



## Macro algal assemblage structure on the reefs of Tuticorin group of islands in the Gulf of Mannar

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### Abstract

The algal assemblage on the reefs of Vaan, Koswari and Kariyachalli islands of Tuticorin group in the Gulf of Mannar was studied for a period of one year. The amount of algae was high during January to April, whereas it was less during May to September. Meanwhile the percentage of rubbles was higher during May to September and lower in January to May, which indicated the coral algal phase shift. The green algae *Halimeda* spp. was found to be the dominant algal representative. Its average percentage in Vaan, Koswari and Kariyachalli was  $11.56 \pm 1.09$ ,  $11.12 \pm 1.70$  and  $8.77 \pm 1.72$  respectively. The ecological importance of algal assemblage in the coral reef ecosystem is discussed.

**Keywords:** Macro algae, assemblage, reefs, Tuticorin, India

### Introduction

Normally, when coral is dead, the resulting space (substrate after the removal of the colony or the surface of the dead coral) is filled within weeks by algae or other benthic forms. The term coral-algal phase shift refers to the phenomenon of coral reefs shifting to unusually low levels of coral cover associated with persistent states of high cover of fleshy macro algae (sea weed). It is widely recognized that the persistence of these shift has increased in the past few decades. This has led to concern over declining coral reef ecosystem health and integrity, losses of biodiversity and decreases in social, cultural and economic values (Hughes *et al.*, 2003; McManus *et al.*, 2001). Although much of this decline has been subsequent persistent increases in macro algal cover, it is generally difficult to separate the process of fleshy retarding coral settlement and recovery from the effects of repetition and diverse perturbation. However it is recognized that merely a reduction in coral does not constitute a coral algal shift. It is widely accepted that nutrients play a leading role in determining coral reef community structure (Birkeland, 1987; Littler and Littler, 1984; Steneck and Dethier, 1994).

In general, studies suggest that corals will dominate over fleshy macro algae under low nutrient conditions with the competitive advantage shifting towards macro algae as nutrient level increase (Szmant, 2002). This leads to the assumption that nutrients are the primary cause of the coral algal phase shift. All over the world, in

practically every habitat, fishing activities have severely reduced the population sizes as well as the average size of individual fish within a species (Jackson *et al.*, 2001; Meyers and Worm, 2003; Pauly *et al.*, 1998; Pauly *et al.*, 2002). The removal of the major herbivores by fishing in tropical and subtropical food webs has resulted in decreased grazing and hence increased proliferation of algae on many coral reefs (McManus *et al.*, 2001). The algal assemblages associated to coral reefs remain largely unnoticed and unstudied in the Tuticorin group of islands in Gulf of Mannar. The present work is conducted to find out the various algal assemblages associated with this reef ecosystem.

### Materials and methods

The Gulf of Mannar and Tuticorin region consist of 21 and 7 islands respectively. The islands in Tuticorin region are categorized into two groups namely, the Tuticorin group (4 islands) and the Vembar group (3 islands). The Tuticorin group of islands includes, Vaan, Koswari, Kariachalli and Vilanguchalli. Among these Vilanguchalli is already submerged. The present study was carried out in the other three islands (Fig. 1) from January 2005 to January 2006.

Since algal assemblages are more in dead coral areas, the sites were selected accordingly. The surveys were initiated by mapping the dead reef areas using Manta tows (Done, 1992). After confirming the position, the sessile

benthic community were surveyed using the Line intercept transect (LIT) (English *et al.*, 1997). Transects of 30m in length were laid along the dead reef area using a flexible measuring tape. The depth range was between 1 and 5 m. Depending on the size of the dead coral areas, 10 to 20 transects were laid every month in each of the 3 islands. Algal presence along the transects was recorded using SCUBA. Most of the algae were identified under water itself. Some of them were taken to the laboratory and identified. The percentage cover of the algal and the other benthic categories were calculated following the

method of English *et al.* (1997). The percentage of each algal species was estimated by using quadrats (50 cm × 50 cm) with 25 squares (10 cm × 10 cm) (Saito and Atope, 1970).

