

Status of Alcyonacean corals along Tuticorin coast of Gulf of Mannar, Southeastern India

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Received 28 November 2012; revised 7 December 2012

In this study, the assessment of alcyonaceans was conducted in Tuticorin coast of the Gulf of Mannar during the period between 2010 and 2012 in 5 locations; Vaan, Koswari, Kariyachalli and Vilanguchalli islands and mainland Punnakayal patch reef. Average alcyonacean coral cover in Tuticorin coast was 6.76% during 2011-12 which was 5.61% during 2010-2011. Percentage cover of alcyonacean corals increased in all the study locations; Kariyachalli 12.04 to 13.96%; Vilanguchalli 8.94 to 10.23%; Koswari 1.6 to 3.69; Vaan 0.53 to 0.72; mainland Punnakayal patch reef 4.95 to 5.21% was documented. In total, 15 species from 7 genera were recorded during the study period. Though anthropogenic threats in Tuticorin coast are comparatively high, the abundance of alcyonacean corals has increased considerably showing their resilience and adaptability.

[Keywords: Alcyonacean corals, Status, Diversity, Tuticorin, Gulf of Mannar]

Introduction

Alcyonacean corals (soft corals and gorgonians) are modular cnidarians composed of polyps that always have eight tentacles and are oftentimes connected by vessels classified under subclass Octocorallia while hard corals have six tentacles (which are hexa corals). The vast majority of alcyonacean corals are colonial and their forms range from simple sheets to complex tree-like networks¹⁻³. Absence of any massive, solid skeleton, unlike the hard corals, has led to coining the term 'soft coral'. Gorgonians or sea fans are distinguished alcyonaceans which have a semi-rigid scleroproteinaceous axis. They are distributed from Arctic to Antarctic waters in habitats ranging from the inter-tidal to abyssal depths⁴.

Over the past decades, coral reef communities around the world have been experiencing increasingly stressful conditions due to a combination of natural and anthropogenic factors⁵. They have declined over the course of human history, culminating in the dramatic increase in coral mortality and reef degradation of the past 20-50 years⁶. Decline of coral reefs is often considered as the decline of hard corals alone; but, when a reef ecosystem is affected, all the associated organisms get affected. As being sessile and adjacent to hard corals, soft corals and gorgonians

experience all the natural and anthropogenic threats. Reef ecosystems of Gulf of Mannar are heavily stressed due to various human induced threats like destructive and over fishing practices, coral mining, domestic and industrial pollution, seaweed and other resource collection in reef areas and invasion of exotic seaweed species, *Kapaphycus alvarezii*. Though, several research reports have been published on hard corals, works on alcyonacean corals are scanty. Most of the publications related to alcyonacean corals are about their medicinal properties and not on their diversity and abundance, which are essential for conservation and management.

Tuticorin is located on the southern part of Gulf of Mannar Marine National Park. There are four islands namely Vaan, Koswari, Vilanguchalli and Kariyachalli in this area. Islands in GoM have fringing and patchy reefs around them. Narrow fringing reefs are located mostly at a distance from 100 to 150 m from the islands. Patch reefs rise from depths of 2 to 9 m and extend to 1 to 2 km in length with width as much as 50 meters⁷. Coral diversity and abundance have been highly affected due to coral mining and other destructive fishing activities. As result of soil erosion caused by excessive coral mining, Vilanguchalli Island now lies 1 m below mean low tide level. Alcyonacean corals in this region

