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RESEARCH ARTICLE

MEIOBENTHIC COMPOSITION OF MANAKUDY ESTUARY, SOUTHWEST COAST OF INDIA

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ABSTRACT

An attempt was made to study the meiobenthic community composition, density, richness, evenness and diversity of Manakudy estuary, south west coast of India, during February 2010 to January 2012. Thirty seven (37) 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.

INTRODUCTION

Meiobenthic organisms are those which are passing through the 0.063 mm sieves. They consume largely bacteria, microalgae and detritus and in turn act as a potential food for macrofauna and thus increase the productivity of the 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 (Ingole and Parulekar, 1998). In turn, their abundance is reduced, alatering the vertical disturbance in sediments. Meiofauna form as prey for several fish species is crucial for survival during their early life history (Coull *et al.,* 1995). Exposure time, desication, 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.

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Meiofauna plays a major role in pollution monitoring studies. Nematodes and foraminiferans are the two key groups sensitive to environmental changes and they act as a 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, south 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 150 ha, 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 (Fig.1).

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 quadrate. 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 corers were 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 0.063mm 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 species density, species diversity, species richness and species evenness of benthic mieofauna was calculated by using Shannon and Wiener, 1949 and Pielous (1966) respectively.

1 species of polychaetes larvae and 2 species of ostracodes. At station 2 (coir retting) a total of 36 species of meiobenthic fauna were recorded. Among this 18 species of foraminiferans, 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 meiobenthic fauna was recorded. Among this 16 species of foraminiferans, 6 species of microflora, 5 species of nematodes, 3 species of harpacticoid copepods, and 2 species of ostracodes. At station 4 (salt pan), a total of 22 species of meiobenthic fauna was recorded.

