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Seagrass Diversity and Associated Flora and Fauna in the Coral Reef Ecosystem of the Gulf of Mannar, Southeast Coast of India

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Abstract: The Seagrass diversity and associated flora and fauna in the coral reef ecosystem of the Gulf of Mannar was assisted with Line Intercept Transects (LIT) with help of SCUBA diving during December - March 2010. There were 13 species of seagrass found, among this *Cymodocea serrulata* was dominant species and the least was *Halophila stipulacea*. Percentage of seagrass was 68% among this 51% distributed towards the shoreward side and 17% towards the seaward side. Shoot density was 345.9 shoot/m^2 at shoreward side and 230.3 shoot/m^2 at in seaward side. Among the species, *Cymodocea serrulata* has high shoot density at both shoreward side and seaward side. Seagrass biomass was 255.6 gdwt/m^2 at shoreward side and 129.1 gdwt/m^2 at in seaward side. Among the species, *Enhalus acoroides* has high biomass with 83.5 gdwt/m^2 and *H. wrightii* and *H. becarii* has lowest biomass with 3.2 gdwt/m^2 at shoreward side. Whereas, in seaward side *Enhalus acoroides* with 54.1 gdwt/m^2 followed by *Cymodocea serrulata* with 35.1 gdwt/m^2 and *H. decipiens*, *H. ovata*, *H. ovalis* and *H. decipiens* has lowest biomass with 2.4 shoot/m^2. Seagrass biomass 384.7 gdwt/m^2 among this seagrass biomass was 330.9 gdwt/m^2 and epiphytic biomass was 53.8 gdwt/m^2. Total epiphytic biomass was 53.8 gdwt/m^2 among this 35.4 gdwt/m^2 at shoreward side and 18.4 gdwt/m^2 at in seaward side. Distribution of seagrass along the islands of Gulf of Mannar varies in a very less proportion. But the spatial variation between the shoreward side and seaward side was very high. The present studies reveal that seagrass distribution, diversity, shoot density and associated flora and fauna were significantly higher in shoreward relative to seaward side. This study of seagrass in the coral reef ecosystem of the Gulf of Mannar would be the base line data to know the changes in seagrass population and associated flora and fauna in future.

Key words: Associated flora and fauna, *Cymodocea serrulata*, *Enhalus acoroides*, Gulf of Mannar, seagrass diversity

INTRODUCTION

Seagrass are specialized marine flowering plants adapted to the near shore environment. These form extensive meadows supporting high biodiversity (Connolly *et al*., 1999). These plants regulate water column dissolved oxygen, modify their physical and chemical environments, and reduce suspended sediments, chlorophyll, and nutrients in the water column (Nixon and Oviatt, 1972). Seagrass stabilize sediments, slow water movements and trap heavy metals and nutrient rich runoff, thus improving the water quality for corals and fish communities. Seagrass filter freshwater discharges from land, maintaining necessary water clarity for coral reef growth. Coral reefs, in turn, buffer ocean currents and waves to create a suitable environment for seagrass. Seagrass meadows are important nursery habitats for reefs that increase young fish survival (Mumby *et al*., 2004; Unsworth *et al*., 2008). Seagrass root and rhizome systems bind and stabilize bottom sediments, and seagrass leaves baffle currents (Koch, 1996) and improve water quality by filtering suspended matter (Short and Short, 1984).

Seagrass, though one of the predominant and specialized group of marine flora, are poorly known in India, compared to other similar ecosystems such as mangroves. The major seagrass meadows in India exist along the southeast coast (Gulf of Mannar and Palk Bay) and in the lagoons of islands from Lakshadweep in the Arabian Sea to Andaman and Nicobar in the Bay of Bengal. The largest area of seagrass occurs along the Gulf of Mannar and Palk Bay. The regions of India that are colonized by seagrasses support rich and diverse fauna like Corals, sea anemones, mollusks, sea cucumbers, star fishes and sea urchins. It serves as feeding and nursery habitat for endangered species like dugong and turtles and also many commercial and recreationally important fishes.

