Asian Journal of Plant Sciences

ISSN 1682-3974

Asian Journal of Plant Sciences 10 (1): 80-85, 2011
ISSN 1682-3974 / DOI: 10.3923/ajps.2011.80.85

Distribution and Spatial Variation of Seagrass in the Northern Part of Gulf of Mannar, Southeastern India

S. Manikandan, S. Ganesapandian, Manoj Singh and A.K. Kumaraguru
Department of Marine and Coastal Studies, Madurai Kamaraj University,
Madurai-625021, Tamilnadu, India

Abstract: The distribution and spatial variation of seagrass in the coral reef ecosystem of the Gulf of Mannar was assisted with Line Intercept Transects (LIT) with help of SCUBA diving during January-March 2009. Overall percentage of seagrass was 63% among this 42% distributed towards the shoreward side and 21% towards the seaward side. There were 13 species of seagrass found, among this *Cymodocea serrulata* was dominant species and the least was *Halophila stipulacea*. The shoot density of seagrass varied between 63 and 13.4 shoot m^{-2} in the shoreward side, while in seaward side it was between 65.1 and 2.4 shoot m^{-2}. Seagrass biomass was 179.2 g dwt m^{-2} at shoreward side and 63.62 g dwt 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 study reveal that seagrass distribution, diversity; shoot density and biomass were significantly higher in shoreward relative to seaward side. This study of seagrass in Gulf of Mannar would be the base line data to know the changes in seagrass population in future.

Key words: Gulf of Mannar, spatial variation, seagrass, *Cymodocea serrulata*, *Enhalus acoroides*

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; Ara *et al*., 2009). The productive assemblage of epiphytic algae on seagrass sustain invertebrate grazer, while seagrass detritus support consumer fish production through bacteria and fungal intermediate (Kathiresan and Aliknhi, 2010). Seagrass root and rhizome systems bind and stabilize bottom sediments and seagrass leaves baffle currents (Koch and Beer, 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.

Seagrass have been described as “coastal canaries, global biological sentinels of increasing anthropogenic influences in coastal ecosystems” (Orth *et al*., 2006). Fundamental monitoring programme should provide a powerful tool for coastal resource managers through improved tracking of seagrass populations over time. Continuously, catastrophic losses of seagrass meadows are worldwide along with rapidly urbanizing coastal zones,

Corresponding Author: S. Manikandan, Department of Marine and Coastal Studies, Madurai Kamaraj University, Madurai-625021, Tamilnadu, India Tel: 04567263900, +919786076605

despite recognition of the enormous ecological and economic value of seagrass meadows (Orth *et al*., 2006). A global conservation effort to protect seagrass habitat is critically needed (Orth *et al*., 2006). Globally about 20% of documented seagrass area had disappeared because of direct and indirect human impacts and many remaining beds are increasingly stressed and fragmented (Green and Short, 2003). Most of the earlier seagrass studies in the Gulf of Mannar have focused only on their quantitative, taxonomic and structural components but no comprehensive study was done on special variation of seagrass in the coral reef ecosystem. Hence, the study provides a baseline record of and associated fauna. The present investigation has been carried out to assess the spatial distribution of seagrass communities in the Gulf of Mannar, Southeastern India. The baseline data collected during the study period would help in the surveillance and monitoring of this element in future.

MATERIALS AND METHODS

The study was conducted in the northern part of Gulf of Mannar region of southeast coast of India during January-March 2009 in the area between latitudes 09° 13' to 09° 16' N and Longitudes between 079° 19' to 079° 47' 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 area of seagrass distribution was assessed by SCUBA diving assisted with Global Positioning System (GPS) at every 0.5 km. One hundred meter 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 (50×50 cm) was laid at 5 m regular intervals. Each quadrat were divided into 25 squares (10×10 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) method. Seagrass associated flora and fauna were also noticed. The most commonly used way of expressing biomass or standing crop is g dry weight m^{-2}.

RESULTS

Seagrass meadows were randomly distributed in the study area of northern part of Gulf of Mannar region and covering 56.6 km^2, among this 44 km^2 of seagrass distributed towards the shoreward side and 12.6 km^2 towards the seaward side. 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 10 species were only found in seaward side where as all 13 species of seagrass were present in shoreward side.

