Oct.–Nov. '98 and it showed the presence of 1% of live corals dominated by *Pocillopora danae* (4.6%), 83.5% dead corals consisting mostly of *Acropora* branching forms (48.9%) and 9.4% rubble.

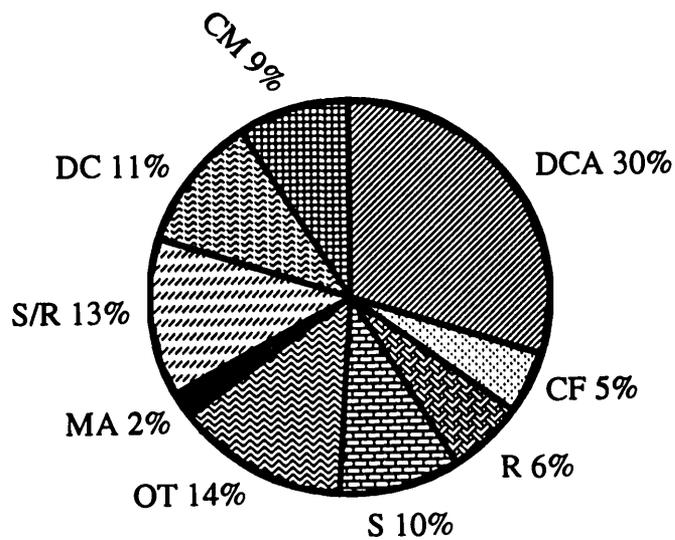
7. **Hare Island** : Hare Island is the largest island in the Gulf of Mannar and it is also called as "Muyal Tivu" This island (9°12' N Lat. and 79°5' E Long.) spreads over an area of 129 ha. Extensive coral reefs were found in the southern and northern side. The first LIT was laid on the western part and the second on the eastern side. The first LIT showed the presence of 3% ACB, 1% CB, 2% CM, 34% CSM, 18% S and 42% DC. The second LIT showed the presence of 44% ACB, 8% CSM, 10% CE, 5% CM and 33% DC.



**Mandapam group**



**Keelakarai group**



**Tuticorin group**

**Fig. 2. :** Percentage cover of life forms in three different groups of islands in GoMBR during 2000.

## KEELAKARAI GROUP OF ISLANDS

(Figs. 1–3)

The following seven islands, which are situated close to Keelakarai, were categorised as Keelakarai group of islands viz. 1. Mulli, 2. Valai, 3. Thalari, 4. Appa, 5. Poovarasampatti, 6. Palliyarmunai and 7. Anaipar. A patch of coral reefs present close to the Keelakarai coast was also surveyed during the present study.

1. **Mulli Island** : It is situated 10 km away from Keelakarai (main land) at 9°11' N Lat. and 78°56' E Long., covering an area of 10.2 ha. Extensive reefs were found on the North Eastern side of the island. Two LIT were laid one on the North Eastern side and another on the Southern side of the island. On the North Eastern side not even a single live coral was found. DC (ACT) (32.4%) dominated the reef. Rubble contributed to 35.6%. The only live coral found during the studies was *Coscinaraea monile*. On the southern side of the island good cover of live coral dominated by *Acropora* sp. (20.8%) was found, even though DC formed half of the reef with algae growing over it (DCA 51%). In addition to this, massive corals contributed to 1.2%, rubble 2% and dead coral without algae 25%. *Sargassum* sp. was the most dominant algae.

2. **Valai Island** : This island is located 10 km away from Keelakarai at 9°11' N Lat. 78°56' E Long. and covers an area of 10.10 hectares. Extensive reefs were found on the Eastern side of the island. Two LIT were laid to measure the coral reef cover in this area. The first transect laid on the south eastern part of the Valai Island revealed a dead reef formed by 15% rubble and the remaining dead coral with a cover of algae (*Caulerpa*, *Sargassum*, *Padina*, *Gelidella*, *Gracilaria* and *Turbinaria*) species. *Halimeda* sp. was also seen growing as pockets. The second transect laid on the eastern side was covered with one fourth sand and almost 65% dead submassive corals. Live coral covers represented by *Pocillopora damicornis*, *Porites solida* and *Montipora digitata* contributed to only 1.2% of the total cover.