## Results

In Vaan Island, among the algal categories, macro algae reaches the maximum percentage of 21.6% in March, followed by February, April and January with 21.2%, 20.6% and 20.5% respectively. Algal assemblage was

also high in January to April with highest of 20.5% in March. Both macro algae and algal assemblage were low in May to August. There was not much deviation in the amount of *Halimeda* throughout the year, where it hit highest in February with 13.3% and lowest in August with 9.9%. The presence of coralline algae and turf algae was between 1.0% and 4.3% and there was no significant deviation in their presence (Fig. 2).

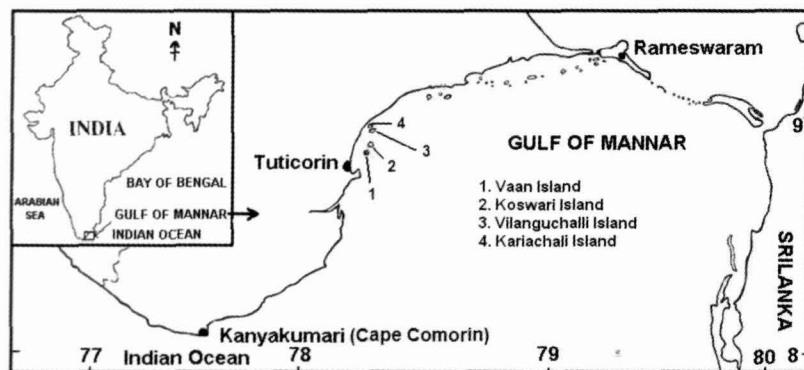


Fig.1. Tuticorin group of islands, Gulf of Mannar

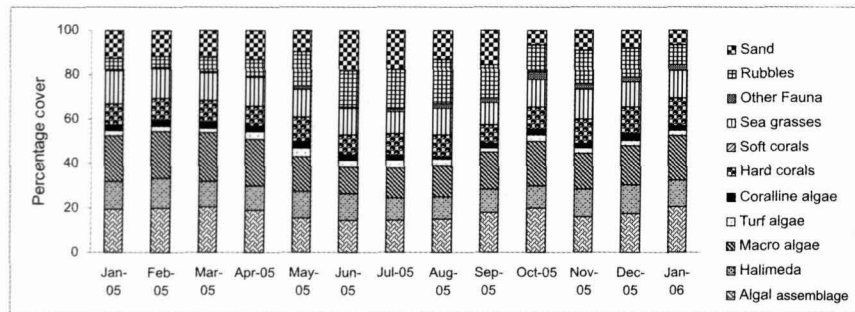


Fig. 2. Percent cover of major benthic categories in Vaan Island

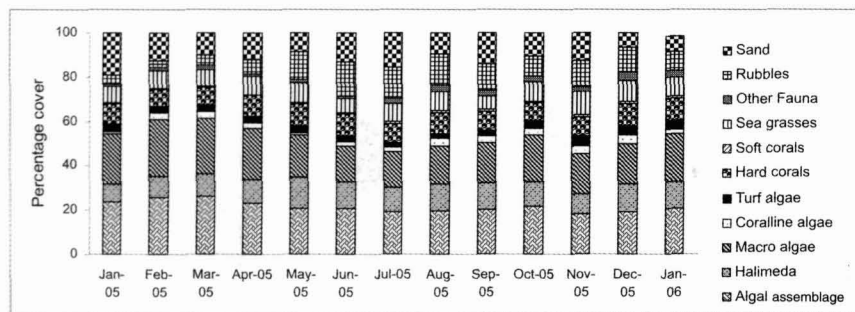


Fig. 3. Percent cover of major benthic categories in Koswari Island

In Koswari, macro algae and algal assemblage reach high percentage cover among the algal categories. Macro algae were highest in February (25.6%) and lowest in June (15.9%). Algal assemblage was also highest in March and lowest in July as 25.9% and 19.3% respectively. *Halimeda* reaches highest percentage in May with 14.3% and lowest in January with 8.2%. Coralline algae and turf algae cover fall between 1.1% and 4.5% (Fig. 3).

In Kariyachalli, algal assemblage was higher than any other algal categories. It was highest in March and February (around 30%) and lowest in June and July

with 19.3% and 19.4%. Macro algae were highest in March and February with 28.6% and 28.5 and lowest in August with 17.1%. *Halimeda* was highest in May with 12.4% and lowest in January with 7%. Coralline algae and turf algae fall between 2% and 4.3% (Fig. 4).