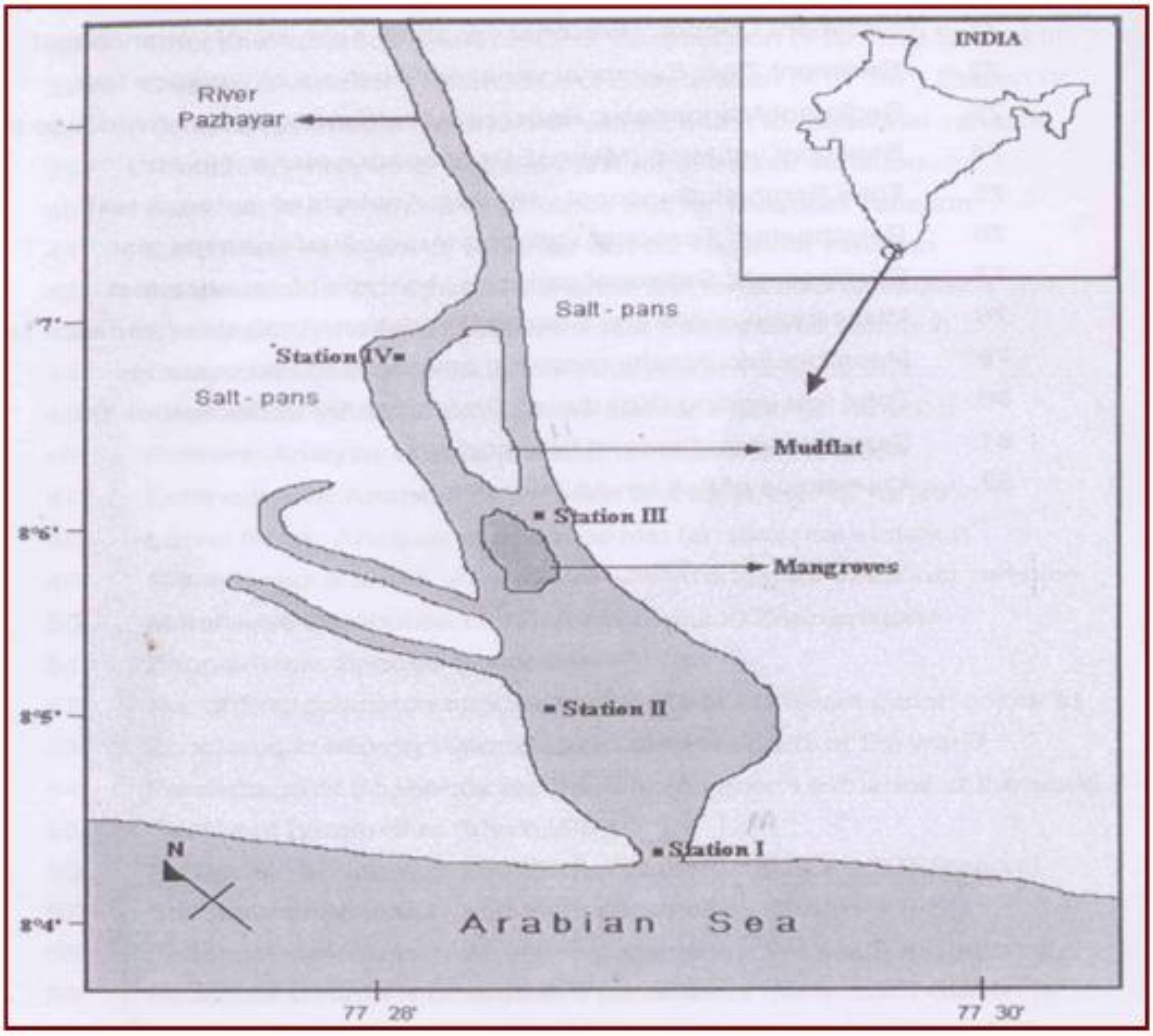

Fig. 1. Study areas of Manakudy estuary

RESULTS

Species composition

A total of 37 species of meiobenthic fauna were recorded in the four stations of Manakudy estuary (bar mouth, coir retting, mangroves area and salt pan). Among this, 19 species of foraminiferans, 7 species of microflora, 5 species of nematodes, 3 species of copepods and 2 species of ostrocodes and 1 species of polychaete larvae. At station 1 (bar mouth), a total of 32 species of meiobenthic fauna were recorded. Among this 14 species of foraminiferans, 7 species of microflora, 5 species of nematodes, 3 species of harpacticoid copepods,

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

Population density

Meiobenthic 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) (Fig.6).

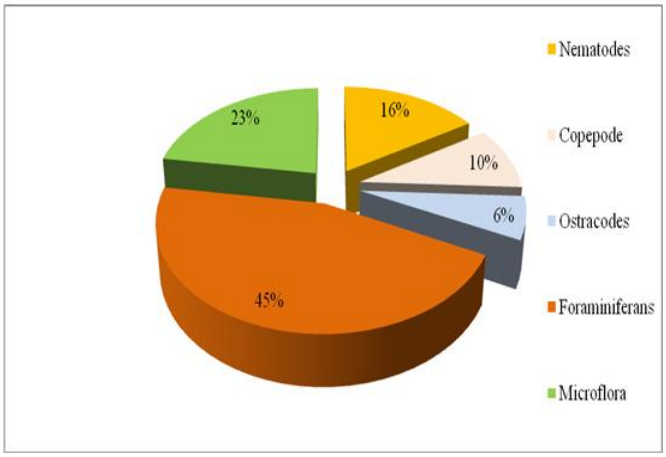

Fig.2 (St-1)

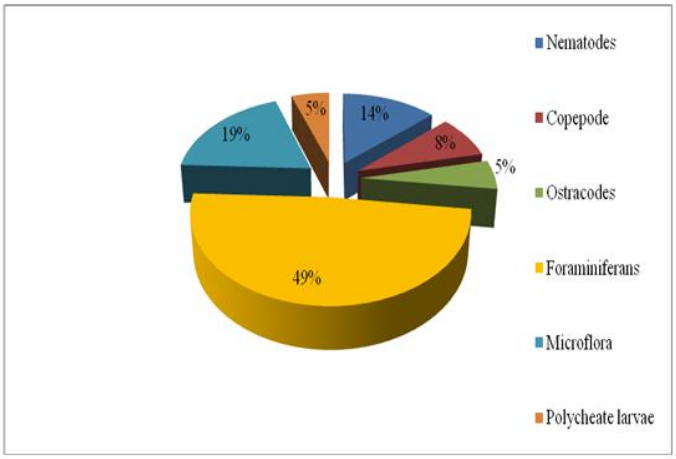

Fig.3 (St- 2)