3. **Thalaiyari Island** : Thalaiyari Island is the second largest island in the Keelakarai group of islands. It is situated 10 km away from Keelakarai at 9°11' N Lat. 78°54' E Long. and covers an area of 75.15 ha. Two LIT were laid on the southern side of the island. Although more than half of the reef was covered by dead coral, nearly one fourth was occupied by the massive corals such as *Goniastrea retiformis*, *Goniopora* sp. and *Pavona decussata* (24%) and the other live corals covered in the LIT were *Favites abdita* (0.4%) and *Echinopora lamellosa* (3.8%). Rubble and Sand cover 15%. Second LIT showed the presence of 72% DCA (dead coral with *Caulerpa*, *Padina*, *Sargassum* and *Turbinaria* species), 16% DC, 4.2% CM such as *Goniastrea retiformis*, 3.4% CF (*Echinopora lamellosa*), 0.8% encrusting and the remaining 3.6% Sand.

4. **Appa Island** : It is situated at 9°09' N Lat. 78°49' E Long., 8 km away from Keelakarai, and covers an area of 28.63 ha. Due to its high elevation and indiscriminate exploitation of weeds around, the northern shore of this island was eroded. Reefs were found on the south eastern part

of the island. Three LIT were laid in the reef area. In the first transect, the dominant life form was DC contributing to 18.4% followed by the sub massive coral (*Montipora digitata*) (11.2%). Other live corals present in this area were *Porites solida* (10%) and *Coscinaraea monile* (1.7%). Sand and rubble occupied more than 30%. In the second transect, *Echinopora lamellosa* was the only live coral available (16.2%), Sand (20.6%), dead massive coral (19.4%), dead coral with algae (19.4%), rubble (15%) and macro algae *Padina* sp. (9.4%) were the other contributors. In the third transect laid further south, sub massive dead corals dominated (66.6%) along with dead branching corals (21.2%). The live corals, contributed to only 4.8% such as *Montipora divaricata*, *Goniastrea retiformis*, *Porites lichen* and *Porites solida*.

**4.1. Keelakarai coast :** In this coast the coral reef occurred along the shore of Keelakarai (9°14' N Lat. and 78°47' E Long.). The coral reefs in the eastern part (near the custom house) were dead due to the dumping of municipal waste and sewage discharge. The corals in this coast were mostly dead and the dead corals were covered by the dense algal growth. The LIT was laid on the western part of the reef. The results of LIT survey showed 14% ACB, 1% CM, 38% R and 47% DC.

**5. Poovarasanpatti Island :** This island is situated at 9°09' N Lat. and 78°49' E Long. and 9 km away from Keelakarai. The reefs rarely got exposed at low tide. An observation made on this island revealed the presence of growing weeds and grasses with associated Holothurian and Hermit crab fauna.

**6. Palliyarmunai Island :** This Island with an area of 6.72 ha is situated at 9°09' N Lat. 78°44' E Long. lies 9 km away from Keelakarai. Extensive reefs were found on the Southern part of the island. Three transects were laid on the Southern part of this island. In the first transect the dead coral (70%) was dominated by branching and digitate forms. Massive corals *Porites solida*, *Porites mannarensis* and *Favia pallida* were the only living forms available in this island. A few sponges (0.2%) were also seen among the reef associates with a few holothurians. Rubble contributing to 30.6% was recorded in the second transect laid. Only 8.3% was the live coral component comprising of *Goniastrea retiformis*, *Porites solida*, *Pavona decussata* and *Pachyseris* sp. *Halimeda* sp. was also seen with *Caulerpa*, *Padina* and *Turbinaria* algae found on the dead corals. The presence of *Porites solida* in the third transect confirmed its wide distribution in this area; along with the other massive coral such as *Goniastrea retiformis* contribute 11.2%. Another live coral was *Echinopora lamellosa* (6.6%). Half of the transect area (51%) was covered with algae (*Sargassum*, *Turbinaria* and *Caulerpa* sps.) over dead coral; another 20.4% of dead coral was without algae. The contribution of sand was 10.8%.

**7. Anaipar Island :** This island is located 9 km away from Keelakarai at 9°09' N Lat. 78°42' E Long. covers an area of 11 ha. It exhibited more diversity and vast expanse of live corals on its Northern side. Two LIT, one on the Northern side and one on the Eastern side were laid.