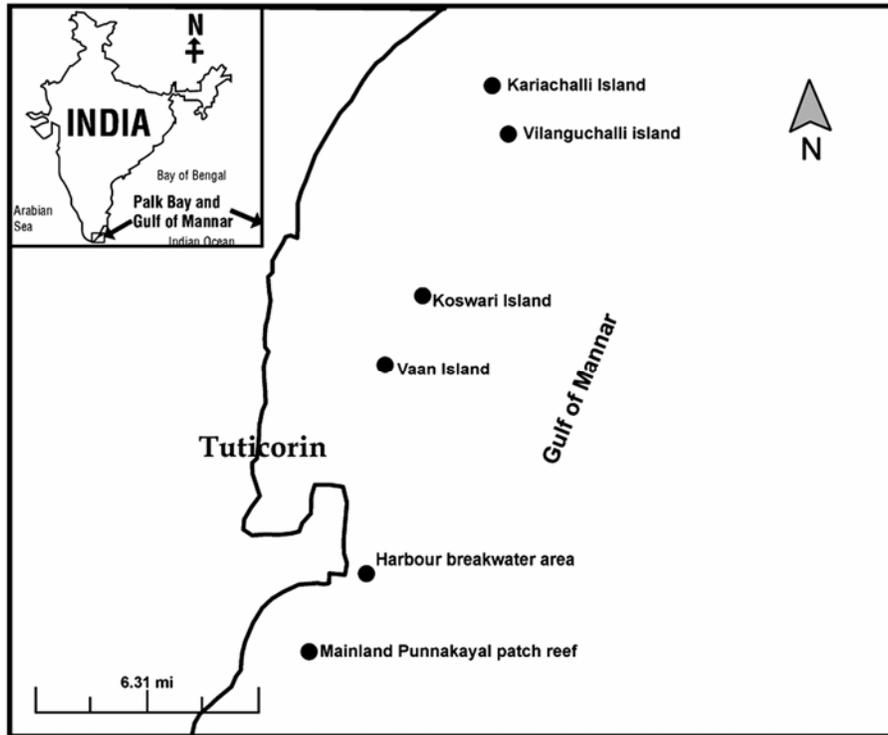


Fig. 1—Map showing study area

have not been studied so far in detail even though they have been witnessed in abundance. Present study consists the abundance, diversity and status of alcyonacean corals in Tuticorin coast.

Materials and Methods

Assessment on soft corals in Tuticorin coast of Gulf of Mannar was carried out during the period between March 2010 and February 2012; data collection was done initially during the period March 2010 to February 2011 and again from March 2011 to February 2012. Line Intercept Transect (LIT) method was used to assess the sessile benthic community of the reef area along the Tuticorin coast and to assess the percentage of each alcyonacean genus. Five study locations (Fig. 1), Vaan, Koswari, Kariyachalli and Vilanguchalli islands and mainland Punnakayal patch reef were identified for detailed data collection. Four sites in each location were selected in the reef areas by using manta tow technique⁸. Selection of the sites was based on the abundance of the soft corals in the reef in order to cover the entire study area. 20 m Line Intercept Transects⁹ (measurement tape) were laid in the study sites randomly, parallel to the depth curves of the reefs. 3 to 6 transects were laid in each site above the sea bottom to assess all the benthic

categories. Measurement tape was laid at fixed depths at each site (1-6 m) and this method was followed for all transects. Each change of life form categories along the tape measured was recorded on data sheets, using SCUBA diving. The names of each genus were taken as separate category to assess the percentage of each alcyonacean genus. Percentage cover of each live form category was calculated following the method of English *et al*, (1997)⁹. Student 't' was performed to assess the changes in soft coral cover between the two periods.

Results

Abundance and diversity of alcyonaceans or soft corals in Tuticorin region was relatively good. Average soft coral cover in Tuticorin coast was 6.76% during 2011-12 which was 5.61% during 2010-2011. However, student 't' test showed the increase in the soft coral cover is not statistically significant (p 0.73). Kariyachalli Island was having the highest cover of alcyonaceans in Tuticorin group of islands with 13.96% during 2011-12 as it increased from 12.04% during 2010-11 (p 0.79) (Fig. 2). Coral reef observed around this island is fringing reef type which extends up to 3 m depth and small patchy reefs are also found in the Southeast direction at 3.5m depth. Hard coral

