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Coralline algae – the untouched life forms in the reefs of Gulf of Mannar, Southeastern India

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Abstract

Gulf of Mannar has long been considered as one of the wealthy reef ecosystems and first ever international coral reef symposium was organized here. Since then, there have been many works regarding the coral reefs and associated organisms of this region. But one major category, the coralline algae has been left out by the scientists because of the tedious sampling protocol though they are an integral part in any reef ecosystem and most of the phycologists in India are not scuba divers and coralline algae are hardly washed ashore. In this paper, four islands of Gulf of Mannar (Vaan, Koswari, Kariyachalli and Vilanguchalli islands) were studied to ascertain the status and role of coralline algae. Live coral cover was 50.13, 23.11, 42.35 and 28.65% respectively in Vaan, Koswari, Kariyachalli and Vilanguchalli islands and the overall cover of coralline algae was 5.09, 6.53, 9.64 and 6.98% respectively.

Key words: Coralline algae, Gulf of Mannar, live coral cover

Introduction

India has four major reef areas which are Gulf of Mannar and Palk Bay, Gulf of Kachchh, Lakshadweep and Andaman and Nicobar Islands. The total reef area in India is estimated to be 2,375 km^2 (Pillai, 1994). Gulf of Mannar (Fig. 1) located in the southeast coast of India extends from Rameswaram Island in the north to Kanyakumari in the south. It has a chain of 21 uninhabited islands stretching from Pamban to Tuticorin covering a coastal distance of 140 km. It falls within Indo-Pacific realm – world's richest region

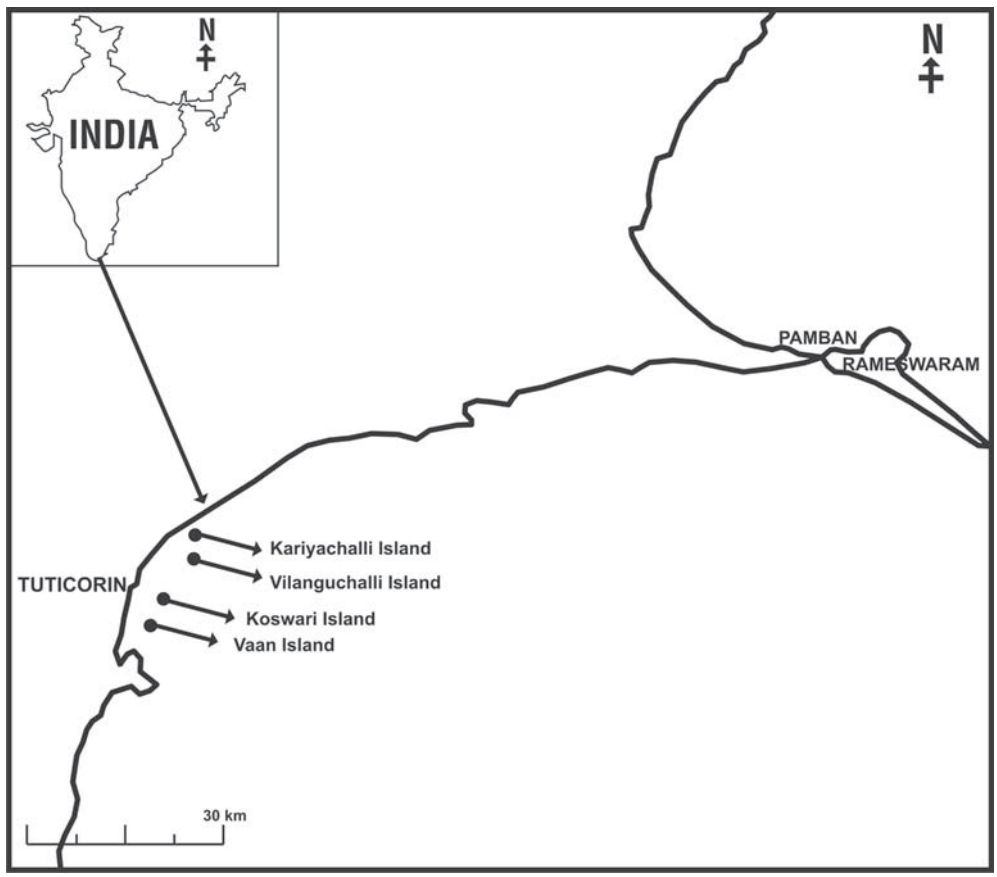

Fig. 1. Map showing Gulf of Mannar

from a marine bio-diversity point of view. The coastal area covering 560 km^2 between Rameswaram and Tuticorin, including the 21 islands and surrounding shallow waters were declared as Marine National Park in 1986 by the Government of Tamil Nadu for the purpose of protecting marine wild life and its environment. The Gulf of Mannar Marine Biosphere was declared in 1989 by the Government of India, covering 10,500 km^2 area between Rameswaram and Kanniyakumari.