Northern side of the island dominated with all other live forms for the first time in the present study. In the first transect, *Acropora* sp. (tabular forms) was 39% of the transect area followed by rubble (35.6%). Other live corals were *Porites solida*, *Goniastrea retiformis*, *Favites abdita* and *Favia pallida* (1.8%). Dead coral covered by algae *Turbinaria* sp. was 2.5% and the dead coral without algae cover 20.4%, sand covered remaining 0.7%. In the second transect of Northern side, live corals dominated with foliose coral *Montipora foliosa* in the front (35.4%) followed by digitate corals *Acropora* spp. (5.3%). *Goniastrea pectinata* (4.4%), *Acropora* sp. (tabular) (2.1%) and *Montipora divaricata* (1%) were the other live corals. Dead corals (21.8%) and dead corals with algae *Turbinaria* sp. (18.4) and rubble (11.6%) were the other components of the reef. Third transect laid on the eastern side showed the dominance of dead coral unlike the dominance of live corals in the northern side. The dominant live coral was *Montipora digitata* (22%). *Pavona decussata*, *Goniastrea pectinata* and *Porites solida* (7%). Dead corals occupied 23.7% area and dead corals with algae 34.7%, rubble 8.6% and sand 5.3%.

### TUTICORIN GROUP OF ISLANDS

(Figs. 1–3)

The following seven islands, which are situated close to Tuticorin town, were categorised as Tuticorin group of islands viz. 1. Nallathanni, 2. Puzhuvuinnichalli, 3. Upputhanni, 4. Velanguchalli, 5. Karaichalli, 6. Kasuwar and 7. Van.

1. **Nallathanni Island** : This island is the largest in the Tuticorin group of islands and second largest in the whole of Gulf of Mannar, covering an area of 101 ha. It is situated close to a fishing village called Munthal at 9°06' N Lat. and 78°35' E Long. Big trees of *Tamarind*, *Ficus*, *Thespesia* were found in the island along with papm and coconut trees. Reefs were found all around this island especially on the southern and northern side. Two transects, one on the southern side and another on the northern side were laid during 1998 survey and two more transects on the northern side and another on eastern side of the island were laid during 1999 survey. In the first transect laid on the southern side of the island, dead *Acropora* branching (23%) and dead *Acropora* tabular (13.2%) occupied much of the area. Among the live corals, massive corals *Goniastrea pectinata*, *Goniastrea retiformis*, *Porites solida*, *Favites* sp. and *Hydnophora* sp. occupied 18.6%. Foliose coral *Turbinaria peltata* occupied 2.4%. A branching *Acropora* sp. (1.9%) and Sea anemone (1.9%) was the other living form found in the present study. A major portion (16.7%) of the transect was occupied by sand. In the second transect laid on the Northern side of Nallathanni Island, most of the area was covered by dead coral with algae (63.2%). Massive dead coral recorded in the present study is very less (24.4%). Live corals occupied only a small area (5.4%) with *Goniastrea pectinata*, *Goniastrea retiformis*, *Porites solida*, *Platygyra* sp., and encrusting *Leptoria phrygia* (0.8%). Soft coral occupied 0.8% of the transect area. In the transect laid on the northern side, 53% was occupied by massive corals such as *Porites*, *Goniastrea* sp., *Favia pallida*,

*Faiva* sp., *Favites* sp. and *Platygyra* sp. In this transect 36% of the area was covered by dead *Acropora* sp. (tabular form) with algae. Recently dead *Porites* occupied 2% of the area and the remaining 9% occupied by sand. Macro algae *Turbinaria* sp. as well as calcareous algae were found in addition to the turf algae grown on corals. In the third transect laid on the Eastern side of the island, dead *Acropora* sp. (branching form) covered by turf algae occupied 43% of the transect area followed by macro algae forms *Caulerpa* sp. and *Turbinaria* sp. (30%). Live corals occupied only 23%, shared by *Montipora foliosa* (15%). Massive *Porites* and *Goniastrea* sp. formed 8% together and sand covered the remaining 4%.