There was not much deviation in the percentage of live coral cover in all 3 islands. It was about 10% in Vaan Island, 9% in Koswari and 17% in Kariyachalli. The percentage of coral rubbles was more during May and September in all the islands, while the percentages of algae were low.

The average percentage of algal assemblage and macro algae in Vaan Island was  $17.7 \pm 2.4$  and  $17.7 \pm 3.2$  respectively. In Koswari, it was  $21.3 \pm 2.5$  and  $20.2 \pm 3.3$ . In the case of Kariyachalli, it was  $23.7 \pm 4.1$  and  $22.5 \pm 3.9$ . The average percentage of *Halimeda* in Vaan, Koswari and Kariyachalli were  $11.6 \pm 1.1$ ,  $11.1 \pm 1.7$  and  $8.8 \pm 1.7$  respectively (Figs. 5, 6, 7).

Among the green algae, genus *Halimeda* showed the highest percentage cover. The average percentage of *Halimeda tuna* and *H. macroloba* were  $8.9 \pm 1.3$  and  $7.2 \pm 1.1$  respectively in Vaan Island. In Koswari, it was  $7.5 \pm 0.7$  and  $8.4 \pm 1.3$  and in Kariyachalli, it was  $7.7 \pm 0.9$  and  $7.2 \pm 1.1$  respectively. Besides *Halimeda*, the genus *Ulva* has a significant percentage cover. The average percentage cover of *Ulva lactuca* and *U. reticulata* in Vaan, Koswari and Kariyachalli islands were  $1.60 \pm 0.43$  and  $0.4 \pm 0.3$ ,  $2.4 \pm 0.5$  and  $2.3 \pm 0.5$  and  $2.3 \pm 0.6$  and  $2.1 \pm 0.6$  respectively (Figs. 8, 11, 14).

Among the red algae, the genus *Gracilaria* was having the highest percentage cover. *G. folifera* was dominant in Koswari with  $2.2 \pm 0.6$ , while *Gracilaria edulis* was