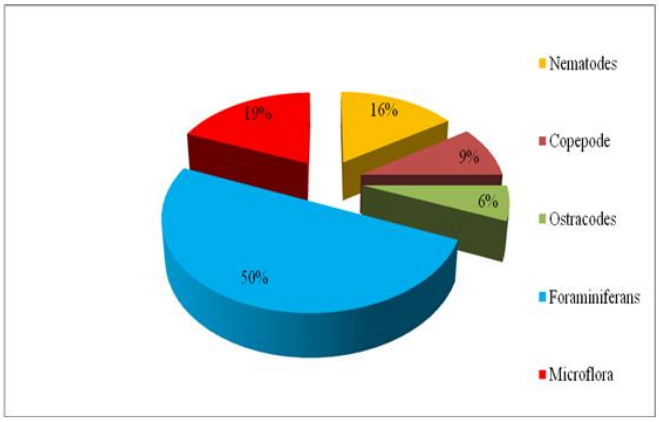

Fig.4 (St-3)

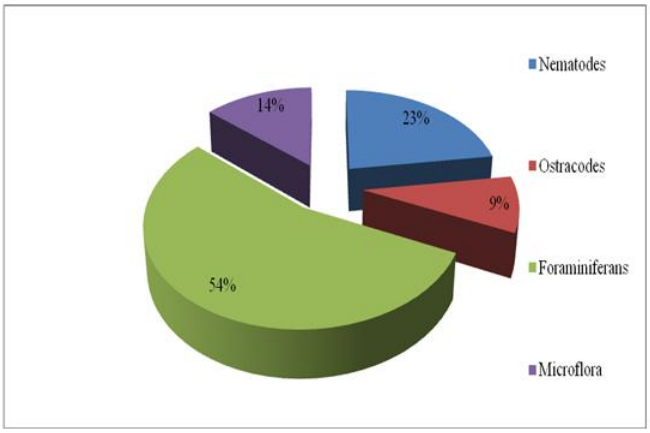

Fig.5 (St- 4)

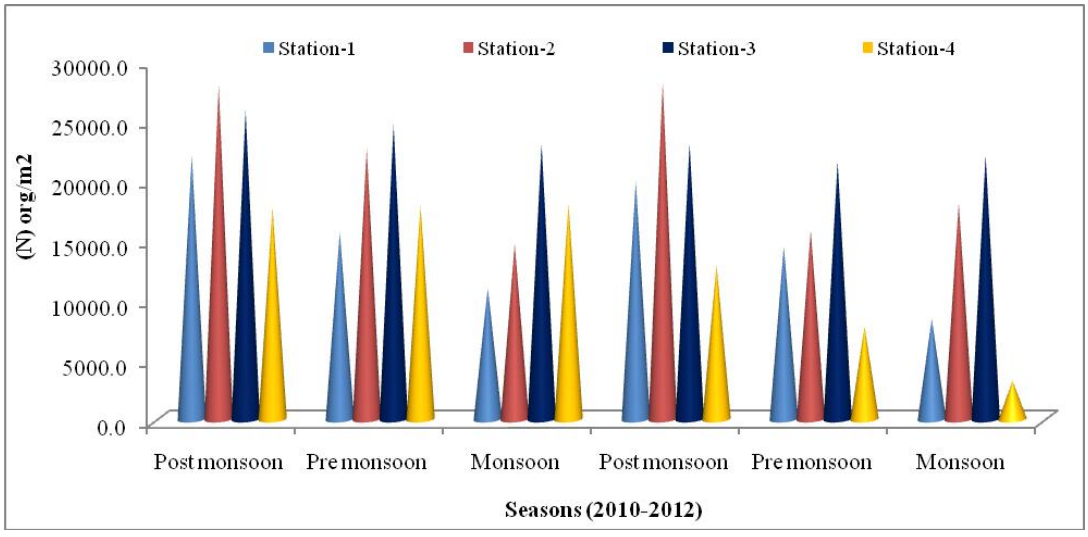

Fig.6. Seasonal variations of population density of meiobenthic faunal group a four stations of Manakudy estuary

Species diversity

Meiobenthic faunal divesity index (H) were varied from 3.059 to 4.551 in station 4 and station 2 respectively. Minimum value (3.059) was recorded during the monsoon season (October and November, 2010) and maximum value (4.551) was recorded during the post monsoon (January and February, 2010) (Fig. 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) (Fig. 8).