2. **Puzhuvunnichalli Island** : It is located at 9°06' N Lat. and 78°35' E Long. The area is 6.12 ha and the circumference is 1372 m. It is 18 km from Vembar. This island has a good sandy beach, and thick vegetation. This island was surrounded by live coral reef all around except for a small gap on the eastern side. Two transects, one on the Northern side and another on the Eastern side was laid. On the northern side of the reef the transect area was covered by dead coral with algae (48.4%). The representative dead corals were *Acropora* sp. (branching form), *Acropora* sp. (tabular form), *Porites* sp., *Montipora digitata* and *Montipora foliosa*. Live forms occupied 37.4% of the area, represented by encrusting *Montipora* sp. (2.4%), *Montipora foliosa* (13.4%) and Massive corals *Porites* sp., *Goniastrea* sp., *Favia fava* and *Favia* sp. (21.6%). Sand covered 14.2% area. In the second transect laid on the eastern side of the island nearly half of the area was covered by live corals, 28% by *Montipora foliosa* and 22% by the Massive corals *Goniastrea* sp., *Porites* sp. and *Favia* sp. 32% of the transect area was occupied by dead corals *Montipora digitata*, *Montipora foliosa* and *Porites* sp. covered by algae. Sand occupied 20%. *Gracilaria* sp., *Turbinaria* sp. and turf algae were the macro algae forms found on the dead corals.

3. **Upputhanni Island** : It is located at 9°05' N Lat. and 78°30' E Long. The area is 22.94 ha and the circumference is 2292 m. It is 8 km from Vembar. It is a big sandy island with plenty of coral rubbles all over. Fringing reefs were found in the mid-eastern portion surrounding south up to the western middle portion at a distance of 150 to 300 m from the island. In the northern side major portion of the area (72%) was covered by dead corals dominated by *Acropora* sp. (tabular forms), followed by *Acropora* sp. (branching forms), other dead corals mostly covered by turf algae were massive *Porites* sp. and *Montipora foliosa*. Other algal forms found on dead corals were *Gracilaria* sp. and *Turbinaria* sp. Live coral cover occupied 27% of the transect area shared by *Montipora foliosa* (16%), massive corals *Goniastrea* sp. (3%) and *Porites* sp. (8%). Soft corals *Lobophytum* sp. occupied 1% of the transect area.

4. **Velanguchalli Island** : It is located at 8°56' N Lat. and 78°15' E Long. The area is 0.95 ha, and the circumference is 614 m. It is 15 km away from Tuticorin. This island is submerged 2–3 m below water. Isolated patches of thin reef of corals along southeastern side of the island were found.

5. **Karaichalli Island** : It is located at 8°52' N Lat. and 78°13' E Long. The area is 16.46 ha and the circumference is 1610 m. Recently some portion of the island has been eroded and the area has become 12.70 ha. It is 15 km from Tuticorin. It is a sandy island, thickly set with bushes in the center and western side. The whole island is covered with grasses and small shrubs. There was small reef along the island at a distance of 500 m to 1 km from the shore. Two transects, one on the eastern side and the other on the northern side was laid. In the first transect much of the area was occupied by sand with sea grass assemblages comprised of sea grasses such as *Halodule* sp. and *Enhalus* sp. (46%). Dead *Acropora* branching forms, *Acropora* tabular forms and *Montipora foliosa* covered by algae, covered another 45%. Rubble was the next major contributor (6%) and only 4% of the area was covered by live *Goniastrea retiformis*, *Montipora foliosa* and *Montipora digitata*. Poor representation of live coral forms and rubble strewn around the island indicated the major human disturbances happening in this island. Few new young colonies of *Favia fava* and *Acropora* sp., were also seen in the island. On the northeastern side of the island not even a single live coral was found. Sand and rubble covered 92% of the transect area, whereas, only 8% was covered by dead *Acropora* branching and tabular forms.