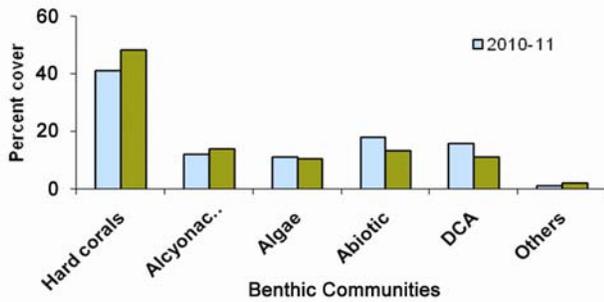


Fig. 2—Benthic community structure in Kariyachalli Island

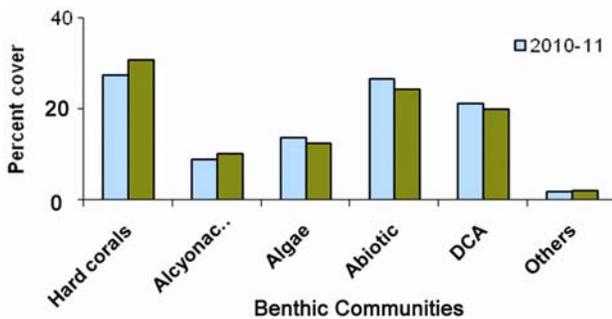


Fig. 3—Benthic community structure in Vilanguchalli Island

cover has also increased from 41.11 to 48.36% and were also highest among Tuticorin group of islands. Abiotic factors and Dead Coral with algae (DCA) were collectively between 25-30% and algae were around 10%. Soft corals in this island were found mostly adjacent to table coral *Acropora cytherea* followed to massive coral *Porites* sp. while few were observed adjacent to branching acroporan corals and few as independent on the hard sea bottom.

In Vilanguchalli Island, alcyonaceans are dispersed and random in their occurrence. Extensive coral mining has led to the submergence of this island. Reef seen here is narrow and elongated. In the lagoon, the wave setup gradient is small and hence wave generated current is feeble to move the bottom sediments. In spite of the discontinuation of the reef rim, the shifting of the focal point is often. Percentage of soft corals was 10.23 during 2011-12 which had increased from 8.94% during 2010-2011 (p 0.82) (Fig. 3). Hard corals also increased from 27.43 to 30.82% during the course of the study. Abiotic factors and DCA were high with over 20% during both the periods while algae were little higher than 10%. Soft corals in this Island were found in the dead coral beds.

Alcyonaceans in Koswari Island were very few and were found in the dead coral beds. Fringing reef type is observed in this Island which extends up to 2.8 m depth and small patch reef is also found in the

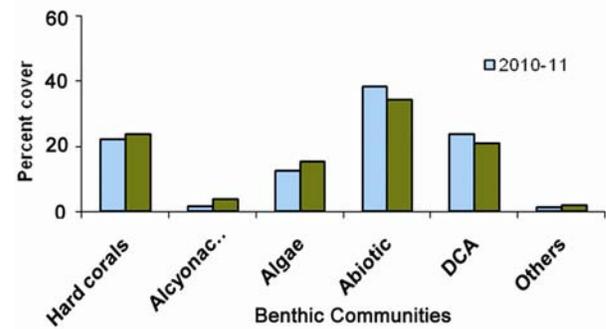


Fig. 4—Benthic community structure in Koswari Island

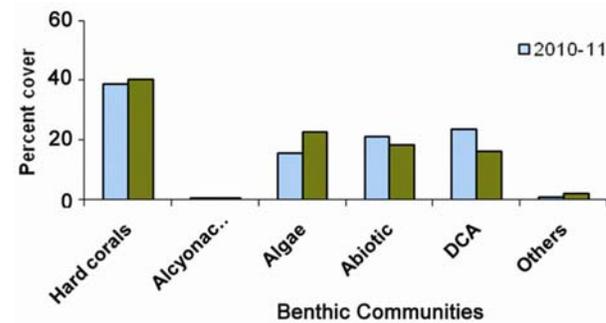


Fig. 5—Benthic community structure in Vaan Island

Southeast direction at 3.5m depth. Reef rim topography is comparatively low and inclined to major wave direction. Only 3.69% of soft corals were observed in this Island during 2011-12 which had increased from a meager 1.6% during 2010-11 period (p 0.21) (Fig. 4). Hard coral cover in Koswari Island increased from 22.24 to 23.69% during the study period. Abiotic factors were very high with over 30% while DCA and algae were around 20 and 15% respectively.

Like Koswari Island, very few alcyonaceans were observed in Vaan Island on the dead coral beds. The reef in Vaan Island is fringing type which extends up to a depth of 3 m. The fringing reef along the windward side of the Island protects it from the direct wave action. The percentage of soft corals in this island was lowest among all Islands in Tuticorin group with 0.72 during 2011-12 and 0.53% (p 0.61) during 2010-11 (Fig. 5). However, this Island has a good hard coral cover with 40.25% during 2011-12 as it increased from 38.64% in 2010-11. Abiotic factors and DCA were between 15 and 25% during the study periods while algae increased from 15 to 22%.

