MEIOBENTHIC FAUNAL COMPOSITION OF MANAKUDY ESTUARY, SOUTHWEST COAST OF INDIA

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ABSTRACT

The present communication deals with community composition, density, richness, evenness and diversity of meiobenthic fauna of Manakudy estuary, west coast of India, during February 2010 to January 2012. Thirty four (30) different species were identified in the present investigation. Foraminiferans are dominated group of all over the estuary and represented by Ammonia beccarii, Lagena semistriata, Rosalina globularis, Eponides repandus and Globigerinoides sp., The second dominated population group of nematodes was represented by Daptonema conicum, Desmoscolex sp., Halalaimus sp., Theristus sp. and Viscosia sp. Third dominated harpacticoids copepods population was represented by Euterpina acutifrons, Macrosetella sp. and Microsetella sp., Ostrocodes population was represented by Cypridina sp. and Cyprideis sp. Abundance of foraminiferans is concentrated at station I, II, III and IV. Organic pollution indicator Daptonema conicum fairly dominated at station I, II and III. The maximum abundance of meio benthic organisms recorded from station III and minimum at the station IV.

Keywords: Community composition, Density, Richness, Evenness, Diversity, Meiobenthic fauna, Manakudy estuary.

INTRODUCTION

Meiobenthic faunal organisms are those which are passing through the 0.063 mm sieves. They consume largely bacteria, microalgae and detritus and in turn act as potential food for macrofauna and thus increase the productivity of ecosystem. They act to bioturbate the sediment enhance recycling of bacterial materials and return accumulated nutrients to the benthos when they die. They are highly responsible for rapid turnover of elements and nutrients (Platt and Warwick, 1980; Harriague et al., 2012).

The meiobenthos, especially those in the mangrove environment plays an important role in the food web in recycling of detritus organic matter. Their community structure and composition are controlled by predation and disturbance by deposit feeders like crabs, gastropods and other macrobenthos. Meiobenthos form prey for macrobenthos, pelagic predators, crustaceans and their larvae (Ingle and Parulekar, 1998). In turn, their abundance is reduced, altering the vertical disturbance in sediments. Meiobofauna form as prey for several fish species is crucial for survival during their early life history (Coull et al., 1995).

Exposure time, desiccation, availability of food, sediment granulometry, tidal zonation and interstitial water quality are the physical parameters that regulate the abundance of meiofauna. Besides, biological environment regulates the structure of meiobenthic faunal community through competitive interaction for available resources. Meiobofauna plays a major role in pollution monitoring studies. Nematodes and foraminiferans are the two key groups sensitive to environmental changes and they act as bioindicators of the ecosystem (Harriague et al., 2012). Hence, the present study was attempted to study the community composition, density, richness, evenness and diversity of meiobenthic fauna of Manakudy estuary, west coast of India.
MATERIALS AND METHODS

Study area Manakudy estuary, located in the Southwest coast of Kanyakumari district has a total area of about 150ha, extending over 2 km and is located between 8° 4’ N latitude and 77° 26’ E longitude. It is a tropical bar-built estuary. The estuary is connected to the sea during the rainy season and remains land-locked for the rest of the year by a sand bar, the local inhabitants cut open the sand bar (Figure 1).

Figure 1. Study areas of Manakudy estuary.

Monthly samplings were done in the four stations of Manakudy estuary. The sampling was covered at high, mid and low tidal levels in a line transect that run perpendicular to the water front. While sampling, tree roots, crab holes and mounts were avoided. In each tidal level, triplicate samplings were done in a 10-meter quadrat. The samples were collected using a 15 cm long core sampler with a diameter of 3.8 cm and sharpened at one end to form a cutting edge. A cork piston was introduced in the lower end of the tube and the core extruded. On retrieval, the core was sliced immediately at the length of 3 cm, 6 cm and 9 cm, and each slice was placed separately and stored in small polythene bags.

The collected samples were brought to the laboratory and sieved through 0.063 mm sieve. The organisms retained on sieve, were preserved in 5% neutralized formalin and stained with Rose Bengal for easy sorting. The preserved organisms were separated and enumerated and identified up to species level. The methodology followed for calculating diversity indices was same as in macrobenthic fauna. The species density, species diversity, species richness and species evenness of benthic meiofauna was calculated by using Shannon and Wiener, 1949 and Pielous (1966) respectively. Biomass was calculated by obtaining wet weight of the meiofaunal fauna.