Nowadays, the biodiversity in the marine environment of Gulf of Mannar in India is being affected

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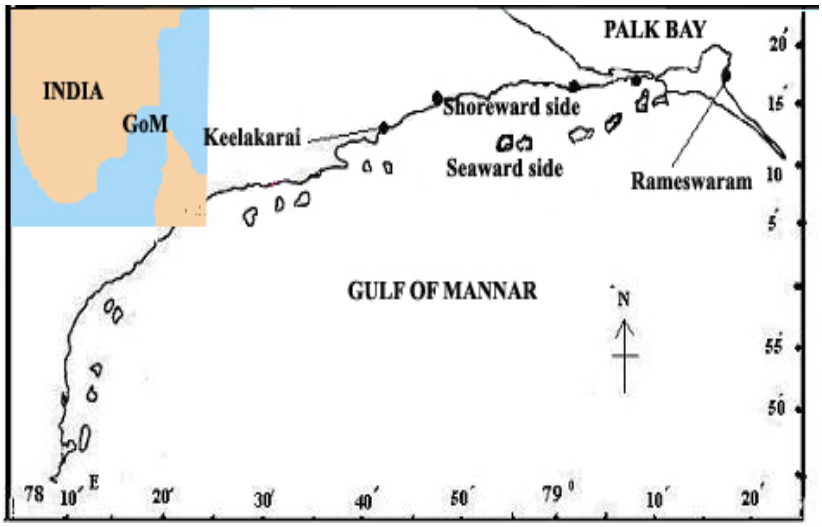


Fig. 1: Distribution of seagrass the coral reef ecosystem of the Gulf of Mannar region

due to increase in fishing and anthropogenic activities. The Gulf of Mannar extends from Tuticorin to Rameswaram Island in the SW-NE direction, lies between 78º5′ and 79º30′ E longitudes and 8º47′ and 9º15′ N latitudes, to a length of about 140 km. This area has luxuriant seagarss growth because of the topography and sediment texture. According to Jagtap *et al*. (2003), the major seagrass meadows in India exist along the Southeast coast (Gulf of Mannar and Palk Bay) and in the lagoons of Islands from Lakshadweep (Arabian Sea) and Andaman and Nicobar in Bay of Bengal. The seagrass species diversity is high in the Gulf of Mannar and Palk Bay, while it is low in the Bay of Bengal (Parthasarathy *et al*., 1991). The seagrass are the one of the important producer in the marine environment from extensive meadows supporting high biodiversity; serves as feeding and nursery habitat. Hence, it is essential to monitor the status of the seagrass in the marine environment so the present study was aim to study the status of seagrass biodiversity, shoot density, seagrass biomass, epiphytic biomass and associated flora and fauna. This study of seagrass in Gulf of Mannar would be the base line data to know the changes in seagrass population and associated flora and fauna in future.

MATERIALS AND METHODS

The study was conducted in the coral reef ecosystem of the Gulf of Mannar region of southeast coast of India during January - March 2009 in the area between latitudes 09º07′ to 09º16′ N and Longitudes between 078º47′ to 079º10′ E. The study sites consist of chain of 14 islands along with stretch of 60 km in the Gulf of Mannar region (Fig. 1). The entire chain of 14 islands was divided into 2 zones namely shoreward (mainland to Islands regions) and seaward side (towards the offshore).

The seagrass distribution and diversity was assessed by SCUBA diving assisted with Global Positioning System (GPS) at every 0.5 km. 100M Line Intercept Transects were laid on the seagrass meadows, transects were separated from each other by a reasonable distance, and were parallel to each other and perpendicular to the shore using English *et al*. (1997) method. In each transects a Quadrat (50 cm × 50 cm) was laid at 5m regular intervals. Each quadrat were divided into 25 squares (10 cm × 10 cm) in order to calculate the percentage cover of seagrass species through visual estimation method (Saito and Atobe, 1970). The seagrass biomass was estimated using Mellors (1991). Epiphytic biomass was estimated by using Penhale (1977) method. The most commonly used way of expressing biomass or standing crop is g dry weight per m^{-2}. Seagrass associated flora and fauna were also noticed.