Alcyonaceans in mainland Punnakayal patch reef occur mostly adjacent to the cup corals *Turbinaria* spp. in the hard sea bottom. Mainland reef is almost

monospecific with *Turbinaria* spp. and it starts from 1.2 km offshore and 5 km long. Starting from the depth of 2 m, the genus *Turbinaria* is widespread up to over 10 m depth. Acroporans are present only as patches in the shallow depths below 2 m. The percentage of alcyonaceans was 5.21 during 2011-12 which had increased from 4.95% during 2010-11 ($p = 0.87$) (Fig. 6). Abiotic factors and DCA were around 12-16% during the study periods while algae were very low around 2%.

In Tuticorin group of islands, seven genera of alcyonaceans were recorded, namely *Sacrophyton*, *Sinularia*, *Sacrophyton*, *Cladiella*, *Subergorgia*, *Juncella* and *Muricella*. Among them *Subergorgia*, *Juncella* and *Muricella* are gorgonians or sea fans. Among the seven genera *Sacrophyton* was the dominant genus followed by the genera *Sinularia*, *Lobophytum* and *Cladiella* in Tuticorin coast. Percentage cover of almost all the genera increased significantly during the study period (Figures 7-11) in all the study sites. In total, 15 species of alcyonaceans were recorded from seven genera along Tuticorin coast, namely *Sacrophyton crassocaul*, *S.ehrenbergi*, *Sinularia polydactyla*, *S.glaucum*, *S.abrupta*, *S.macropodia*, *Lobophytum crassum*, *L.pauciflorum*, *L.depressum*, *Cladiella pachyclados*, *C.australis*,