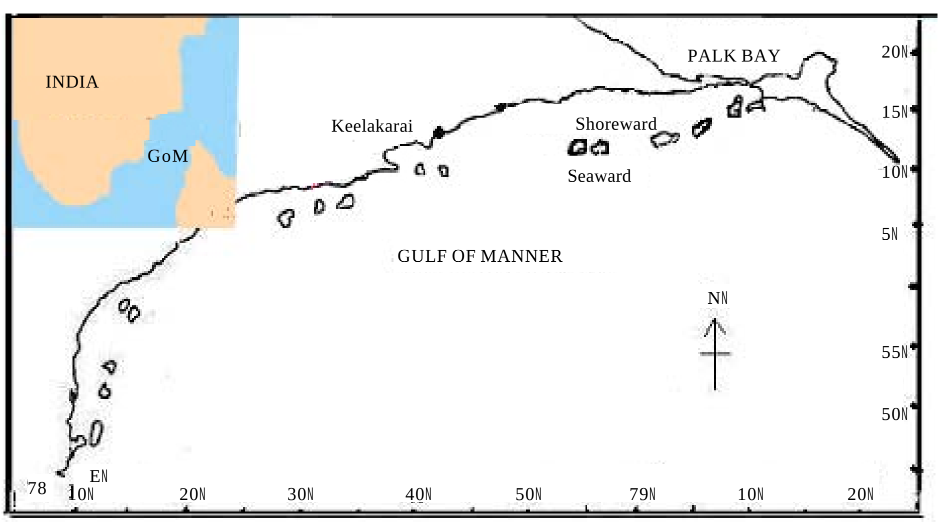

Fig. 1: Distribution of seagrass in the northern part of Gulf of Mannar region, India