6. **Kasuwar Island** : It is located at 8°52' N Lat. and 78°13' E Long. The area is 19.50 ha and the circumference is 2160 m. Symptoms of recent erosion were observed and the area of this island has become 15 ha. It is 7 km away from Tuticorin. This island is found with small sand mounds and bushes here and there. The whole island is covered with xerophytic vegetation. Coral reefs were found at the southwest corner of the island at a distance of 500 m. Three transects, one on the eastern side, the second on the northern side and third on the southwestern side were laid. On the first transect laid on the eastern side, 74% was covered by sand, 25.9% sand with grasses *Halodule* sp. and *Enhalus* sp. In the second transect 71% of the area was covered by sand with sea grass and one fourth (25%) of the total area was covered by sand. Dead *Acropora* tabular form occupied 3%. In the third transect 0.4% of the area was covered by two sponges; remaining 99.6% was covered by robust dead *Acropora* sp. (branching forms) covered with turf algae. Close to this area diving up to 4-fathom depth revealed the presence of scattered live corals represented by *Favites abdita*, *Favia fava*, *Goniastrea* sp. and *Goniopora* sp.

7. **Van Island** : It is located at 8°50' N Lat. and 78°13' E Long. The area is 16.0 ha and the circumference is 2015 m. It is 6 km away from Tuticorin. This island is covered with some vegetation of low bushes mostly grasses and xerophytic plants. Fringing reefs were present on the eastern side of the island at a distance of 500 m. Two transects, one on the southern side and the other on the eastern side was laid. The first transect laid on the southern side revealed a mixture of rubble and sand contributing to 82% covered by dead *Acropora* sp. with macro algal forms such as *Caulerpa* sp., *Gracilaria* sp. and *Padina* sp. Dead *Acropora* tabular forms covered by turf algae constituted covered only 4%. The second transect laid on the eastern side revealed that nearly 75% was covered by rubble, 24% covered by sand and 0.6% a mixture of rubble and sand. 0.4% was represented by *Holothuria atra* and a single *Stoichactis* sp.