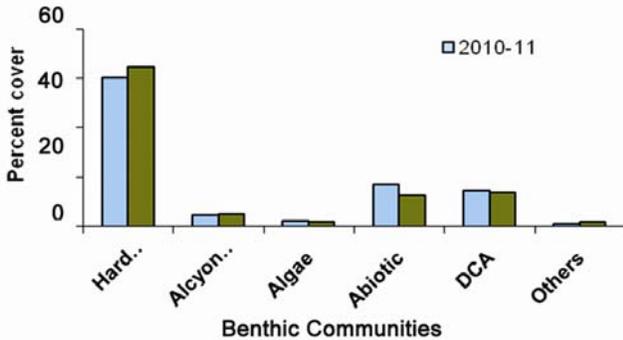


Fig. 6—Benthic community structure in mainland Punnakayal patch reef

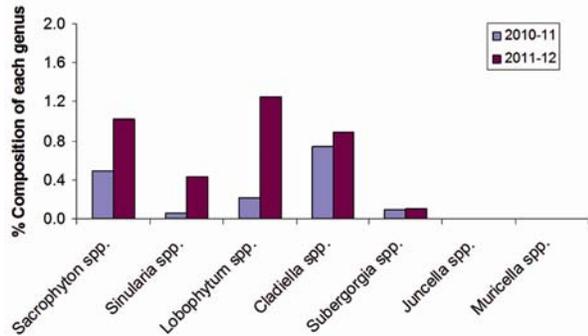


Fig. 7—Percentage composition of each alcyonacean genus in Kariyachalli Island

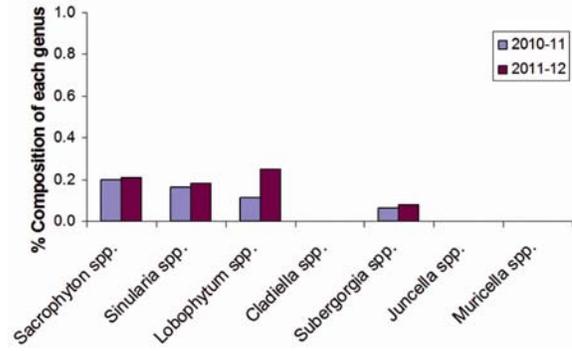


Fig. 8—Percentage composition of each alcyonacean genus in Vilanguchalli Island

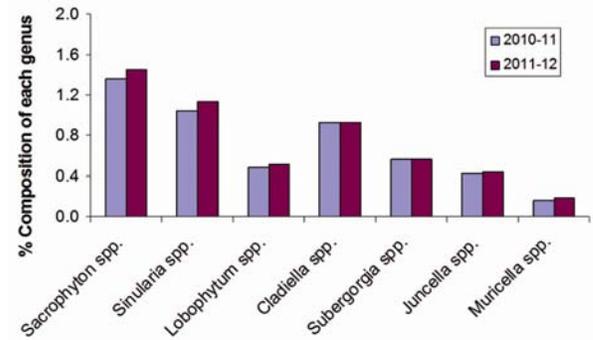


Fig. 9—Percentage composition of each alcyonacean genus in Koswari Island

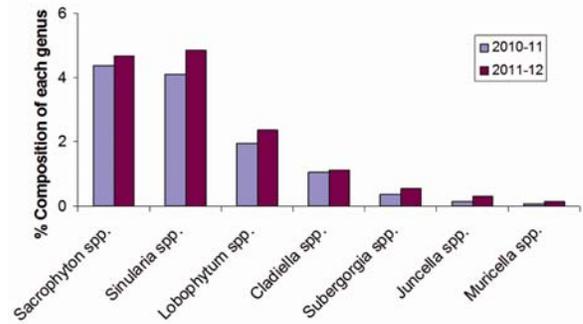


Fig. 10—Percentage composition of each alcyonacean genus in Vaan Island

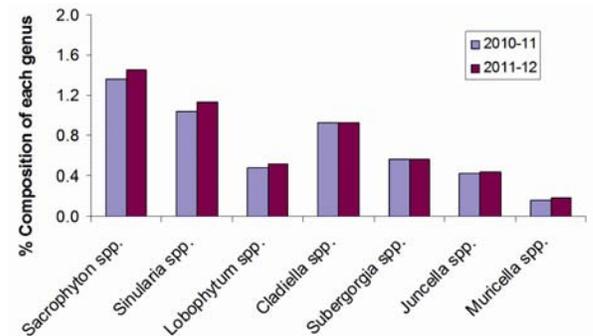


Fig. 11—Percentage composition of each alcyonacean genus in mainland Punnakayal patch reef

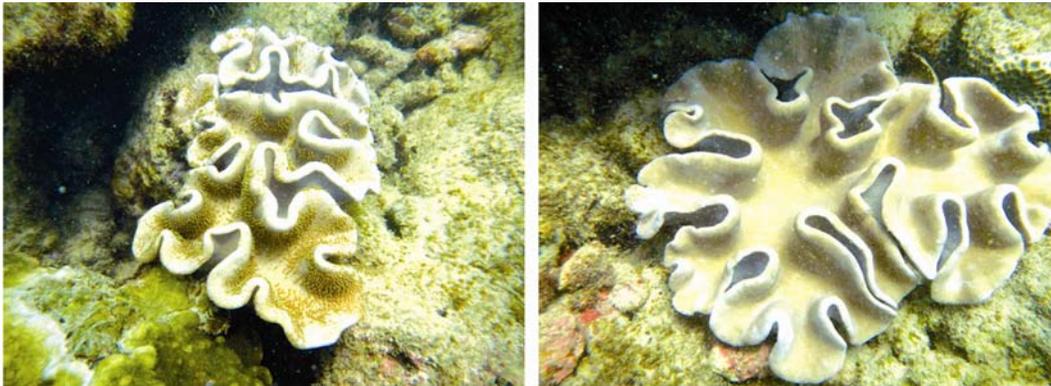


Fig. 12—Genus *Sacrophyton*

Subergorgia reticulate, *S. suberosa*, *Juncella juncea* and *Muricella* sp. Under water images of common alcyonaceans (genus level) in Tuticorin are given in the figures 12 to 16.