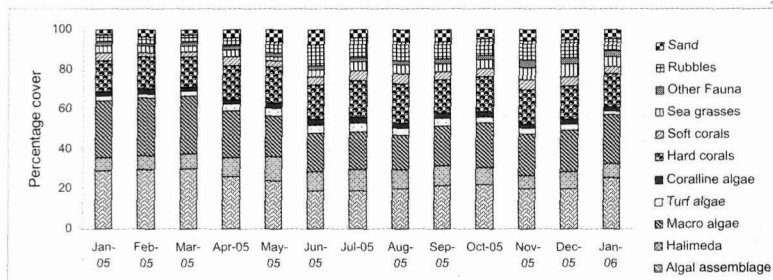


Fig. 4. Percent cover of major benthic categories in Kariyachalli Island

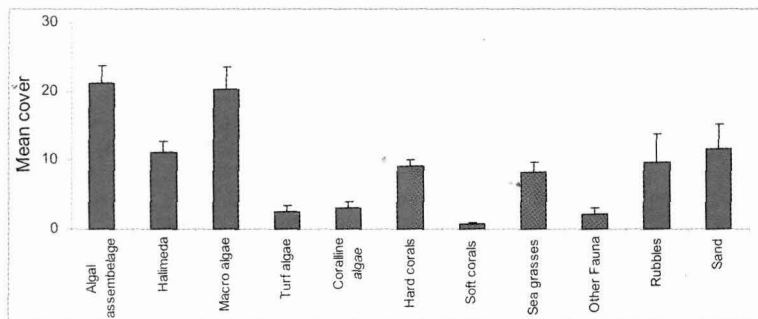


Fig. 5. Overall percent cover of major benthic categories in Vaan Island

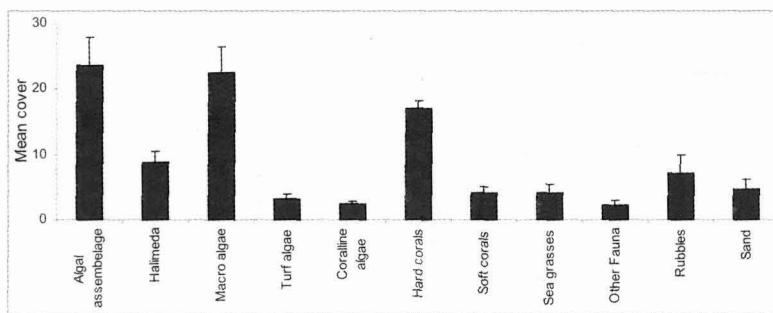


Fig. 6. Overall percent cover of major benthic categories in Koswari Island

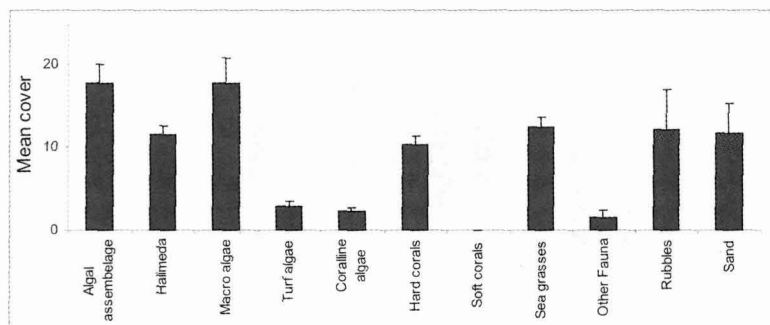


Fig. 7. Overall percent cover of major benthic categories in Kariyachalli Island

recorded highest in Kariyachalli with  $2.7 \pm 0.7$  (Figs. 9, 12, 15). Others were not significant..

Among the brown algae, the genus *Padina* showed a high percentage cover in all islands. *Padina gymnospora* was recorded highest in Koswari with  $8.1 \pm 0.8$ . *P. tetrastomatica* was also having a high percentage cover in all islands, with a highest average percentage cover in Kariyachalli with  $7.5 \pm 1.6$ . The genus *Sargassum* was having a high percentage cover in all islands followed by the genus *Turbinaria*. Others were not significant (Figs. 10, 13, 16).

### Discussion

It has been reported that Kariyachalli Island is having a high live coral cover than other islands in Tuticorin group with 46.6% and Koswari Island with lesser live coral cover as 15.3% (Edward *et al.*, 2005). The present study in three islands viz. Vaan, Koswari and Kariyachalli has shown that the percentage of algae on the dead reef areas is high. The waters around the islands are found to be highly nutritive due to the presence of a major sewage outlet in adjacent Threspuram Village. Kariyachalli Island is a little far away from this sewage outlet and hence it is not significantly affected and is also having the high coral cover. All the three islands constitute almost the same bottom substrate composition and hence the results did not show much variation.

The percentage of algae was high during January to April and low from May to September. Meanwhile the percentage of rubbles was higher from May to September and lower in January to May, indicating the coral algal phase shift.

