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RESEARCH ARTICLE

MACROFAUNAL ASSEMBLAGE ON TWO MANGROVE ECOSYSTEMS, SOUTHEAST COAST OF INDIA

***Sekar, V., Prithiviraj, N., **Savarimuthu, A and Rajasekaran, R**

Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India
** Sri Bharathi College of Education, Kaikkurichi, Pudukkottai – 622 303

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ABSTRACT

An ecological survey was carried out to divulge the spatial distribution and macrofaunal composition of two mangrove ecosystems of Tamilnadu. We scrutinize their relationship with environmental factors and faunal distribution which were monitored by means of 12 surveys over a period of one year. With the intention of studying the macrofaunal composition and seasonal changes along the three stations, these areas were chosen closed to the mangrove environment towards sea. Total number of species varied between 2 to 15 in each group and the total abundance were ranged from 78 to 119 in Pitchavaram mangroves. The macrobenthos density was found to be greatest at S2 followed by S3 and S1. S2 had the maximum diversity index (1.38 in bivalves) and minimum at S1 (1.32 in polychaetes). While in Muthupettai, mangroves varied 114 to 158, the diversity index varied maximum 1.37 at S2 (*Cerethidia cingulata*) minimum 1.27 at S1 (Amphipods). In both stations, the dominated fauna were polychaetes, bivalves, gastropods amphipods and tanaids, reliably being the most copious group at all stations. The domineering polychaetes encountered during this study included *Chaetopterus* sp. *Pista* sp., *Nephtys* sp. in Gastropods *Cerithedia cingulata, Meretrix meretrix* and *Peneaid shrimp larvae.* The statistical findings revealed a significant distinction that existed between the benthic assemblages of the three stations in both ecosystems. The differences in environmental parameters might be accountable for the assemblages of benthic community between stations as well as temporal seasons.

INTRODUCTION

Mangroves are a gifted indication of the most diverse and productive biological systems with important ecological benefit and economic resource of the coastal marine environment. It the assorted zone in the nursery ground for an array of organisms, coastal shoreline stabilizers, primary producers of coastal pollution and hold up food web for the estuarine and coastal ecosystems (Alongi, 1990)

Generally, the benthos includes marine invertebrates, microscopic algae and bottom dwelling fishes. It plays a critical role in tropic relationship by providing major sources of energy to economically and ecologically important demersal fishes and the adaptation of morphology modified to various habitat to generate the food availability of other large benthic organisms (Gerlach, 1978). These are widely studied benthic groups thus seemingly barren benthic bottoms might cover a teaming community of various sizes and taxonomic categories, it was mainly represented by polychaetes, mollusks, crustaceans etc.

In environmental assistance, the hydrographical parameters of the biotopes are mainly responsible for the biological productivity especially temperature, salinity, dissolved oxygen and sediment organic matter which plays a key role in the biological processes of ecosystems.

Whereas the boundaries of niche of any organism are depended on the variation of physicochemical parameters either individually or together, they influence the biology of the organisms (Kinne, 1963).

In each mangrove associated ecosystems there is massive and rich biodiversity in Pichavaram (Kathiresan, 2005) and Muthupettai (Thilagavathi, 2010), in order to determine the availability of the macrofauna and distributional variation between these ecosystems along these stations of study. These studies will reveal physical and chemical variables from the collection of grab samples for the estimation of benthic productivity and studying sediment characteristics. This survey was conducted in order to investigate any changes in the community structure of benthic fauna by analyzing their density and diversity of this mangrove area.

MATERIALS AND METHODS

Pichavaram mangrove

The Pichavaram mangrove forest is located between the vellar and coleroon estuaries along the Tamilnadu Fig.1. The forest occurs on 51 islets, ranging in size from 10m^2 to 2 km^{2,} separated by intricate water ways that connect aforementioned two estuaries. The mangrove cover an area about 11 km2, of which 50% is covered by forest, 40% by water ways and the remaining filled by sand flats and mud flats (Krishnamurthy

** Corresponding author: Tel: +91 4144 243223*
E-mail address: sekarveera15@gmail.com

and prince jayaseelan,1983).The sampling point was selected towards sea shore from the canal of Pichavaram namely Ts. Pettai (11°25'14.6 N 79°48'15.5E), Kanakeluthi Mada (11°25'48.3N 79°47'51.8E) and Periyakuda (11°25'28.31N 79°47'35.1E).

