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DIVERSITY AND DISTRIBUTION PATTERN OF MEIOBENTHIC NEMATODES IN THE ADIMALATHURA ESTUARY, SOUTHWEST COAST OF INDIA

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Abstract
Meiobenthic nematode abundance, species composition and diversity was studied in the Adimalathura estuary (8^o 0' - 8^o 24'N latitude and 77^o 01' - 77^o 03' E longitude) on the southern part of Kerala, on the south west coast of India. The data presented is based on the observations on 108 core samples of sediment collected seasonally. A total of 10 species belonging to 3 orders, 7 families and 10 genera were observed in which Desmodora extensa, Enoploides labiatus, Mesacanthion armatus and Sabatieria intermissa formed the dominant nematode species at all stations in the estuary. Moderate diversity, richness and evenness indices were observed at all stations. Notable change in community structure associated with the monsoon rains and a reduction of species diversity in response to anthropogenic stress was observed.

Keywords: Species diversity, Meiobenthic nematodes, Pollution, Estuary.

Introduction

Nematodes are considered as one among the three multicellular organisms that form a large part of world's species, the others being insects and fungi (May, 1988; Gaston, 1991). Short lifespan, high fecundity and representation in several trophic levels in the form of bacterial feeders, herbivorous and carnivorous are the peculiar characteristics of nematodes. Another important feature of nematode population is its greater species richness in any habitat, often in an order of magnitude higher than any other taxon (Plat and Warwick, 1980; Ansari *et a*l., 1980; Ansari and Ganus 1996; Sajan and Damodaran, 2007; Schratzberger *et al*., 2007; Ansari *et al*., 2012(a)). Free living nematodes constitute as much as 60-90 % of the meiobenthic community in marine and coastal habitats. Free living nematodes are focused widely as indicators of aquatic pollution and are used in aquatic toxicological studies worldwide.

Although nematodes comprise the major fraction of benthic communities in marine and coastal ecosystems and many studies have reported the dominance of nematodes in meiofaunal population in the Indian beaches and coastal habitats, only little studies have been undertaken on the species diversity and distribution pattern of meiobenthic nematodes of Indian waters (Sinha *et al*., 1987; Chinnadurai and Fernando, 2006(a); 2006(b); Anila Kumary, 2008; Sajan *et al*.2010, Ansari *et al*.,2012(b); Annapurna *et al*.,2012). Adimalathura estuary (Karicha kayal) is a small brackish water biotope lying between 8^o 0' - 8^o 24'N latitude and 77^o 01' - 77^o 03' E longitude on the southern part of Kerala on the south west coast of India. The estuary is important from the point of view of fishery and seed resources and constitutes the life line of the local economy. The coastal habitat is exposed to pollution from domestic waste and coconut husk retting almost on a continuous basis. The present study has attempted to focus on the diversity and distribution pattern of meiobenthic nematode community in this estuarine biotope of Kerala.

Materials and Methods

The study area extends from 8^o 0' - 8^o 24'N latitude and 77^o 01' - 77^o 03' E longitude in the Adimalathura estuary on the southern part of Kerala in Thiruvananthapuram district, on the south west coast of India. Totally 108 core samples of sediment were collected from three stations in the estuary located in the upper, middle and lower reaches of the habitat. Samples of sediment were collected using a steel corer of 5.5 cm inner diameter and 25 cm long. After extraction of benthic fauna by suspension decantation(Wieser,1960), the meiofauna samples were sieved through a set of 0.5 mm and 0.042 mm sieves and stored in 5% neutral formalin solution stained with Rose Bengal. Meiobenthic specimens were sorted out and the nematode individuals were counted and identified to the highest taxonomic level possible under binocular microscope following the standard pictorial keys of Platt and Warwick (1983, 1988) and Warwick *et al.*(1998). The replicates from each station were pooled and the total numbers of each species were determined. From the species composition at each station the descriptive measures of diversity indices were computed following the expressions,