*Halimeda* spp. appeared be the most successful green algae, which

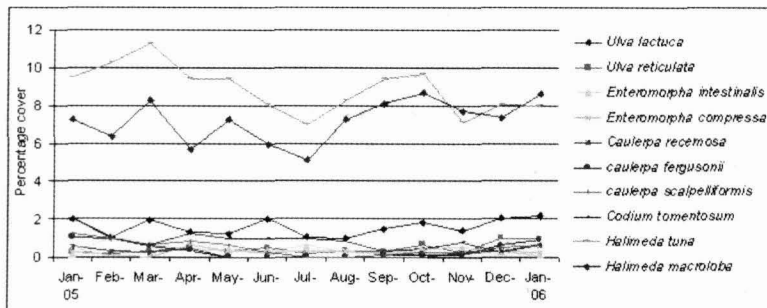


Fig. 8. Overall percent cover of green algae in Vaan Island

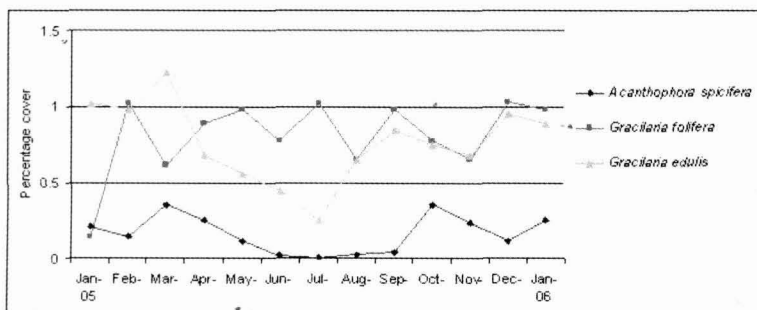


Fig. 9. Overall percent cover of red algae in Vaan Island

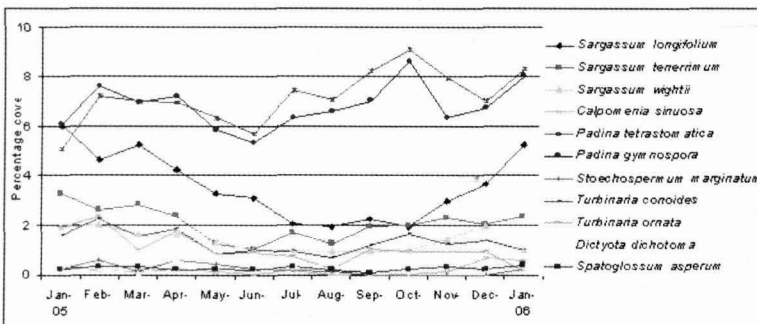


Fig. 10. Overall percent cover of brown algae in Vaan Island

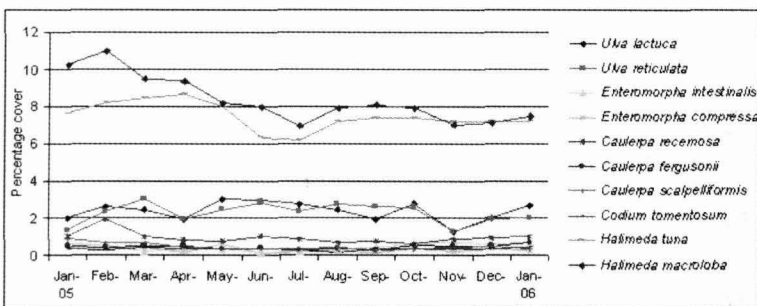


Fig. 11. Overall percent cover of green algae in Koswari Island

were found to grow on the coral rubbles in all the three islands. This was followed by the brown algae *Padina* spp. It has been reported earlier that the corals have a special mechanism to inhibit the growth of *Halimeda opuntia* (Nugues *et al.*, 2004). In the present study, it can be noted that *Halimeda* spp., algal assemblage and macro algae have a higher percentage cover than the live coral cover in the three islands.

Note much is known about the fate of bleached corals, which may either regain their zooxanthellae and recover, or may die, in which case they generally become overgrown by algae (Diaz-Pulido *et al.*, 2002). Competition between corals and algae is an important process on coral reefs, especially during reef degradation, when abundant corals are often overgrown by benthic macroalgae (Jamaluddin *et al.*, 2003). The dead coral rubbles are usually overgrown initially by turf algae and coralline algae. Earlier studies have shown that filamentous algae or 'algal turfs' can negatively affect survival and growth of juvenile corals (Birkeland, 1977; Van Moorsel, 1985). In the present study, it was observed that the percentage of turf algae in all the three islands were comparatively less due to the lack of recently dead corals, which normally forms the basic substrate for attachment.

Quantifying the consequences of phase shifts to coral recruitment, growth and competition is critical to the management and restoration of coral reefs. Although the inverse relationship between algal and coral cover on degraded reefs suggests that the algae are competitively dominant over adult corals, algal proliferation usually follows coral mortality. This indicates that the corals are competitively dominant over algae as adults, but inferior as larvae