Muthupettai mangroves

Muthupettai mangroves situated 400 km south of Chennai which lies on the southern part of Cauvery delta region along the south east coast of Peninsular India. It spreads to an area of about 6,800ha in which two specialized habitats are found viz. mangrove and lagoon. Mullipallam Lagoon (11 sq.km) in Muthupettai is the second largest lagoon in Tamilnadu. In Muthupettai mangrove environment diurnal type of tidal rhythm is observed throughout the year. Dry season prevails during February to August. Wet season starts with the onset of Northeast monsoon and lasts till December. The sampling was started from Mouth (10°18'53.4N 79° 31'43.3E). Mullimunai (10°19'22.9N 79° 32'22.3E) and Sethukadavu (10°20'35.09N 79° 31'33.63E)

Sampling strategy

The benthic macro fauna were surveyed and analyzed on a seasonal basis from August, 2009 to July, 2010. The part of stretch of the inundated canal was surveyed using a mechanized boat with outboard motor facility. The study area was divided into three selected sampling stations on each mangrove Fig.1; on ecosystems a grid pattern basis and exact location ascertained using the Garmin-E maps-GPS. The samples were collected using a Peterson's grab (0.25m²); the environmental parameter like temperature was measured using a standard mercury filled thermometer. The salinity was estimated using a hand refractometer (Atago, Japan) and the pH with an Elico pH meter (Model LC-120). The dissolved oxygen was measured using the modified Winkler's method (Strickland and Parsons 1972). Estimation of sand, silt and clay and .Altogether the sediment (grab) samples were collected for textural analysis from sediments other sediment samples were sieved (500 µm); others were immersed in 5 % brackish formalin during 10–15 min to remove the collected specimens and washed in clean tap water and preserved in 70% alcohol. The sample were segregated for group-wise separation of all the taxa which were identified to specific, generic or other higher levels to the greatest extent possible with the help of standard taxonomic references (e.g. Polychaeta: Fauvel 1953; Day 1967; Mollusca: Subba Rao et al. 1991). The data measures on macrofaunal abundances from the both station were amalgamated together in different seasons and subjected to Shannon–Wiener diversity (*H'* log2) were done using PRIMER 6 (Version 6.1.12)

RESULTS

Environmental variables

The environmental parameters recorded during all the seasons at Pitchavaram the mean water temperature was lowest Kanakeluthi madai (S2) 24.2±0.52 in monsoon highest in Periyakuda 30.76± 0.61 at summer, similarly in Muthupetai lowest 22.13±0.08 in S2 and highest in S3 29.76±0.28 (Fig.2.), in Pitchavaram the pH was varied between 6.23±0.08 (Post monsoon) to 6.93±0.03 (Pre monsoon) similarly in Muthupettai ranged from at 7.1±0.05 to 8.1±0.57.

The environmental variable of Muthupettai showed Fig.3. The salinity of the water during study period in Muthupettai varied between 23±0.54 to 37±0.57, in Muthupettai 22.3±0.20 to 39.2± 0.14. Dissolved oxygen varied among stations3.63±0.08 to 4.53± 0.17. The highest mean Dissolved oxygen (mg/L) was recorded in S1, which was 4.53 mg/L in monsoon period, and the lowest mean was 3.63 mg/L in S2at post monsoon seasons, while in Periyakuda (S3), the Dissolved oxygen (mg/L) was 4.43 mg/L. In Muthupettai (SI) 4.7±0.11 to 2.67±0.12 (SII).