The reefs in the Gulf of Mannar (GoM) are developed around the 21 uninhabited islands that lie along the 140 km stretch between Tuticorin and Rameswaram of Tamilnadu, Southeast coast of India. In Gulf of Mannar thousands of research works have been published on coral reefs and macro algae. Coralline algae are left out because of the tedious sampling protocol though they are an important part in any reef ecosystem. The red algae belong to the division

Rhodophyta, within which the coralline algae form a distinct, exclusively marine order, the Corallinales. Despite their importance, they have been a poorly studied group of marine organisms (Maneveldt et al., 2008) even by specialist phycologists especially in India. This is because most of the phycologists are not scuba divers and coralline algae are hardly washed ashore. However, non-geniculate coralline algae have been reported by the geologists from India with fossil specimens (eg. Tandon et al. 1978; Gosh, 2002; Kishore et al. 2012). Understanding the role of coralline algae in this already disturbed reef becomes important since it plays vital role in the reef building.

Though Gulf of Mannar was once considered as biological paradise, decades of exploitation has caused the destruction of reef areas in an unprecedented manner. Coral mining was the major culprit behind the destruction coupled with destructive fishing methods and pollution. Natural factors such as coral diseases and elevated sea surface temperature were also contributors to the decline. Because of this most of the reef dominated areas have been converted to algal dominated areas. However, after 2004 Indian Ocean tsunami, coral mining was stopped and since then successful coral reproduction and subsequent coral recruitment have made significant change in the live coral cover (Edward et al. 2008, Raj and Edward 2010).

At this juncture, new threats such as bio-invasion of exotic seaweed and trap fishing coupled with elevated sea surface temperature making the recovery difficult. It is highly important to have baseline information on the status and abundance of coralline algae to ascertain their role in reef construction. Since Tuticorin region is the most exploited among Gulf of Mannar reefs, the study has been planned to assess the status of non-geniculate coralline algae around 4 uninhabited islands of this region. A preliminary study on the abundance and types of non-geniculate coralline algae was carried out hoping the study would serve as baseline information about coralline algae and would help the conservation managers for a better management.

Materials and methods

Study site:

Islands in Gulf of Mannar have been grouped into four namely, Mandapam group (7 islands), Keezhakarai group (7 islands), Vembar group (3 islands) and Tuticorin group (4 islands). These islands occur at an average distance of 8-10 km from the mainland (Edward et al., 2007). The Tuticorin group of islands is located at the southern tip of the Gulf of Mannar Marine National Park which consists of four islands namely, Vaan (Lat 8° 50' N, Long. 78° 13' E), Koswari (Lat. 8° 52' N, Long.78° 13' E), Kariyachalli (Lat. 8° 57' N, Long. 78° 15' E) and Vilanguchalli (Lat. 8° 56' N, Long. 78° 15' E). As a result of

erosion caused by excessive coral mining, Vilanguchalli Island has submerged and now lies 1 m below mean low tide level and Vaan Island is experiencing severe erosion currently. The islands have fringing and patch reefs around them. Narrow fringing reefs are located mostly at a distance of 100–150 m from the islands. Patch reefs rise from depths of 2–9 m and extend to 1–2 km in length with width as much as 50 m (Edward et al., 2005).

Assessment:

The percentage cover of corals and other sessile benthic categories were assessed by Line Intercept Transect (LIT) method following English et al. (1997) around the islands of Tuticorin group (Vaan, Koswari, Kariyachalli and Vilanguchalli islands). Data collection was done between January and March 2014. Percent cover was calculated by determining the total distance on the transect covered by each category. Density of different types of coralline algae was assessed using 1 X 1 m^2 quadrats by following English et al. (1997). Four permanent monitoring sites were fixed in each Island and four permanent quadrats were fixed in each monitoring site to assess the density and initial assessment has been done in this study. Following Harvey et al. (2005), types of non-geniculate coralline algae were categorized. Totally six types of non-geniculate coralline algae were found to occur in Tuticorin group islands which are encrusting, warty, lumpy, layered, foliose and fruticose. Densities of each type of coralline algae were assessed by counting them individually inside the quadrats and then averaged. Following is the description of each type, encrusting: these are plants with flat crusts or sleeve-like and without protuberances or branches; warty: these are plants with short (usually < 3 mm), unbranched protuberances; fruticose: these are plants with cylindrical to compressed branches that are mostly > 3 mm long, do not look lumpy, and are free from one another or laterally coherent; lumpy: these are plants with short, swollen protuberances that may vary in length, are often crowded and contiguous and rarely branched; foliose: these are plants consisting of flattened plate-like branches arranged at various angles to one another, but not in horizontal layers; layered: These are flattened branches forming horizontal layers overlapping one another, often giving the plant a terraced appearance in surface vie. Specific density of each coralline algae type was recorded.