RESULTS

Species composition

A total of 37 species of meiofaunal fauna were recorded in the four stations of Manakudy estuary (bar mouth, coir retting, mangroves area and salt pan). Among this, 19 species of foraminifers, 7 species of microflora, 5 species of nematodes, 3 species of copepods and 2 species of ostracodes and 1 species of polychaete larvae.

At station 1 (bar mouth), a total of 32 species of meiofaunal fauna were recorded. Among this 14 species of foraminifers, 7 species of microflora, 5 species of nematodes, 3 species of harpacticoid copepods, 1 species of polychaetes larvae and 2 species of ostracodes. At station 2 (coir retting) a total of 36 species of meiofaunal fauna were recorded. Among this 18 species of foraminifers, 7 species of microflora, 5 species of nematodes, 3 species of harpacticoid copepods, 2 species of ostracodes and 1 species of polychaetes larvae.

At station 3 (mangroves area), a total of 32 species of meiofaunal fauna was recorded. Among this 16 species of foraminifers, 6 species of microflora, 5 species of nematodes, 3 species of harpacticoid copepods, and 2 species of ostracodes. At station 4 (salt pan), the total of 22 species of meiofaunal fauna was recorded. At saltpan area,
among this 12 species of foraminiferans, 3 species of microflora, 5 species of nematodes and 2 species of ostracodes.

**Percentage composition of meiobenthic faunal group in station 1-4 of Manakudy estuary**

At station 1, the groupwise percentage composition of foraminiferans 45%, microflora 23%, nematodes 16%, harpactcoides copepods 10% and ostracodes 6%, were recorded (Figure 2). At station 2, groupwise percentage composition of foraminiferans 49%, microflora 19%, nematodes 14%, harpactcoides copepods 8%, polychaete larvae 5% and ostracodes 5% were recorded (Figure 3).

At station 3, groupwise percentage composition of foraminiferans 50%, microflora 19%, nematodes 16%, harpactcoides copepods 9% and ostracodes 6% were recorded (Figure 4). At station 4, groupwise percentage composition of foraminiferans 54%, nematodes 23%, microflora 14% and harpactcoides copepods 9% were recorded (Figure 5).

**Population density**

Meiobenthic faunal population densities were varied from 3212.0 to 28655.7 individuals 0.0256 m\(^2\) in station 4 and station 2 respectively. The minimum (3212.0) was recorded during monsoon season (October and November, 2011), whereas, the maximum (28655.7) was during early premonsoon season (Apirl and May, 2010). (Figure 6).

**Species diversity**

Meiobenthic faunal Shannon and Wieners diversity index (H) were varied from 3.059 to 4.551 in station 4 and station 2 respectively. Minimum value (3.059) was recorded during monsoon season (October and November, 2010) and maximum value (4.551) was recorded during post monsoon (January and February, 2010) (Figure 7).

**Species richness**

Meiobenthic faunal species richness index were varied from 1.307 to 3.448 in station 4 and station 3 respectively. Minimum value (1.307) was observed during monsoon season (October and November, 2010) and maximum (3.448) was observed during post monsoon (January, February and March 2010) (Figure 8).

**Species evenness**

Meiobenthic faunal species evenness index (J') were varied from 0.861 to 0.913 in station 2 and station 1 respectively. Minimum value (0.861) was recorded during monsoon (October and November 2010) and maximum value (0.913) was recorded during post monsoon (January and February 2010) (Figure 9).

![Figure 2](image1.png)  
**Figure 2.** Station 1.  
![Figure 3](image2.png)  
**Figure 3.** Station 2.  
![Figure 4](image3.png)  
**Figure 4.** Station 3.  
![Figure 5](image4.png)  
**Figure 5.** Station 4.  

**Figure 2-5.** Percentage composition of meiobenthic fauna.
Figure 6. Seasonal variations of population density of meiobenthic faunal group at four stations of Manakudy estuary.