Table 1 List of dominant macrobenthos observed in all the three stations of both mangrove ecosystems

Macrofauna Species	Pitchavarm	Muthupettai
Polychaete	+	-
Chaetopterus Sp	-	+
Pista Sp.	+	+
Heteromastus similis	-	+
Euclymene annandale	+	+
Capitella captata		
Gastropods		
Telescopium telescopium	+	+
Cerithidea Sp.	+	+
Ambonium Vesitarium	+	-
Bivalve		
Modiolus metcalfi	+	+
Meretrix Sp.	+	+
Cardium Sp.	-	+
Anadora Sp.	+	-
Amphipod		
Ampithoe Sp.	+	+
Paracalliope Sp.	-	+
Tanaids		
Tanais sp.	+	+
Apseudes gymnophobia	+	-
Halmyrapseudes killaiyensis	-	+
Crustaceans		
Peneaid shrimp larvae	+	+
Penaeus Sp	+	+
Scylla serrata	+	+
Scylla tranquebarica	+	+

All the three stations in Pitchavaram mangrove area, the percentage composition of sand Minimum (5%) was observed St.3 compare to the St.2 and St.1 the St.1 is slight variation observed in the sediment compositions maximum was observed in St.1.Whereas in Muthupettai relatively high percentage silt and clay was observed st.3 and maximum sand was observed in St.2 and S.3

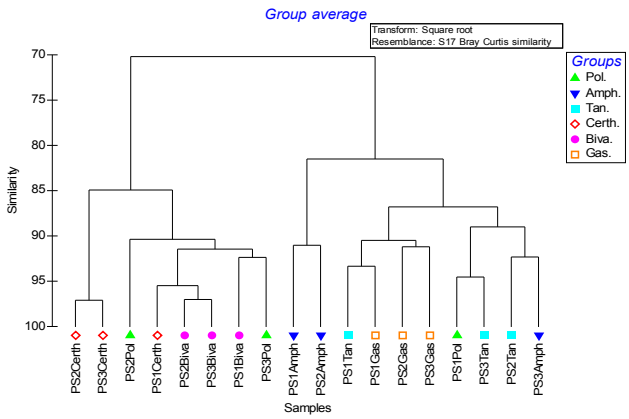

Figure 1 .Hierarchical clustering analysis of the stations showing assemblage of macrobenthos in various similarity levels at Pitchavaram mangroves

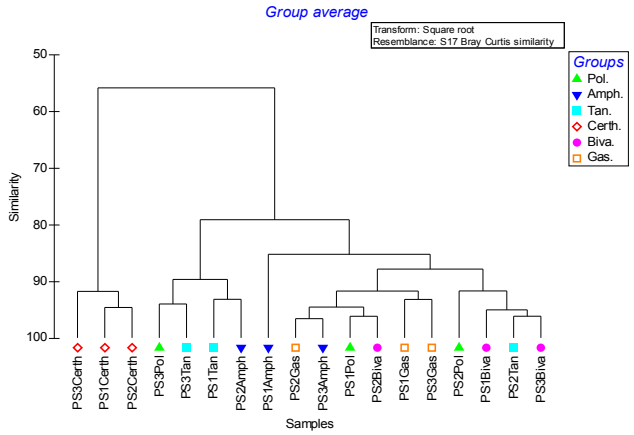

Figure 2 hierarchical clustering analyses of the stations showing assemblage of macrobenthos in various similarity level at Muthupettai mangroves

Macro benthos

A total of 5 macrofauna taxa were found in the mangrove ecosystems of Muthupettai and Pitchavaram lagoons, within three sampling sites. The maximum abounded taxa were classified in order to bivalves, other gastropods, polychaetes, tanids and amphipods. In all sampling stations, the dominant macrobenthos was *Cerethidia* (Table) with a mean density ranging from 78 to 119 individuals at 4 seasons in pitchavaran mangrove the macrofaunal assemblage was followed by Periyakuda (S1), 4 to 29 inds/ 1 cm^2 in Kanakeluthi Madai (S2), 4 to 39 ind 1/cm^2 and 111 to 174 inds /1cm^2 in Ts. Pettai (S3). While in Muthupettai maximum in *Cerethedia* macrofaunal abundance was varied from S1 S2 and S3. Polychaetes were the second dominant group in Salimunai (S2) and Mouth (S3) with a mean density ranging from 5 to 22 inds 1 cm^2 along the three stations. In both ecosystems Polychaete and *Cerethidia* is dominant groups least numbers of Amphipods were contributed and se. In seasonal basis, the faunal composition the group *Cerethidia* was dominant in Pitchavaram mangrove during all the seasons. The maximum contribution of macrobenthos composition was recorded during the summer season. Whereas in Muthupettai mangroves maximum number of faunal composition were collected in premonsoon season. In case the sample aggregation increase towards seashore