Species evenness

Mieobenthic 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 the monsoon (October and November 2010) and maximum value (0.913) was recorded during the post monsoon season (January and February 2010) (Fig. 9).

DISCUSSION

In the present study, the meiobenthic faunal assemblages recorded were foraminiferans, nematodes, harpacticoid copepods, ostrocodes, polychaetes larvae and micro flora.

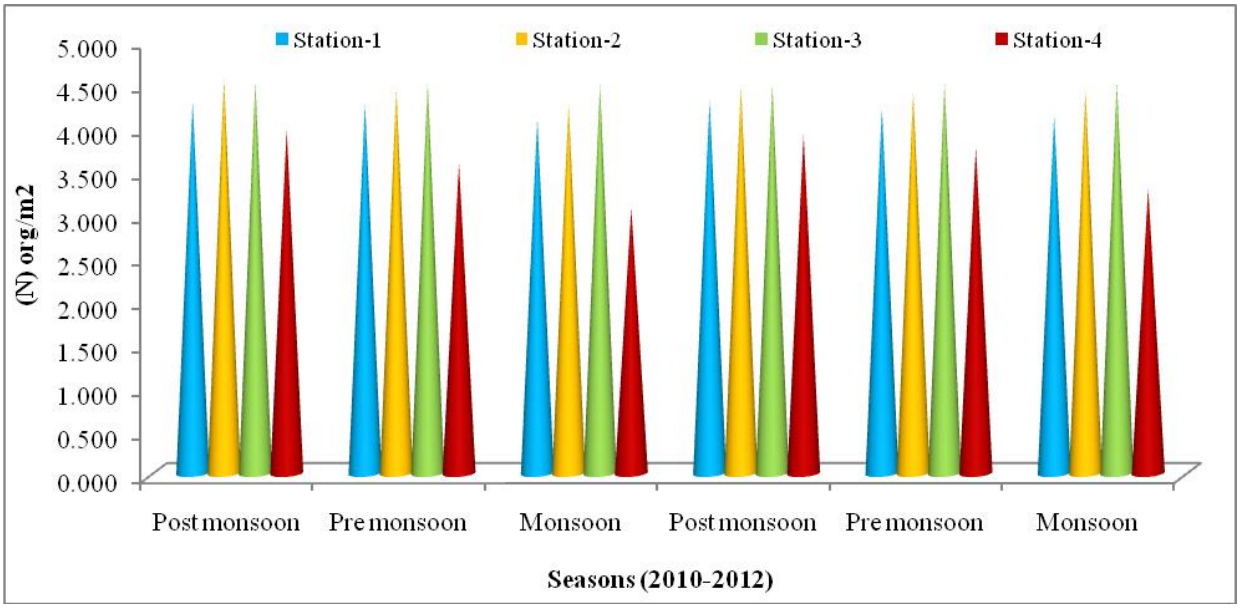

Fig.7. Seasonal variations of species diversity of meiobenthic faunal group at four stations of Manakudy estuary