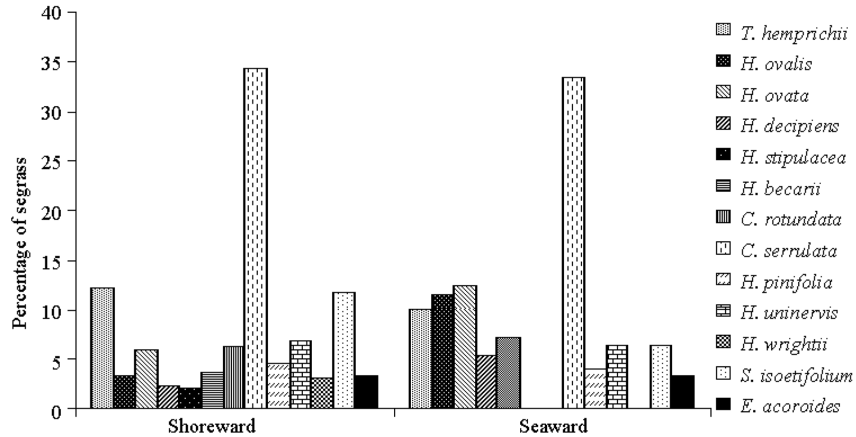

Fig. 2: Percentage of seagrass in the northern part of Gulf of Mannar

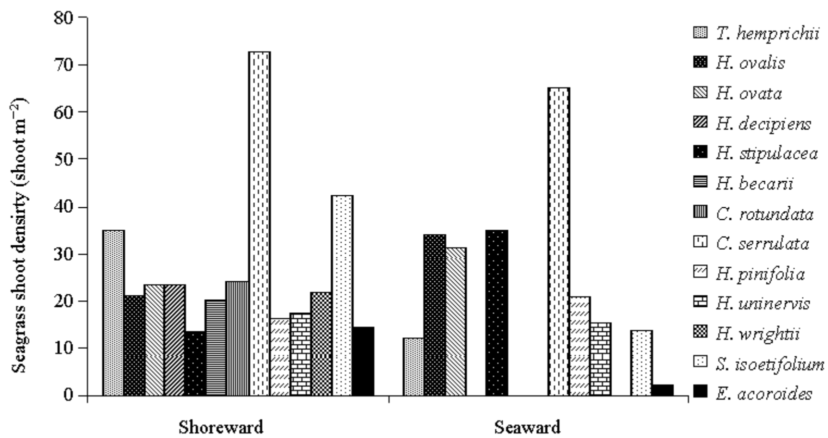

Fig. 3: Shoot density of seagrass in the northern part of Gulf of Mannar

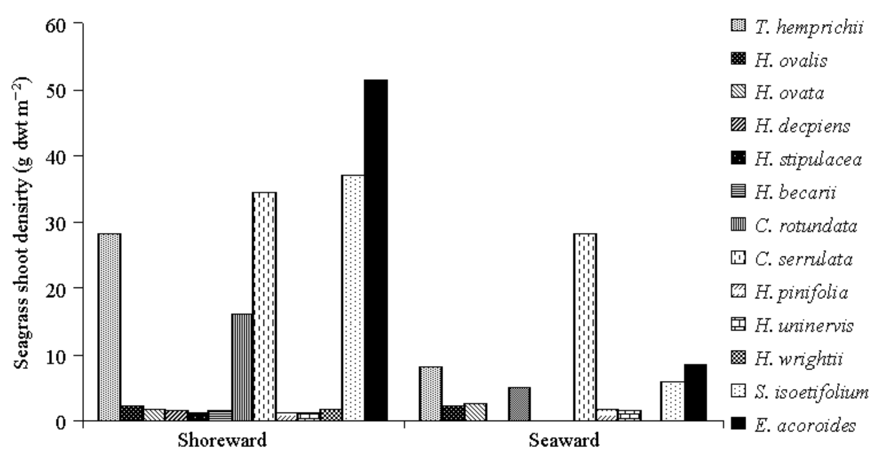

Fig. 4: Total Biomass of seagrass in the northern part of Gulf of Mannar

Overall percentage of seagrass was 63%, among this 42% distributed towards the shoreward side and 21% towards the seaward side. Among the seagrass species, the percentage of *Cymodocea serrulata* was 34.42% and was the dominant species in both shoreward and seaward side where as *Halophila stipulacea* was least dominant species with percentage of 2.1 in shoreward side (Fig. 2). 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 179.2 g dwt m^{-2} at shoreward side and 63.62 g dwt m^{-2} at in seaward side. Among the species, *Enhalus acoroides* has high biomass with 51.4 g dwt m^{-2} and *Halophila stipulacea* and *Halodule uninervis* has lowest density with 1.1 g dwt m^{-2} at shoreward side. Whereas, in seaward side *Cymodocea serrulata* has high shoot density with 28.3 g dwt m^{-2} and *Halodule uninervi* has lowest density with 1.4 g dwt m^{-2} (Fig. 4).

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 (Abu-Hena *et al*., 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; Manikandan *et al*., 2011). *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 and biomass of seagrass was higher in the shoreward side due to known light and nutrient. Seagrass biomass decreased with increasing depth due to insufficient ambient light (Mazzela and Alberte, 1986) and biomass of seagrass increased with light and nutrients availability was recorded (Stapel *et al*., 1997). Any natural stresses may affects on the biomass and productivity of seagrass in this marine ecosystem (Abu-Hena *et al*., 2004). 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, biomass and epiphytic biomass 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, biomass 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). 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.

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.

ACKNOWLEDGMENTS

The authors would like to acknowledge, The Directors of the Department of Marine and Coastal Studies, Madurai Kamaraj University, Madurai, Tamilnadu, India and Aqua Clinic Centre, Mandapam, Ramanathapuram-Dist, Tamilnadu, India for their valuable support.

REFERENCES

Abu Hena, M.K., K. Misri, B. Japar Sidik, O. Hishamuddin and H. Hidir, 2004. A preliminary study of the biological aspects of an intertidal seagrass *Thalassia hemprichii* (Ehrenberg) ascherson in port Dickson, Malaysia. Pak. J. Biol. Sci., 7: 1801-1807.

Abu Hena, M.K., K. Misri, B.J. Sidik, O. Hishamuddin and H. Hidir, 2001. Photosynthetic and respiration responses of dugong grass *Thalassia hemprichii* (Ehrenb) Aschers. at teluk kemang seagrass bed, Malaysia. Pak. J. Biol. Sci., 4: 1487-1489.

Ara, R., A. Arshad, N. Amrullah, S.M. Nurul Amin, S.K. Daud, A.A. Nor Azwady and A.G. Mazlan, 2009. Feeding habits and temporal variation of diet composition of fish larvae (Osteichthyes: Sparidae) in the sungai pulai seagrass bed, johore, Peninsular Malaysia. J. Biol. Sci., 9: 445-451.

Burrel, D.C. and J.R. Schubel, 1977. Seagrass Ecosystem Oceanography. In: Seagrass Ecosystem-A Scientijic Perspective, Mcroy, C.D. and C. Heilfferich (Eds.). Maccel Dekker, New York, pp: 195-225.