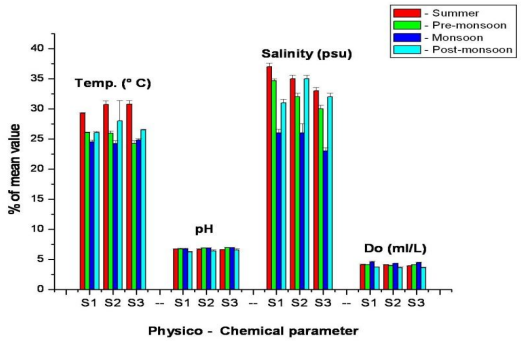

Figure 3 Station wise variation of temperature in Pitchavaram mangroves

Diversity indices

The various diversity indices calculated in the six stations during four different seasons at two mangrove ecosystem. The diversity (H') of macrobenthos during the study period varied between 3.82 (Pitchavaram) and 5.14 (Muthupettai).

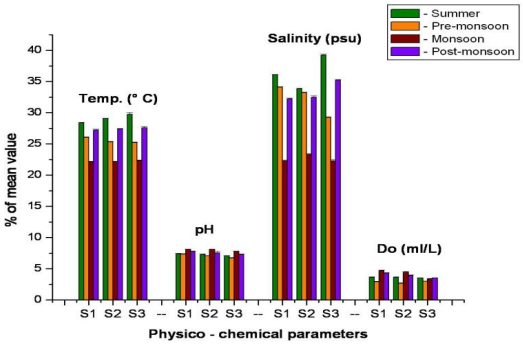

Figure 2 Station wise variation of temperature in Muthupettai mangroves

The present observation the status of benthic community diversity in the mangroves areas was determine showed (Table.3). The Shannon index (H) (Shannon & Wienner, 1949) showed in higher value in St.3 (1.517) and lowest value followed by St 2 (1.07). Station I had the highest value of diversity index at (1.547) showing the minimum during monsoon and the maximum during pre-monsoon in Muthupettai mangrove.

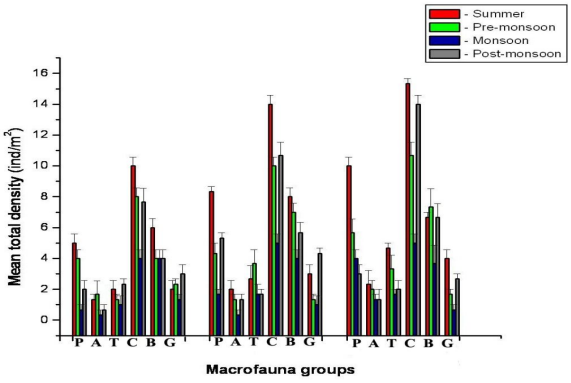

Figure 4 Total mean density macrofaunal assemblage of Muthupettai mangroves

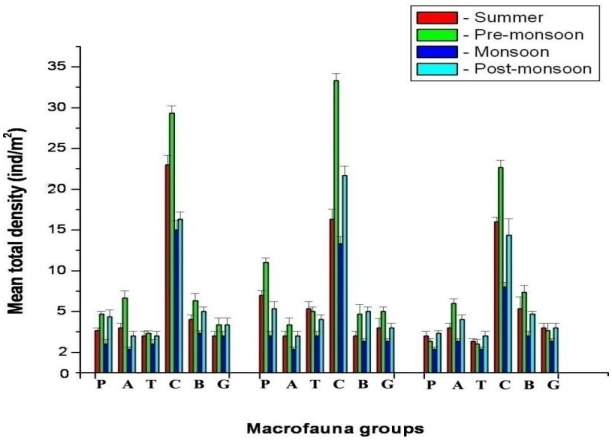

Figure 3 Total mean density macrofaunal assemblage of Muthupettai mangroves

In the cluster analysis, the similarity found between these mangrove ecosystems within the macrofaunal assemblage *Cerethidia* abundant between the PS2 and PS3 Pichavaram and PS3Certh at 96.97% to which PS3Biv joined at 95.94%.PS1Biv joined with this group at 92.28%.PSICer