Figure 7. Seasonal variations of species diversity of meiobenthic faunal group at four stations of Manakudy estuary.

Figure 8. Seasonal variations of species richness of meiobenthic faunal group at four stations of Manakudy estuary.
DISCUSSION

In the present study, the meiobenthic faunal assemblages recorded were foraminifera, nematodes, harpacticoid copepods, ostracods, polychaetes larvae and micro flora. Similar faunal occurrence has been reported earlier in tropical mangrove regions and other estuaries of India. Sarma and Wilson (1994) reported nematodes, harpacticoid copepods, polychaetes larva, kinorhyncha, solenogaster, foraminifera, ostracoda, oligochaetes, palanaria, and tanaidacea in Bhitarankanika mangroves of river Mahanathi estuarine system, east coast India. Likewise, Kondala Rao and Ramanamurty (1998) studied the similar faunal assemblages in Kakinada Bay, Gautami Godavari estuarine system, east coast of India.

Similar reports were made by Ingole et al. (1987) in Saphala salt marsh of India, Ingole and Parulekar (1998) in Siridao beach, west coast of India and Schrijvers et al. (1996) in Gazi bay of Kenya. Sasekumar (1994) reported that nematodes, harpacticoid copepods, oligochaeta, kinorhyncha were dominant meiobenthic fauna in tropical mangroves. It is concluded that mangrove habitats is highly supportive to meiobenthic fauna even at temperate region with hard environmental characteristics.

Foraminifer is the dominant group in the present study in terms of abundance and density. The percentage composition of foraminifera in the station varied from 40 to 65%. It is reported that maximum percentage in almost all the stations, might be due highly favorable conditions prevailing in this site. The dominant foraminifera in the present study were Globigerinoides sp., Globigerina sp., Lagena semistriata, Neoconorbina sp., Nonion depressulum, Quinqueloculina sp., Rotalia pulchella, Rosalina globularis, Spiroloculina sp., Spirillina limbata, Textularia sp., Triloculina sp., Eponides repandus and Discorbis sp. Nigam and Chaturvedi (2000) investigated the foraminifera of Kharo creek – Kachchh, Gujarat and reported 47 species out of which 18 species were hentic.

Among them, Quinqueloculina sp, Triloculina sp, lagena sp, Globigerinoides, Spiroloculina sp. were recorded in the present study. The species such as Triloculina oblonga, Trochammina inflata, and Quinqueloculina sp. were also reported in Cochin estuary (Kameswara Rao and Balasubramanian, 1996). Comparison of these studies with the present study shows that few species are found commonly distributed all along the west coast and tends to cope with wide fluctuations in environmental variables.

Nematodes were the one of the dominant group comprised of 5 species. Of this Daptonema conicum, Theristus sp and Viscosia sp were found to be dominance. Similar to the present observation, dominancy of Riscosia sp, Daptonema conicum, Halalaimus gracilis in Malasiyan mangrove (Sasekumar, 1994), Gazi bay (Schrijvers et al., 1996) and Pichavaram mangroves (Sultan Ali et al., 1983) were found. The present study revealed that it might be common species with cosmopolitan distribution. Ansari and Parelekar (1998) reported that nematodes were the most dominant group in Zuari estuary of Goa west coast of India. Maximum percentage composition observed in stations 1 and station 3 in the postmonsoon season due to the enrichment of organic materials. The other groups recorded in the present study were microfauna, ostracods, harpactiocoid copepods and polychaete larva. Similar pattern of meiofaunal assemblage was already recorded in the Malaysian mangrove environment (Sasekumar, 1994).