Results

The percentage of non-geniculate coralline algae was slightest in Vaan Island among the four islands of Tuticorin. Total cover of coralline algae in Vaan Island was 5.09%, but, live coral cover was highest in Vaan Island as it was recorded with 50.13%. Abiotic factors (Sand, rock, rubbles etc.) and DCA (Dead corals with algae) were the other dominant benthic

categories with 19.8 and 13.25% respectively; Macro algal cover was recorded as 5.26% while turf algal cover was 0.36%. Coralline algae cover in Koswari Island was higher than that of Vaan Island but lower than Kariyachalli and Vilanguchalli islands. Total cover of coralline algae in Koswari Island was 6.53% and live coral cover was very minimal with 23.11%. Abiotic factors were the most dominant benthic category in this Island with 45.5% and DCA was recorded with 10.63%. Macro algal cover was recorded as 4.89% and turf algal cover was 1.63% in Koswari Island.

The percentage of coralline algae was highest in Karicyachalli Island among the four islands of Tuticorin. Total cover of coralline algae in Kariyachalli Island was 9.64% and live coral cover was also comparatively high with 42.35%. Abiotic factors and DCA were the other dominant benthic categories with 22.69 and 12.15% respectively. Macro algae and turf algae were recorded with 4.23 and 1.26% respectively in Kariyachalli Island. Coralline algae cover in Vilanguchalli Island was higher than that of Vaan and Koswari islands but lower than Kariyachalli Island. Total cover of coralline algae in Vilanguchalli Island was 6.98 where live coral cover was 28.65%. Abiotic factors were the dominant benthic category with 36.7% followed by DCA with 11.58%. Macro algae were recorded with 3.25% and turf algae with 1.09% in Vilanguchalli Island. Benthic community structure in the study sites is given in table 1.

According to the observations made on the quadrats, totally six types of non-geniculate coralline algae were recorded which are encrusting, warty, lumpy, layered, foliose and fruticose and encrusting type was the dominant type in all the islands followed by layered type In Vaan Island, total density of coralline algae was 8.75, 10.5, 7.75 and 7.25 no.m^{-2} respectively at sites 1, 2, 3 and 4. Encrusting type was by far the dominant category with an average density of 4.13 no.m^{-2} followed by layered type with 1.81

Table 1. Benthic community structure

	Live corals	Soft corals	DCA	Macro algae	Coralline algae	Turf algae	Others	Abiotic
Vaan	50.13	1.42	13.25	5.26	5.09	0.36	4.69	19.80
Koswari	23.11	1.75	10.63	4.89	6.53	1.63	5.96	45.50
Kariyachalli	42.35	3.56	12.15	4.23	9.64	1.26	4.12	22.69
Vilanguchalli	28.68	1.12	12.39	3.81	7.03	1.23	10.52	35.22

no.m^{-2} while warty, fruticose, foliose and lumpy types were 0.88, 0.81, 0.5 and 0.44 no.m^{-2} respectively. In Koswari Island, total density of coralline algae was 11.75, 10.5, 11.25 and 12 no.m^{-2} respectively at sites 1, 2, 3 and 4. As in Vaan Island, encrusting type was the dominant category in Koswari Island also with an average density of 5.75 no.m^{-2} followed by layered type with 2.56 no.m^{-2} and the densities of warty, fruticose, foliose and lumpy types were 0.25, 0.88, 0.94, and 1 no.m^{-2} respectively.

In Kariyachalli Island, total density of coralline algae was 18.25, 18.25, 15.75 and 16.25 no.m^{-2} respectively at sites 1, 2, 3 and 4. Encrusting type was the dominant category in this Island also with an average density of 7.63 no.m^{-2} followed by layered type with 2.81 no.m^{-2} while warty and lumpy types were also recorded significantly with 1.94 and 1.94 no.m^{-2} respectively while fruticose and foliose types were 1.06 and 1.75 no.m^{-2} respectively. In Vilanguchalli Island, total density of coralline algae was 14.25, 12.25, 15 and 12.5 no.m^{-2} respectively at sites 1, 2, 3 and 4. Again encrusting type was the dominant category here with 5.94 no.m^{-2} followed by layered type with 2.31 no.m^{-2} while warty, fruticose, foliose and lumpy types were 1.44, 1.19, 1.56 and 1.06 no.m^{-2} respectively. Density of each coralline algae type is given in figure 2. Underwater photos of non-geniculate algae are given in figure3.