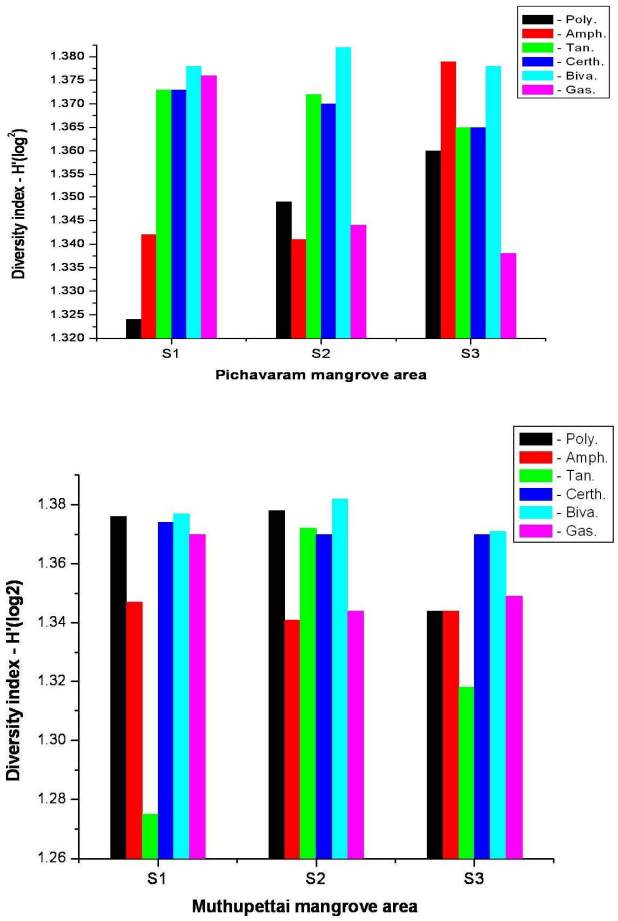

Figure 4 Diversity index in Muthpettai and Pitchawaram mangroves

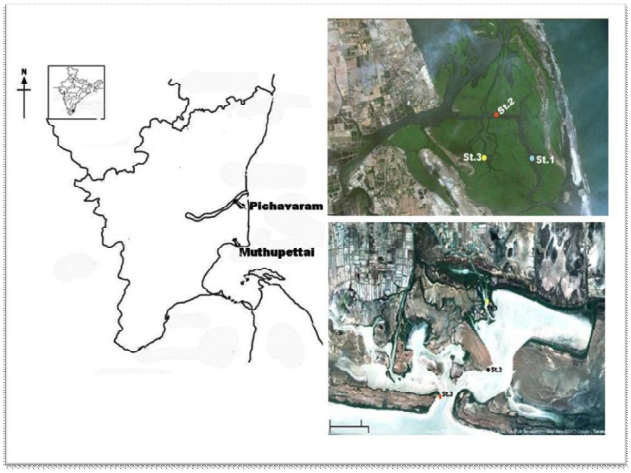

Figure 5 Location of the two mangrove ecosystems each in three stations

again joined with this group at 93.32%. Another group PS1pol and PS3Tan was formed at 92.3% similarity to which PS3Tan joined at 88.9. (Fig.99).Whereas in Muthupettai mangroves PS2Gas and PS3Amp found at 96.61% were joined at PS1Pol and PS2 Biva at 95.06 another group PS1Gas and PSIGas at 93.19. In PS1Cer and PS2cer found at 95.57 were joined PS3cer at 91.71% (Fig)