Alongi (1989) recorded a mean total meiobenthic faunal density of 1000 to 3000 individual 10cm$^2$ for most mangrove sites. Nevertheless several studies dealt with mangrove sediments contained higher density. For example Kondala Rao (1984) indicated about 2130 individual 10cm$^2$ in Kakinada Bay and Nicholas et al., (1991) counted up to 5000 individual /10cm$^2$ with maximum 6101 individual 10/cm$^2$ in Australian mangrove mudflat. Sasekumar (1994) reported that the high mean density 1109 individual 10cm$^2$ was found in the Avicennia sp. mangrove station. In the
The harpacticoid copepods, though observed throughout the year, were abundant only in postmonsoon season in the present study. Temperature may trigger or terminates the reproductive activities of harpacticoid copepods and determines the development time (Harris, 1972). Generally, higher ambient temperature results in shore development times for harpacticoid copepods. Nikolaos et al., 1991 and Mc Gregor (1991) found that majority of harpacticoid nauplii were found during postmonsoon in Aalaska. Salinity in the study area did not show much variation and its impact was meager to distribution of benthic meiofauna and its diversity. However, Rao and Sarma (1994) pointed out that the harpacticoid copepods densities were reduced during low salinity. This study corroborated the result of the present study where high salinity was observed in the premonsoon season which might have supported the high harpacticoid copepods density however; high pH and low concentration of dissolved oxygen in premonsoon might also have related the benthic meiofaunal abundance and diversity.

Food acts as a factor in the distribution and abundance of meiobenthic fauna (Ingole et al., 1987; Harriague et al., 2012). Organic carbon serves as a food sources for many meiobenthic organisms (Coull, 1973). Guadros et al., (1996) stated that organic matter would enhance the density of meiobenthic faunal assemblage. Brenda Healy and Kathrya Coates (1997) reported the Enchytraeids (Oligochaetes) were limited by shortage of organic matter. Schrijvers et al., (1996) found that denude density of meiobenthos due to the decrease of organic materials. High density of meiofauna was observed with maximum occurrence of organic matter in Mahanadi system, east coast of India (Sarma and Wilson, 1994). In the present study, the maximum percentage of organic matter observed in the mangroves area correlated well with the maximum meiofaunal density which subsequently reduced to salt pan with a concomitant reduction in organic matter. In addition, the organic matter produced in the late monsoon is being converted into food which would further enhance the meiobenthic faunal assemblage in post monsoon and premonsoon.

Sediment grain size is the important factors for benthic fauna and it influences the distribution and settlement of different forms of benthic life (Ansari and Parulekar 1998; Harriague et al., 2012). Meiobenthos distribution is largely determined by sediment particle and silt constituent which showed significant correlation with their abundance in the present study. The nature of silt is reportedly allows movement of pore water and easy penetration of meiobenthic fauna (Ingole et al., 1987). Foraminefera did not show any preference to the substratum. Nigam and Chatureddi (2000) stated that fine sand mixed with some shells fragments and silt or clay support richest sampling crop of foraminifera. The structure of the meiobenthic faunal community is regulated not only by the physical environment, but also by biological competitive interactions with the epibenthos. In mangrove environment, the potential influence of macrobenthos is to structure the meiobenthic fauna by predation (Dittamann, 1993).

Greater numbers of meiobenthic fauna occurred in the 3-6 cm depth level. Although nematodes and foraminifera were found in the entire core, nematodes members number was high in the top layer. Ansari and Parulekar (1998) reported that over 60% of the total meiofauna were present in the 0-2 cm layer of the core sample with the nematodes distributed through the entire core with high abundance in the top layer. Possible causes for this decline of meiobenthic fauna revertival changes in pH, oxygen, organic matter and interstitial water content (Tietjen 1969, Mc Lachalan, 1978). The oxidation of organic matter by anaerobic bacteria causes reducing condition indicated by low pH value and presence of H2S and low availability of free oxygen often influence the vertical distribution of meiobenthic faunal community.

CONCLUSION
Benthic meiobenthic faunal assemblies recorded were foraminifers, nematodes, harpacticoid copepods, ostrocodes, polychaetes larvae and microflora. Meiobenthic faunal population density varied from 3212.0 to 28655.7 individuals in station 4 and station 2 respectively. The minimum (3212.0) was recorded during monsoon season (October and November, 2011), whereas, the maximum (28655.7) was during the premonsoon season (April and May, 2010). The maximum population density occurred during premonsoon season at station 1 and 3.

However, the coir retting liquor affected station 2 population. Thus, this showed maximum density in the monsoon and postmonsoon season, which minimise to pollutants and minimum in the premonsoon season when pollution is accumulated. Species diversity, species richness and species evenness were maximum in the premonsoon season in station 2. The benthic fauna of 2010-2011 was slightly lower than that of 2011-2012.

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REFERENCES