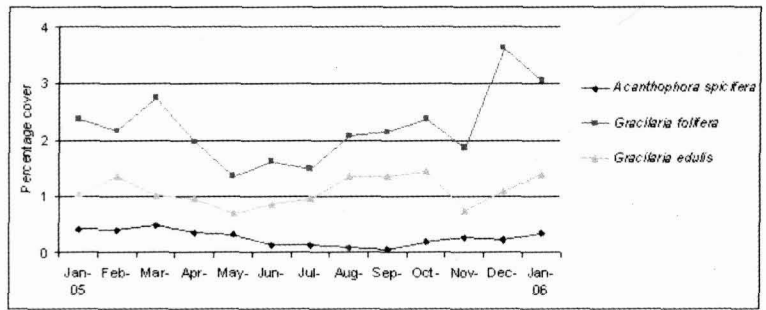


Fig. 12. Overall percent cover of red algae in Koswari Island

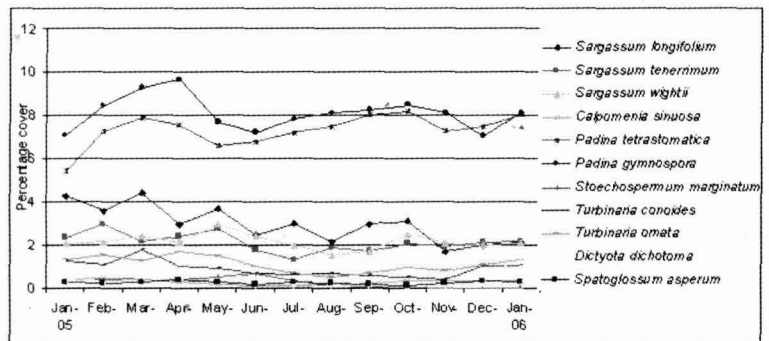


Fig. 13. Overall percent cover of brown algae in Koswari Island

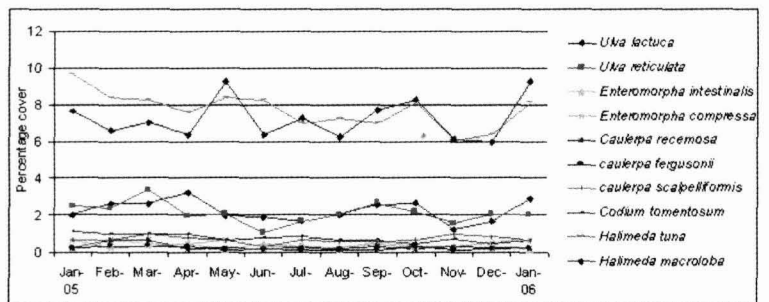


Fig. 14. Overall percent cover of green algae in Kariyachalli Island

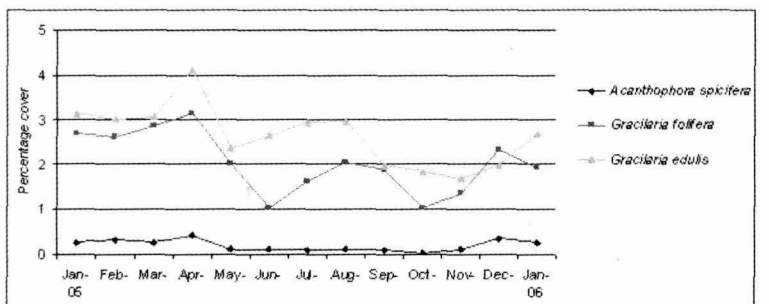


Fig. 15. Overall percent cover of red algae in Kariyachalli Island

and recruits (McCook *et al.*, 2004). Coral recruitment is significantly lower in areas that have undergone phase shifts (Edmunds and Carpenter, 2001). However, the mechanisms involved remain unknown. Understanding the algal assemblage is very essential because it is directly related to the health of the corals, especially the study area has been exploited and degraded indiscriminately for over 2-3 decades.

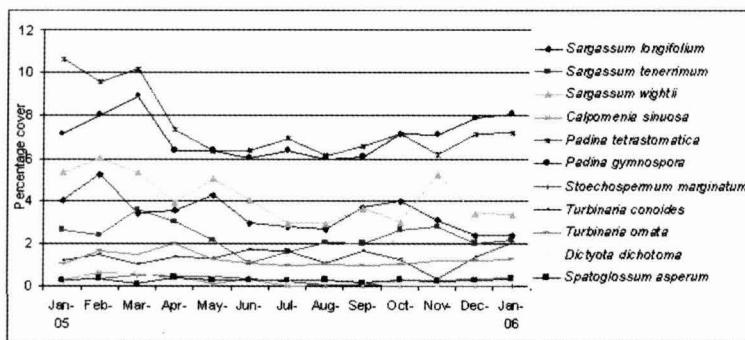


Fig. 16. Overall percent cover of brown algae in Kariyachalli Island

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