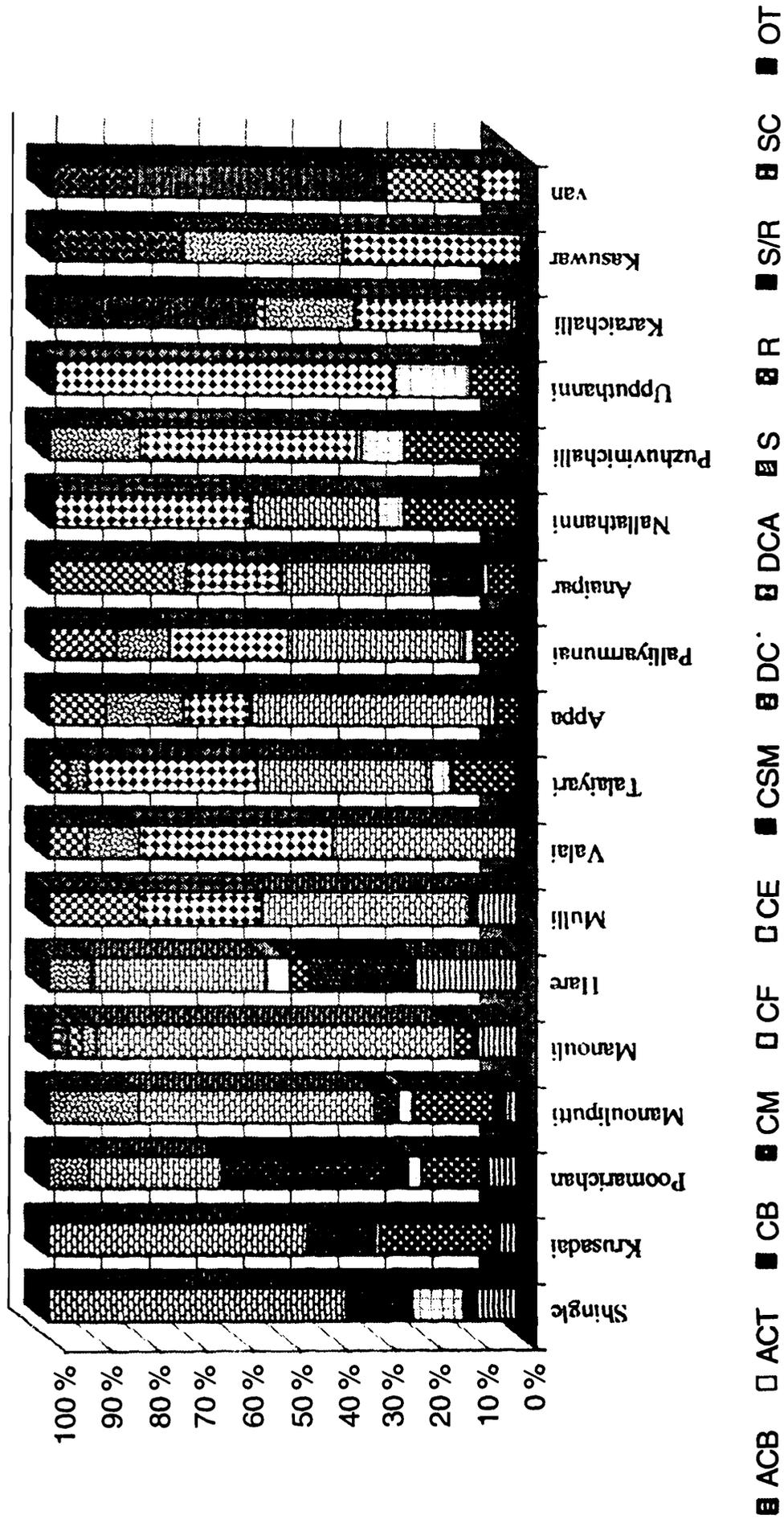


Fig. 3. : Comparison of life form categories in 18 islands of Gulf of Mannar during 1998–2000.

## DISCUSSION

The present study revealed 36%, 16%, 11% of live corals; 46%, 38%, 10% of dead corals; 7%, 24%, 28% of dead coral with algae; 7%, 7%, 10% of sand from the Mandapam, Keelakarai and Tuticorin Group of Islands respectively (Figs 2–3). Mandapam group of islands showed rich coral cover when compared to Keelakarai and Tuticorin group of Islands. Species diversity was also more in Mandapam and Keelakarai group than the Tuticorin group. The reduction in coral species diversity in the Tuticorin group may be due to human activities such as over exploitation of reef resources, illegal coral mining, oil spill by fishing boats and lethal chemicals discharged from the coastal industries. Among the Tuticorin group of islands, the Nallathanni and Puzhuvichalli had good coral reefs, which are away from the Tuticorin town.

The 1998 bleaching event has played a major role in reducing the live coral cover not only in the coral reefs of GoMBR but also in Lakshadweep, Gulf of Kachchh, Andaman and Nicobar reefs (Muley *et al.*, 2000). It has been reported that the 1998 bleaching reduced the live coral cover in the Gulf of Kachchh to 30%, 40% in the Gulf of Mannar, 20% in Lakshadweep and 65–70% in Andaman and Nicobar Islands (Venkataraman, 2000).

Inadequate awareness among the fishermen about coral reefs and their importance, increasing coastal industries and over exploitation is the major causes for coral reef degradation. In order to conserve the coral reefs of Gulf of Mannar Marine Biosphere Reserve, the present status report may help the managers to take proper initiative.

## SUMMARY

Gulf of Mannar Marine Biosphere Reserve (GoMBR) is the first declared marine Biosphere reserve in the south east Asia. It is endowed with 3600 species of flora and fauna. There is a chain of 21 islands from Mandapam to Tuticorin and these islands are surrounded by fringing reefs. Exploitation of biological resources from these reefs is the only source of income for the coastal village fishermen of this area. For the purpose of the present study, all the 21 islands of GoMBR were divided into three groups, such as Mandapam, Keelakari and Tuticorin, each group with seven islands in their vicinity. The status survey revealed 36%, 16%, 11% of live corals, 46%, 38%, 10% of dead corals, 7%, 24%, 28% of dead coral with algae, 7%, 7%, 10% of sand from the Mandapam, Keelakarai and Tuticorin groups respectively. The present study on status survey of coral reefs of Gulf of Mannar was conducted immediately after the bleaching event (1998–2000). Among the three groups of islands in GoMBR, Mandapam group had the highest percentage of live coral cover than the Keelakarai and Tuticorin group of islands. The reasons for the less percentage of coral cover in other two groups of islands of GoMBR, as well as status of coral reefs of Lakshadweep, Gulf of Kachchh and Andaman Nicobar Islands have been compared in the present paper.

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