Discussion

Reef communities have been described as “disturbance-adapted” ecosystems¹⁰⁻¹¹, but that adaptation is natural rather than human-enhanced disturbances. Alcyonaceans are an integral part of any reef around the world which gives beauty to the reef along with their ecological role. Alcyonaceans occupy a considerable amount of reef area, particularly in sheltered reef habitats¹²⁻¹⁴. The contribution of alcyonaceans to the habitat structure of coral reefs is complex. Massive alcyonaceans contain internal calcareous skeletal elements, and thus increase reef area both during their life and following death of the colony. Amount of reef occupied by alcyonaceans at a locality is temporally dynamic due to differences in growth rate, susceptibility to disturbances such as storms¹⁵, and interactions with other occupants of space such as hard corals. Biotic interactions between soft and hard corals are generally aggressive, and may occur by colony overgrowth¹⁶⁻¹⁷ and allelopathic inhibition of settlement¹⁸⁻²⁰. Mortality and growth rates of alcyonaceans are also taxonomically variable, with both ephemeral and pioneering growth modes, and long-lived, slow-growing forms forming the soft coral group²¹.

Alcyonaceans produce a range of secondary metabolites, principally terpenoids²²⁻²⁵. Several ecological roles have been attributed to these compounds, including defense against predation²⁶⁻³⁰, competition for space³¹⁻³³, gamete protection and sperm attraction in reproduction³⁴⁻³⁵, and antifouling³⁶⁻³⁷.

Some species of alcyonaceans release terpenoid toxins³⁸, which act as allelopathic agents in competitive interactions with nearby scleractinian corals³¹.

The percentage cover of alcyonaceans in Tuticorin group of islands is not significantly high as the average cover was 6.76% in 2011-12 with an increase from 5.61 in 2010-11. Among the four Tuticorin group islands, two are having a reasonable percentage of alcyonaceans with 13.96 and 10.23% in Kariyachalli and Vilanguchalli islands respectively. In Kariyachalli Island alcyonaceans are found abundant near the table coral *Acropora cytherea*, massive coral *Porites* sp. and branching corals of *Acropora*, whereas in Vilanguchalli Island they are randomly distributed in occurrence. Vaan and Koswari islands have very little alcyonacean cover since these islands have experienced rampant mining for few decades earlier and hence the distribution is scattered on dead coral beds. Mainland Punnakayal patch reef had a nominal 5.21 % of soft corals during 2011-12. In total, 15 species of alcyonaceans were recorded from seven genera during this study.

Populations of alcyonaceans have dramatically decreased due to a number of anthropogenic and pollution factors as seen in American Samoa reefs³⁹; other factors include bleaching⁴⁰ and the impacts of tourism⁴¹. Alcyonaceans in Tuticorin region have been reduced greatly due human activities like coral mining and destructive fishing practices even before they are well studied. They are being affected either directly or indirectly with the degradation of the reef. The natural factors such as climatic change, freshwater runoff during monsoon from small rivers, strong waves and tides also affect the survival of the alcyonaceans. Though mining was halted in reef areas of Gulf of Mannar since 2005, destructive