RESULTS

Overall percentage of seagrass was 63%, among this 42% distributed towards the shoreward side and 21% towards the seaward side. There were total 13 species of seagrass found around the islands, out of this 11 species were only found in seaward side where as all 13 species of seagrass were present in shoreward side. Overall percentage of seagrass was 68% among this 43% distributed towards the shoreward side and 25% towards the seaward side. Among the seagrass species, the percentage of *Cymodocea serrulata* was 37% and was the dominant species in both shoreward and seaward side where as *Halophila stipulacea* was least dominant species with percentage of 2 in shoreward side (Fig. 2).

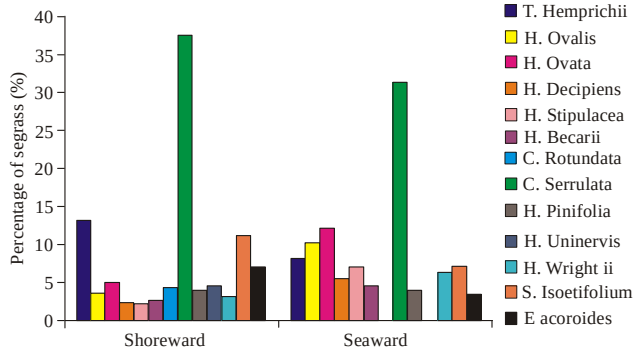


Fig. 2: Percentage of Seagrass the coral reef ecosystem of Gulf of Mannar

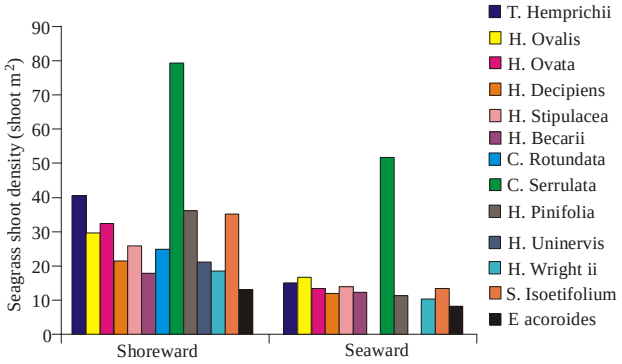


Fig. 3: Shoot density of seagrass in the coral reef ecosystem of Gulf of Mannar

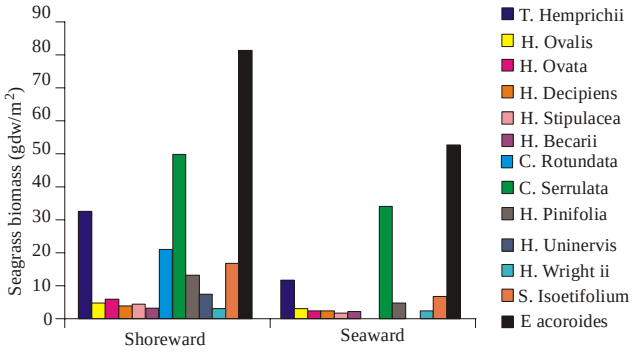


Fig. 4: Biomass of seagrass in the coral reef ecosystem of Gulf of Mannar

Seagrass shoot density was 345.9 shoot/m^2 at shoreward side and 230.3 shoot/m^2 at in seaward side. Among the species, *Cymodocea serrulata* has high shoot density with 72 shoot/m^2 and *Halophila stipulacea* has lowest density with 13.4 shoot/m^2 at shoreward side. Whereas, in seaward side *Cymodocea serrulata* has