DISCUSSION

Mangroves are most productive ecosystems of the world, due to availability of the organic matter, in these habitats playing the role on maintaining the ecological complexity **to** manipulate the diversity and distribution of animals (Liu et al 2006). Benthos assemblages of macrofauna inhabit directly on the seafloor (Anderson, 1994), those organisms that live on or inside the deposit at the bottom of a water body (Idowu and Ugwumba, 2005). Benthic organisms constitute an essential component in the marine environment and play an important role in the ecology both as consumers of plankton and as food for bottom feeding fin and shellfishes. They provide key linkages between primary producers and higher tropic level animals in the marine food web. In each ecosystem at all the stations, *Cerethidia* were the dominant groups in terms of abundance and diversity. The present findings consists of maximum numbers of *Cerethedia* which were collected in all the three stations selected for highly favorable conditions prevailing in these sites, some of the reasons namely, periodic anoxia, sediment instability and estuarization the inshore benthic communities are low biomass (Longhurst & Pauly 1987),

In upwelling areas exemption of benthic standing stocks are high beneath the highly productive surface waters (Rowe 1981).In these lagoons, such phenomena are generally do not happen, and so other factors must account for the observed patterns of low to moderate densities and low biomass predominantly near surface dwelling infauna, these information are comprised the low food availability, physical disturbances and moderate to high predation pressure by epibenthic. The benthic diversity in the intertidal and shallow areas generally lowers than the deep-sea. In the high intertidal and shallow seas the fauna is subjected to environmental factors that fluctuate in an unpredictable manner, and because many species are not able to tolerate these fluctuations, the species complement is low. In the present study, a marked spatial variation were noticed from the S1 the faunal assemblage was varied along the three station each mangrove systems. Harkantra *et al.* (1982) made similar observations for several locations along the west coast of India and more recently Ingole *et al.* (1992) for the southwest Indian Ocean where benthic faunal abundance and diversity were largely attributed to the nature of sediment and the depth. In benthic studies sediment composition is a most significant to the marine benthic organisms (Ingole et al. 1998), which provides shelter and food in the form of organic matter (Gray 1981).

The distribution pattern of the macrofauna in all the stations of the creek did not show major differences. This indicates that all the in fauna are able to inhabit both sandy and sand loamy substrates with or without vegetation cover.

In general the distribution of macro benthos was dominated by polychaetes gastropods bivalves and Tanaids, with polychaetes and *Certhiedra* Sp. were consistently being the most abundant group at all stations represented by the total macrofauna with greater diversity and rich population compared to the remaining groups as well as stations in each mangrove habit. In subsequently abundant groups polychaetes followed by Tanaids and other gastropods, bivalves and crustaceans. Frequently maximum numbers of animals were observed at station III and minimum numbers were occurred at station II. The benthic fauna to the most abundant constituent was showed (table.2.)

Many of the issues with probable to affect the distribution of macrobenthic species and their productivity (Kennish, 1990). A further problem associated with relating environmental

variables to biological variables is a lack of knowledge about how environmental factors affect the biota, and whether upper or lower extremes, or mean values, most need to be considered. In the present survey the optimum salinity encountered in St.2 was due to the spatial location of St.1 it was located at the down stream, the salinity decreased as this station was far from the sea. Benthic communities in the inner estuarine areas are very low in densities due to the low salinity (Nybakken, J.W., 2001).

In the present study, it could be seen that there are characteristics which seems to have influenced by physicochemical and biological characteristics prevailing in the environment. The species composition of the macrofauna in the present study showed the domineering of polychaetes followed by Tanaids, Bivalves, Amphipods, Gastropods and *Cerethidia*. Similar studies were carried east and west coast of India, showed the polychaetes were the foremost species. It is strengthening in Cochin backwater, coleroon estuary. Harkantra (1998) opined that as far as the demersal fishery recourses are concerned, the benthic biomass is more valid parameter in projecting the potential demersal fishery resources, which is also pointed out by Moiseev (1971). Godfriaux (1970) while studying the food of predatory demersal fish indicated that the fishes feed on some element of the benthic fauna; in general, crustaceans were the most important group. The elevation of the beach and substrate characteristics may be the dominant factors controlling community structure of macrofauna. While it is true, physicochemical conditions in the environment control the overall nature and distribution of organisms living in the intertidal zone, it is equally true that biological factors may profoundly influence conditions in the habitat (Newell, 1979).

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