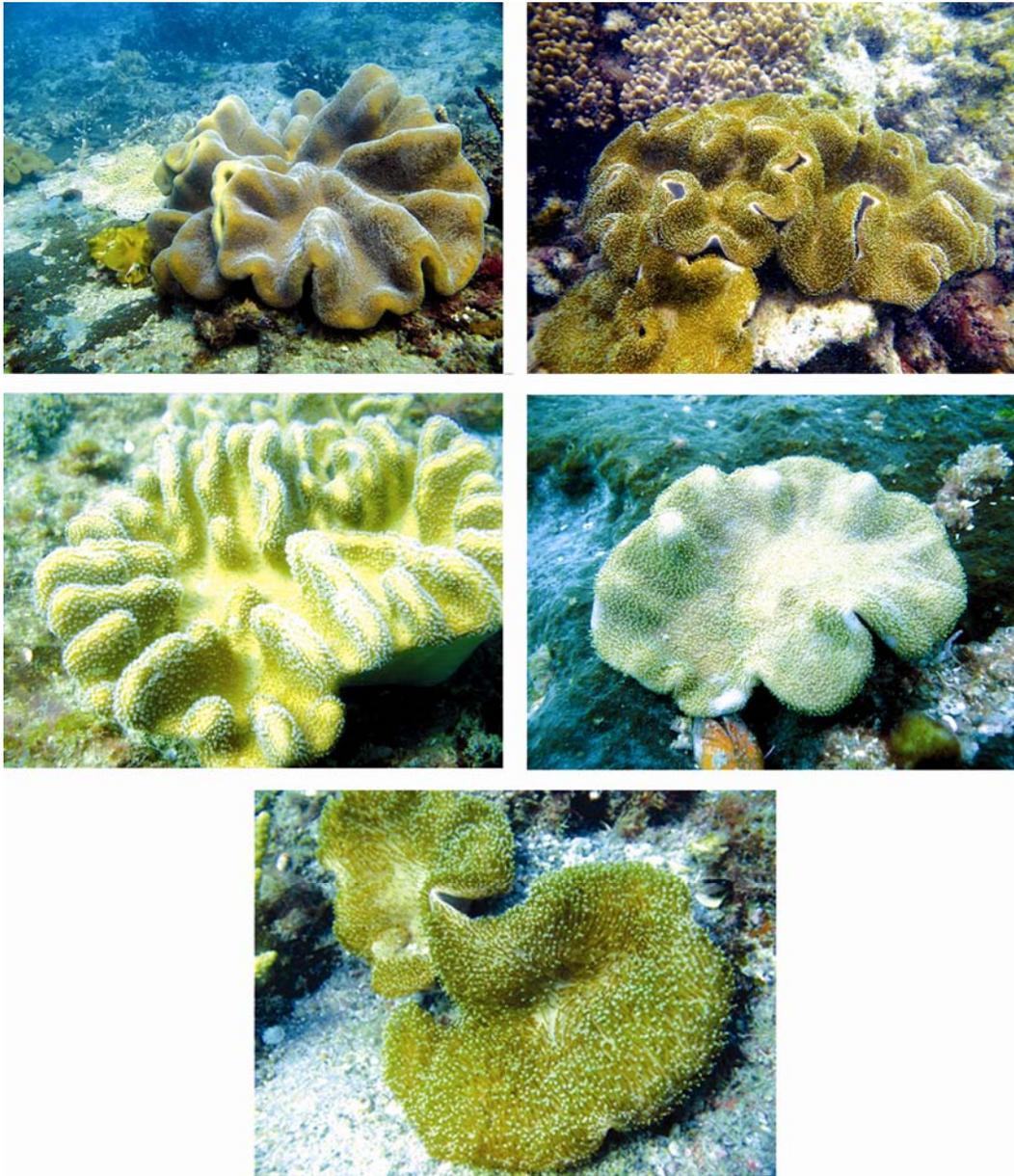


Fig. 13—Genus *Lobophytum*

fishing activities are still continuing in the reef areas. Other destructive activities like boat anchoring, shore seine, push net, bottom trawling, sea weed collection, shell collection, etc., make huge impact on the survival of the soft corals in Tuticorin region.

The steady increase of coastal population and need for the food and income prompt fishermen to go for the destructive fishing activities. In addition, pollution is another major factor due to discharge of untreated industrial effluents and domestic sewage, which not

only reduce the water quality, but also enhance the disease prevalence among marine organisms. Alcyonanceans are rich in potential bio active compounds and hence they are being collected in huge quantities by the scientists who are involved in related research without the knowledge and permission of conservation authorities and also cause depletion of resources as well severe damage to reef areas. Gulf of Mannar has been experiencing these threats for few decades especially in Tuticorin group of islands.