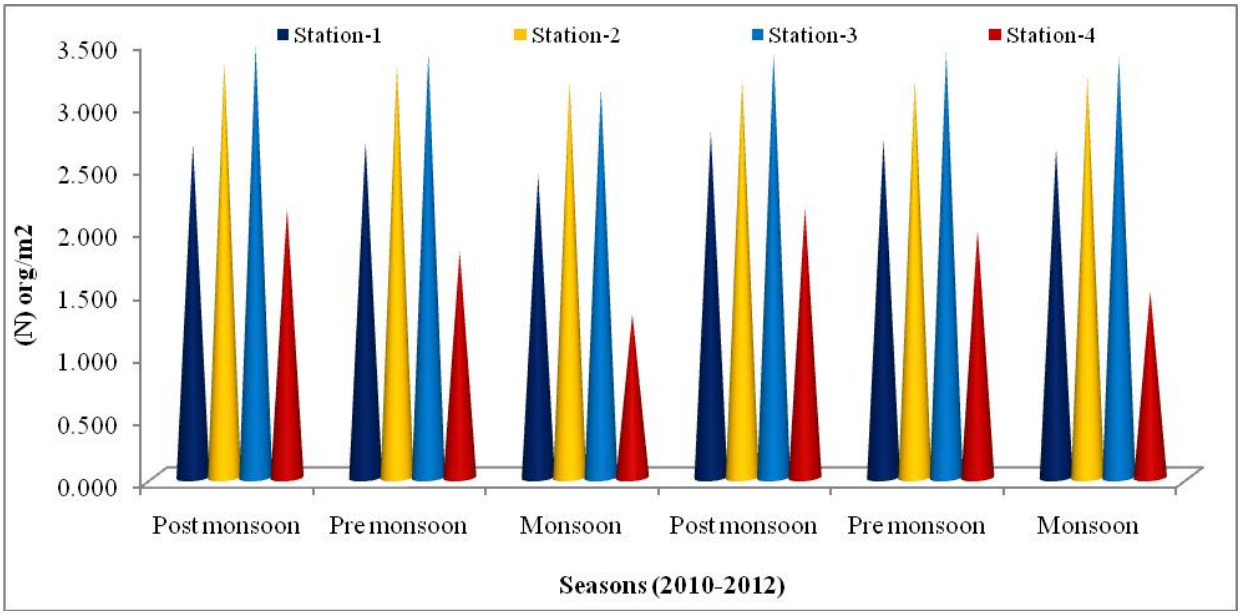

Fig.8. Seasonal variations of species richness of meiobenthic faunal group at four stations of Manakudy estuary

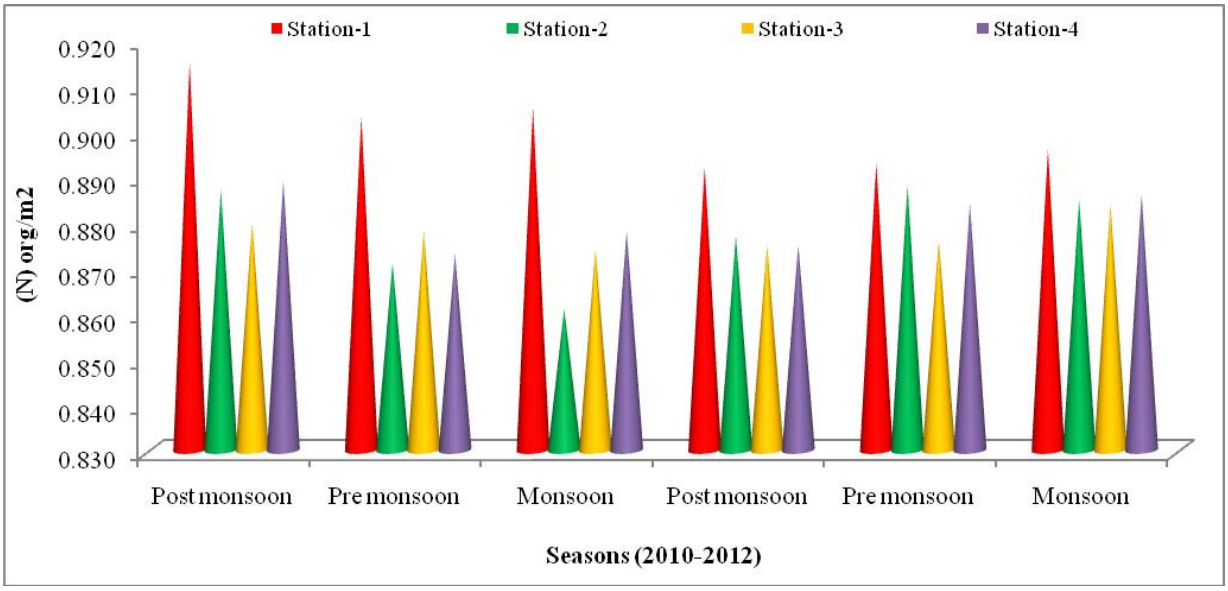

Fig.9. Seasonal variations of species evenness of meiobenthic faunal group at four stations of Manakudy estuary