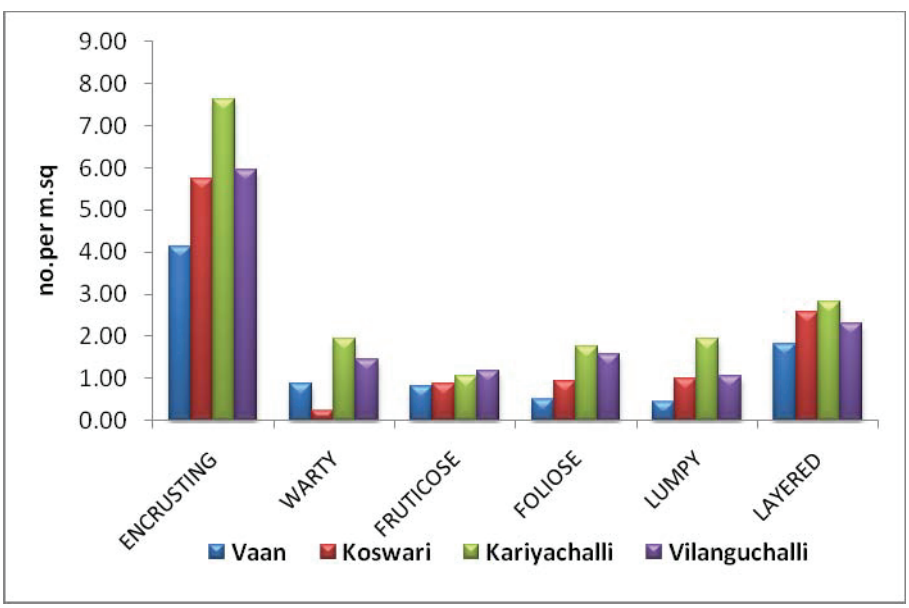

Fig. 2. Density of each coralline algae type

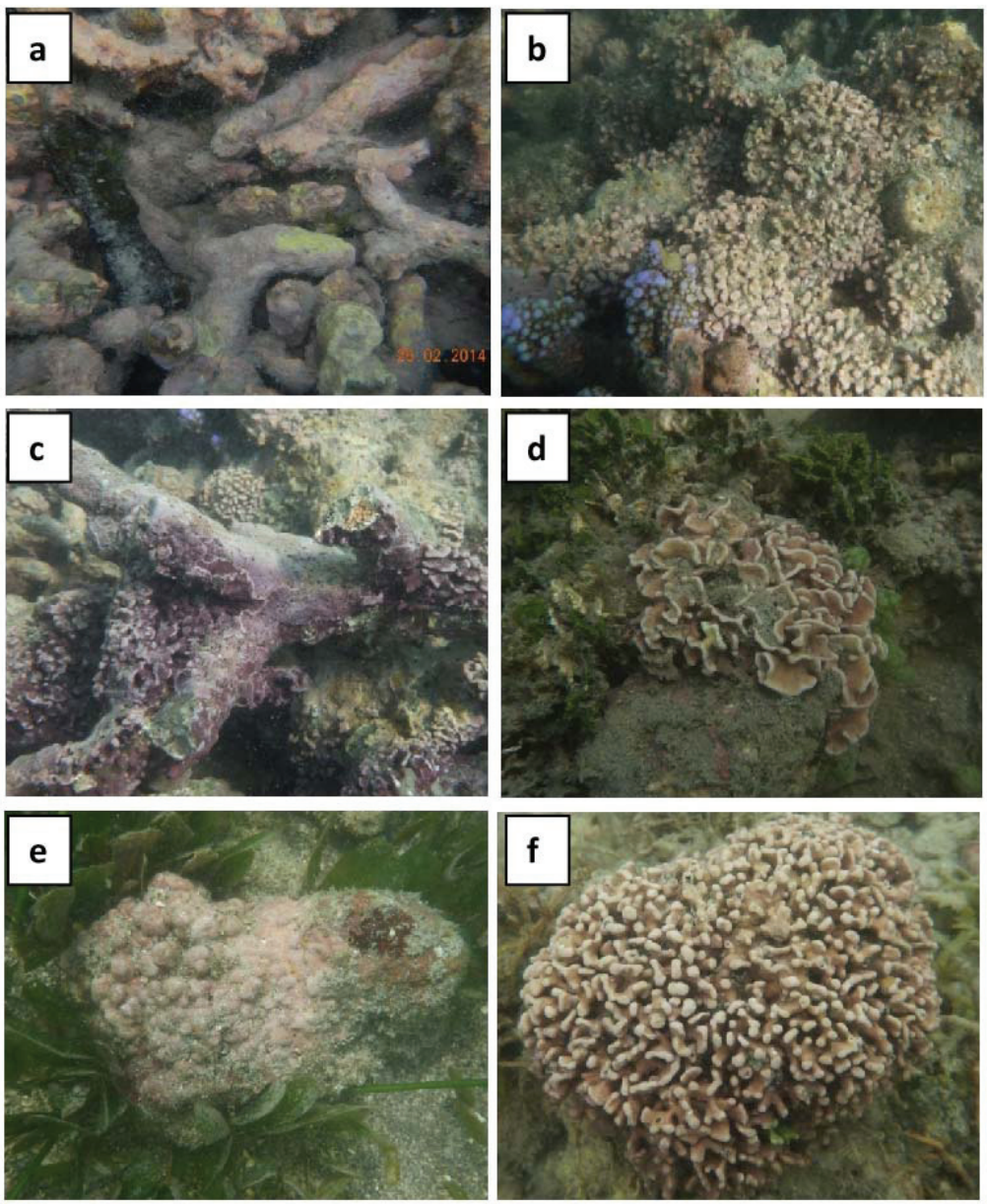

Fig. 3. Non-geniculate coralline algae recorded from Gulf of Mannar
a, encrusting; b, warty; c, layered; d, foliose; e, lumpy; f, fruticose

Discussion

The formations of reef platforms of pleistocene and modern reef are reported in the Gulf of Mannar along the periphery of the 21 uninhabited islands between Tuticorin and Rameshwaram (Ramanujam and Mukesh 1998). This discontinuous chain of islands (Stoddart and Fosberg 1972) protects the low lands of Ramnad and Tuticorin districts from cyclonic effects. Coral mining reduces the function of reefs as natural barriers and lead to increased beach erosion (Qazim 1999; Ramanujam and Sudarsan 2003), and is probably responsible for the submersion of two islands in the Gulf of Mannar (Edward et al. 2007). However, it has been reported that live coral cover in Tuticorin group of islands has increased considerably after 2004 Indian Ocean tsunami because of the end of coral mining (Edward et al. 2008; Raj and Edward 2010; Edward et al. 2012). Though, corals are vital to the reef building and their other uses are immense, the role of coralline algae in a reef system cannot be undermined.

Coralline algae occur from the Arctic to the Antarctic and from the highest and most inhospitable intertidal levels to the cold, dim depths of the ocean at the extreme limit of light penetration (Bjork et al. 1995). Coralline are known for their reef building capacity though the main organisms of reef building activity being corals. In some areas the contribution of calcareous matter from algae exceeds the contribution from corals and other reef builders and in some cases they