Coles, R.G., W.J.L. Long, B.A. Squire, L.C. Squire and J.M. Bibby, 1987. Distribution of seagrasses and associated juvenile commercial penaeid prawns in north-eastern Queensland waters. Aust. J. Mar. Freshwater Res., 38: 103-119.

Connolly, R., G. Jenkins and N. Loneragan, 1999. Seagrass Dynamics and Fisheries Sustainability. In: Seagrass in Australia; Strategic Review and Development of an R and D Plan, Butler, A. and P. Jernakoff (Eds.). FRDC, CSIRO, Sydney, pp: 25-62.

English, S., C. Wilkinson and V. Baker, 1997. Line Intercept Transect. In: Survey Manual for Tropical Marine Resources, English, S., C. Wilkinson and V. Baker (Eds.). Australian Institute of Marine Science, Townsville, Australia, pp: 34-51.

Green, E.P. and F.T. Short, 2003. World Atlas of Seagrasses. University of California Press, Berkeley.

Kathiresan, K. and N.M. Alikunhi, 2010. Tropical coastal ecosystems: Rarely explored for their interaction!. Ecologia (in press).

Koch, E.W. and S. Beer, 1996. Tides, light and the distribution of *Zostera marina* in long island sound, USA. Aquat. Bot., 53: 97-107.

Longstaff, B.J. and W.C. Dennison, 1999. Seagrass survival during pulsed turbidity events: The effects of light deprivation on the seagrasses *Halodule pinifolia* and *Halophila ovalis*. Aquatic Bot., 65: 105-121.

Manikandan, S., S. Ganesapandian and K. Parthiban, 2011. Distribution and zonation of seagrasses in the palk bay, Southeastern India. J. Fish. Aquat. Sci., 6: 178-185.

Mazzela, L. and R.S. Alberte, 1986. Light adaptation and the role of autotrophic epiphytes in primary production of the temperate seagrass *Zostera marina* L. J. Exp. Mar. Biol. Ecol., 100: 165-180.

Mellors, J.E., 1991. An evaluation of a rapid technique for estimating seagrass biomass. Aquat. Bot., 42: 67-73.

Mumby, P., A. Edwads, E.A. Gonzalez, K. Lindeman and P. Blacwell *et al*., 2004. Mangroves enhance the biomass of coral reef fish communities in the Caribbean. Nature, 427: 533-536.

Nixon, S.W. and C.A. Oviatt, 1972. Preliminary measurements of midsummer metabolism in beds of eelgrass, *Zostera marina*. Ecology, 53: 150-153.

Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte and J.W. Fourqurean *et al*., 2006. A global crisis for seagrass ecosystems. BioScience, 56: 987-996.

Saito, Y. and S. Atobe, 1970. Phytosociological study of intertidal marine algae. I. Usujiri Benten-Jima, Hokkaido. Bull. Fac. Fish. Hakkaido Univ., 21: 37-69.

Short, F.T. and C.A. Short, 1984. The Seagrass Filter: Purification of Estuarine and Coastal Water. In: The Estuary as a Filter, Kennedy, V.S. (Ed.). Academic Press, Orlando, pp: 395-413.

Short, F.T., D.M. Burdick, J. Wolf and G.E. Jones, 1993. Eelgrass in Estuarine Research Reserves along the East Coast. Part I: Declines from Pollution and Disease and Part II: Management of Eelgrass Meadows. NOAA, Coastal Ocean Program Publication, USA., pp: 107.

Stapel, J., R. Manuntun and M.A. Hemminga, 1997. Biomass loss and nutrient redistribution in an Indonesian *Thalassia hemprichii* seagrass bed following seasonal low tide exposure during daylight. Mar. Ecol. Prog. Ser., 148: 251-262.

Thangaradjou, T. and L. Kannan, 2005. Marine sediment texture and distribution of seagrasses in the Gulf of Mannar biosphere reserve. Seaweed Res. Utiln., 27: 145-154.

Unsworth, R.K., P.S. De Leon, S.L. Garrard, J. Jompa, D.J. Smith and J.J. Bell, 2008. High connectivity of Indo-Pacific seagrass fish assemblages with mangrove and coral reef habitats. Mar. Ecol. Prog. Ser., 353: 213-224.

Vinithkumar, N.V., S. Kumaresan, M. Manjusha and T. Balasubramaniank, 1999. Organic matter, nutrients and major ions in the sediments of coral reefs and seagrass beds of gulf of mannar biosphere reserve, southeast coast of India. Ind. J. Mar. Sci., 28: 383-393.