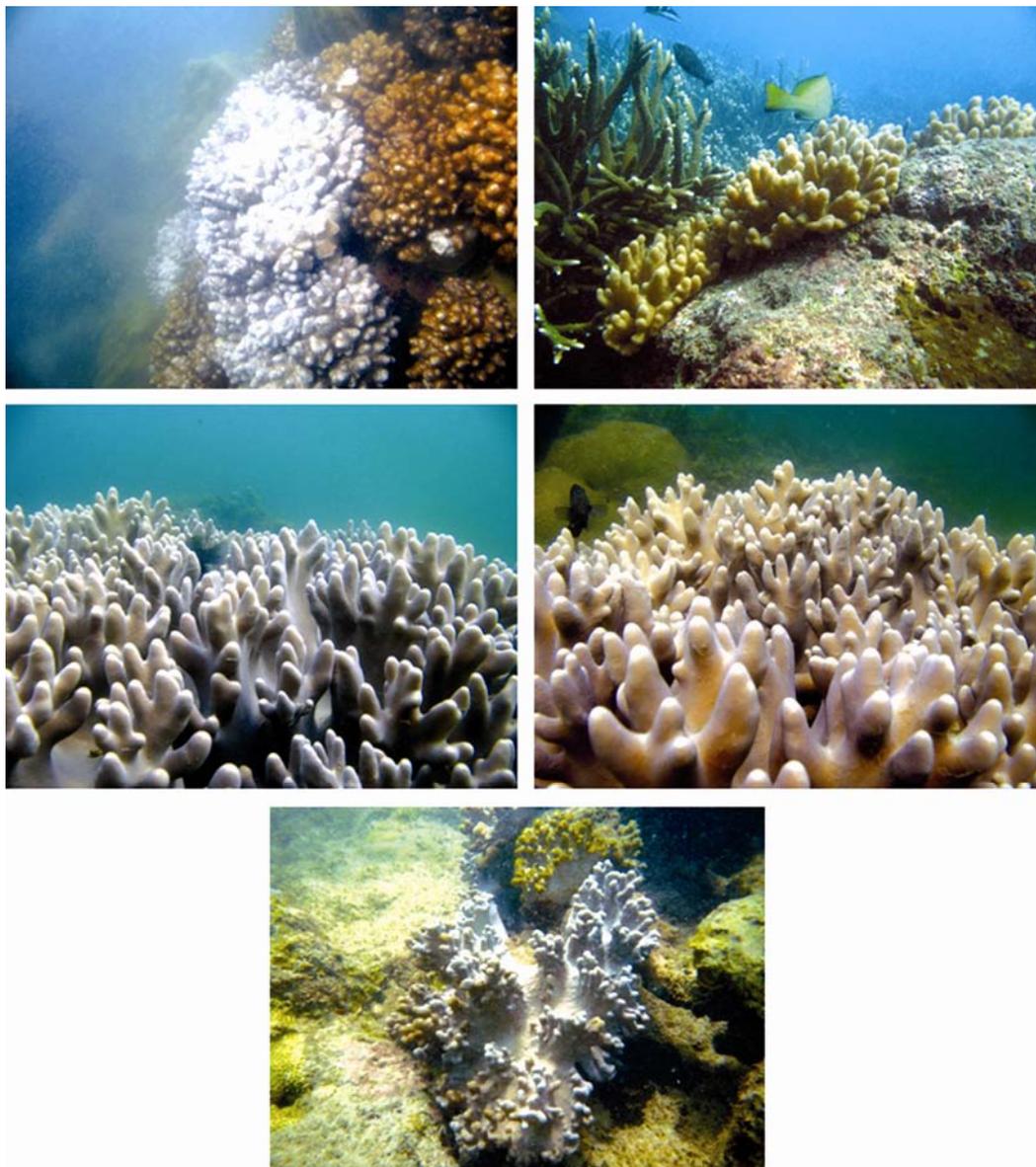


Fig. 14—Genus *Simularia*

Among all the threats, bottom trawling seems to be the major source of destruction either it is shore seine, push net or mechanized trawling. Bottom trawls are designed to tow along the sea floor, on which its operation indiscriminately smashes everything on their way crushing, killing, burying and exposing to predators the benthic fauna. It causes physical and biological damages that are irreversible, extensive and long lasting⁴². Impact of bottom trawling on coral reefs has been well documented⁴³⁻⁴⁴. Kaiser *et al.* (2000)⁴⁵ reported off Start Bay, Devon, United Kingdom that the biomass of alcyonanceans was

higher in the areas closed to fishing gear than those areas under bottom fishing pressures even at a small scale.

In recent years, the status of alcyonanceans in Tuticorin coast has increased slightly indicating the resilience and adaptability. This increase can also be attributed to the effective enforcement and surveillance by the marine national park authorities along with the complete halt of coral mining since 2005. Hard coral cover has also increased significantly after 2005, however the climate change issues along with local threats, in particular the



Fig. 15—Genus *Cladiella*



Fig. 16—Genus *Subergorgia*

fishing activities near reef areas pose threat to alcyonaceans. More baseline data collection, regular monitoring, rehabilitation and focused research have to be done for effectively managing the alcyonacean resources of entire Gulf of Mannar.

Acknowledgements

Thanks are due to University Grants Commission for research support and Principal Chief Conservator of Forests and Chief Wildlife Warden, and Wildlife

Warden, Gulf of Mannar Marine National Park Government of Tamil Nadu for research permissions.

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