comprise almost the whole of the biomass of the reef framework (Bjork et al. 1995; Kishore et al. 2012). In fact, the corallines and other calcareous algae are so structurally important on reefs that it has been suggested that the term coral reef is misleading and could be changed to biotic reef, or even algal reef (Hillis-Colivaux, 1986).

Though India has a long coastal length and bestowed with a significant amount of coral reefs, studies involving underwater protocol are seriously insignificant. It has been scanned that a total of 376 publications have been made on Indian coral reefs and less than 25% works involve either snorkeling or scuba diving. Hence, the importance of reef binding coralline algae has been neglected. It has been found in this initial study that all the study islands in Gulf of Mannar have a significant amount of coralline algae. Coralline algae were found everywhere, starting from the live coral to dead reef area around the islands. Encrusting type of non-geniculate coralline algae was observed to be the dominant type followed by layered. It is ironical that Vaan Island had the highest amount of live coral cover and a lowest amount of coralline algae, but on the other hand Kariyachalli Island had the highest cover of coralline algae where live coral

cover was second best.

Though the current study is a preliminary one, it provides information that status of coralline algae in Gulf of Mannar is fair and would help other researchers to take up these neglected organisms as their scope of research. Detailed study though is needed to find out the diversity and role of coralline algae in Gulf of Mannar and their role in Gulf of Mannar reef ecosystem.

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