high shoot density with 65.1 shoot/m^2 and *Enhalus acoroides* has lowest density with 2.4 shoot/m^2 (Fig. 3). Seagrass biomass was 255.6 gdwt/m^2 at shoreward side and 129.1 gdwt/m^2 at in seaward side. Among the species, *Enhalus acoroides* has high biomass with 83.5 gdwt/m^2 and *H. wrightii* and *H. becarii* has lowest biomass with 3.2 gdwt/m^2 at shoreward side. Whereas, in seaward side *Enhalus acoroides* with 54.1 gdwt/m^2 followed by *Cymodocea serrulata* with 35.1 gdwt/m^2 and *H. decipiens*, *H. ovata*, *H. ovalis* and *H. decipiens* has lowest biomass with 2.4 shoot/m^2 (Fig. 4). Total seagrass biomass 384.7 gdwt/m^2 among this seagrass biomass was 330.9 gdwt/m^2 and epiphytic biomass was 53.8 gdwt/m^2. Total epiphytic biomass was 53.8 gdwt/m^2 among this 35.4 gdwt/m^2 at shoreward side and 18.4 gdwt/m^2 at in seaward side (Fig. 5). During the survey the seagrass associated flaura

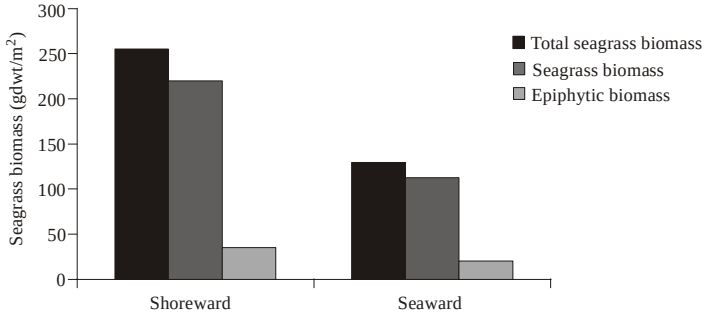
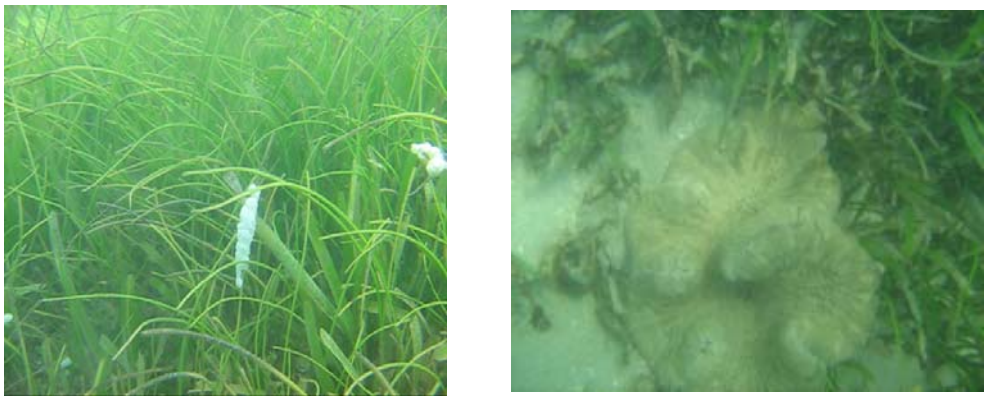


Fig. 5: Epiphytic biomass of seagrass in the coral reef ecosystem of Gulf of Mannar



a. Seagrass associated Ascidians b. Seagrass associated Sea anemone

Fig. 6: Seagrass associated fauna in the coral reef ecosystem of Gulf of Mannar

and fauna was observed like seaweeds, sponges, scleractinian corals, colonial zoanthid Palythoa, Ascidians, polychaete worms and mollusks, (Fig. 6).