Table 1. List of meiobenthic fauna recorded in Manakudy estuary

S.No	Name of the species	Stations			
		St-1	St-2	St-3	St-4
	Nematodes				
1	*Desmoscolex sp.*	*	*	*	*
2	*Daptonema conicum*	*	*	*	*
3	*Halalaimus sp.*	*	*	*	*
4	*Theristus sp.*	*	*	*	*
5	*Viscosia sp.*	*	*	*	*
	Ostrocodes				
6	*Cypridina* sp.	*	*	*	*
7	*Cyprideis* sp.	*	*	*	*
	Harpacticoids copepods				
8	*Euterpina acutifrons*	*	*	*	-
9	*Macrosetella* sp.	*	*	*	-
10	*Microsetella* sp.	*	*	*	-
11	Polychaeta larvae	*	*	_	-
	Foraminiferans				
12	*Ammonia beccarii*	*	*	*	-
13	*Globigerinoides sp.*	*	*	*	*
14	*Globigerina sp.*	*	*	*	*
15	*Lagena semistriata*	*	*	*	*
16	*Neoconorbina sp.*	*	*	*	*
17	*Nonion depressulum*	*	*	*	*
18	*Planorbulinella sp.*	-	*	*	-
19	*Quinqueloculina sp.*	*	*	*	*
20	*Rotalia pulchella*	*	*	*	*
21	*Rosalina bradyi*	*	*	*	*
22	*Rosalina globularis*	*	*	*	*
23	*Spiroloculina sp.*	*	*	*	*
24	*Spirillina limbata.*	*	*	*	*
25	*Textularia sp.*	*	*	*	*
26	*Triloculina sp.*	*	*	*	-
27	*Bolivina abbreviata*	-	*	*	-
28	*Discorbis sp*	-	*	_	-
29	*Eponides repandus*	-	*	_	-
30	*Planorbulinella sp.*	-	_	_	-
	Microflora				
31	*Coscinodicus centralis*	*	*	*	*
32	*C. gigas*	*	*	*	*
33	*C. radiatus*	*	*	*	*
34	*C. thori*	*	*	*	-
35	*Triceratium favus*	*	*	*	-
36	*Pleurosigma elongatum*	*	*	*	-
37	*Odentella sinensis*	*	*	_	-
Total		32	36	32	22

* Present, - Absent

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, solenogester, foraminifera, ostracoda, oligochaetes, palanaria, and tanaidacea in Bhitarkanika 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 by Schrijrers *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 faunal assemblages 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 benthic. 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), 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 patterrn 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, Nicholas *et al.*, (1991) counted up to 5000 individual /$10cm^2$ with maximum 6101 individual 10/cm2 in Australion mangrove mudflat. Sasekumar (1994) reported the high mean density 1109 individual $10cm^2$ was found in the *Avicennia* sp. mangrove station. In the present study, the mangroves and coir retting areas 28655.7 and 25756.0 $10cm^2$ high levels of population densities were recorded; lower density values obtained in the present study might be owing to arid climate prevailing in the study area.

The harpacticod 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; Mc Gregor, (1991) found that majority of harpacticoid naupli 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 corroborate 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 Purulekar 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 Chaturredi (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 meiobnthic 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 revertical 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 H_2S and low availability of free oxygen often influence the vertical distribution of meiobenthic faunal community.

Conclusion

Benthic meiobenthic faunal assemblages recorded were foraminiferans, 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 the monsoon season (October and November, 2011), whereas, the maximum (28655.7) was during the premonsoon season (Apirl and May, 2010). The maximum population density occurred during premonsoon season at station 1 and 3. However, the coir retting liquor affected station 2 showed maximum density in the monsoon and postmonsoon season which minimise to pollutants and minimum in the premonsoon season when pollution is accumulated.

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