DISCUSSION

This study revealed that percentage of seagrass was moderate at shoreward side whereas seagrass percentage and distribution was low in seaward side. Persisting strong waves in the seaward side is a big reason behind their relatively low percentage cover because it has been reported that in their natural environment seagrass are exposed to wind-driven currents, tides, waves and wave-driven currents (Koch, 2001). Due to the presence of soil erosion, prevalent wave action and water current during monsoon wind most of the seagrass species are unable to withstand. *Cymodocea serrulata* was dominant species in the Gulf of Mannar because *Cymodocea serrulata* is a runner and possess more root density and also drop-off all its leaves during seasonal changes (especially during monsoon wind wave action). Spatial variation of seagrass species in these study indicated that various physicochemical and geomorphological characteristics have role in the distribution of seagrass as noted by Coles *et al*. (1987). *Enhalus acoroides* were observed dominantly in shoreward side of island because of which this region possess rich amount of clay toasted silt soil. *Enhalus acoroides* are endemic to the region which possess rich amount of clay toasted silt soil (Thangaradjou and Kannan, 2005). *Halodule stipulacea* was only distributed in the depth region of the shoreward and seaward side because these are alive under low light circumstance as suggested by Longstaff and Dennison (1999).

The shot density of seagrass was higher in the shoreward side due to known light and nutrient. According to Short *et al*. (1993) the overall reduction in the total seagrass weight could be due to insufficient light and also the effects of decreased light have reduction in shoot density, number of leaves per shoot, and growth rate. The shoot density and diversity of seagrass were less in seaward side this indicated that, the rising of depth and reduced light penetration affect the shoot density and biomass. The physical factors such as temperature, salinity, waves, currents, depth, substrate and day length that regulate the physiological activity of seagrass and

natural phenomena such as light, nutrients, epiphytes and diseases that limit the photosynthetic activity of the plants, and anthropogenic inputs such as nutrient and sediment loading that inhibit the access to available plant resources. Various combinations of these parameters may permit, encourage or eliminate seagrass from a specific location. The present study revealed that on comparing both shoreward and seaward side, the shoreward have more seagrass percentage, shoot density and seagrass associated flora and fauna because in the shoreward side of Gulf of Mannar region which possess more salinity and more temperature, less waves, less currents, less depth, sandy-clay substrate, light, nutrient and less sedimentation which favor the growth of seagrass.

Sedimentary environment suitable for seagrass colonization, distribution and abundance of seagrass depend upon the substratum (Burrel and Schubel, 1977). The substratum of the Islands contain moderate amount of sand toward shore, which favor the growth of seagrass. Presence of higher percentage of stone and gravel and sand fractions in the seagrass beds of the Gulf of Mannar have also been reported earlier (Vinithkumar *et al*., 1999). The seaward side is sand bottom with rock, another one important as depth of the seaward side is high with more than 20 M, where as depth of the shoreward side is below 6-8 M and depth plays a vital role in the occurrence of seagrass. It is a fact that low light availability occurs at depth. Distribution of seagrass meadows in deep water habitats is particularly affected by light reduction from pulse turbidity events (Longstaff and Dennison, 1999). In conclusion, the findings of this study show that the different species exhibited differences in biomass when the two sides were compared. Of the 13 seagrasses, and *Cymodocea serrulata* showed significantly higher shoot density in the nutrient rich shoreward side. Distribution of Seagrass along the islands of Gulf of Mannar varies in a very less proportion. But the spatial variation between the shoreward side and seaward side is very high. Seagrass diversity, shoot density, biomass, epiphytic biomass and associated flora and fauna were significantly higher in shoreward side relative to seaward side.

CONCLUSION

Biodiversity in the marine environment of Gulf of Mannar in India is being affected due to increase in fishing and anthropogenic activities. The seagrass are the one of the important producer in the marine environment from extensive meadows supporting high biodiversity; serves as feeding and nursery habitat for endangered species like dugong, turtles and many commercial, and recreationally important fish specie. Hence, it is essential to monitor the status of the seagrass in the marine environment so the present studies revealed that seagrass distribution, diversity, shoot density and biomass were significantly higher in shoreward side relative to seaward side.

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