Shannon and Weaver (1963) index of species diversity $H' = -\sum (ni/N) \log (ni/N)$
Index of Dominance (Simpson, 1949) $C = \sum (ni/N)^2$
Species richness index (Margalef, 1958) $d = S-1/\log N$
Species evenness index (Pielou, 1966) $e = H'/\log S$
Where ni= importance value for each species
N = total importance values
S = number of species

Results and Discussion

Nematoda was the most dominant group of meiobenthic community present at all stations in the estuary. Nematodes are credited to be relatively resistant to pollutants such as domestic sewage (Vidakovic, 1983) and generally exhibit a high tolerance to oxygen deficiency (Josefson and Widbom, 1988). Population density of nematodes in the estuary fluctuated between 20 - 458 m^{-2} (station I), 0 – 302 m^{-2} (station II) and 50 -2821 m^{-2} (station III). Population density of nematodes in the estuary was associated with increasing temperature, high salinity, stable bottom conditions and probably greater food availability during pre and post monsoon periods.

The nematode population was composed of 10 species belonging to 3 orders, 7 families and 10 genera (Table I). The species composition, density and distribution of nematodes vary considerably from area to area in the estuary depending on the nature of the substratum, environmental characteristics and the marine influence (Table II). A few successful species such as *Desmodora extensa*, *Enoploides labiatus*, *Mesacanthion armatus* and *Sabatieria intermissa* always dominate the quantitative abundance, while a majority of remaining ones occur in small numbers (Fig.1). This does not mean that the rare species are not important because they primarily determine diversity, an important aspect of community structure. Species compositions of a natural community are to a large extent replaceable in time and space so that functionally similar communities may have different species composition.

The species diversity has a number of components which may respond differently to geographical, developmental and physical factors. A species diversity index is a measure of the way in which individuals of an ecological community are distributed among species. The index of Shannon and Weaver (H') used to evaluate the diversity of nematodes varied seasonally from 0.5095 (station II) during the monsoon season (June-Sept) to 1.2168 (station III) during the premonsoon season (Feb-May) in the estuary (Table III). Stations I and III had the highest diversity of meiobenthic nematodes during the premonsoon season while station II had the maximum H' value during the post monsoon season. All the three station had the minimum H' during the monsoon season coinciding with poor density of nematode fauna which is also evident in other Indian estuaries (Bouman *et al*., 1984; Sajan and Damodaran, 2005; Anila Kumary, 2008).

Species richness is the ratio between the total number of species and the total number of individuals of the population. Species richness index increase with the occurrence of several species. At station I, the peak value of species richness was during the premonsoon season (0.4071) along with the peak value of H'. Higher values of species richness are due to the occurrence of several species without allowing a single species to dominate the community (Reddy and Coring, 1975). Values of species richness were higher at station III whereas the lower values were for station II. Postmonsoon season registered the peak values of richness (0.2913) as well as diversity indices at station II while the peak richness index (0.5985) at station III was during the premonsoon season. The lowest values of species richness were during the monsoon season at all stations in the estuary.

Species evenness describes how equally the various species are distributed in the community. High evenness index occurs when all the species are virtually equal in abundance. The evenness in the distribution of the species in a community may be the result competition under optimum conditions or may be a response to unfavourable conditions (Patrick, 1971). Evenness index of nematodes in the Adimalathura estuary varied from 0.3569 during the monsoon season at station II to 0.8440 at station III during the premonsoon season. At stations I and III the distribution of nematode community was more even during the premonsoon season whereas at station II post monsoon season registered the peak evenness index.

The degree to which dominance in a community is concentrated in one or several species can be expressed by the index of dominance which sums up the importance of each species in relation to the community as a whole. Dominance index is described as the opposite to equitability and when ever equitability is least dominance index is maximum. The dominance index of nematodes in the study varied from 0.4043 to 0.4797 at station I, 0.4196 to 0.6250 at station II and from 0.3958 to 0.4447 at station III (Table III). At stations I and III, peak dominance was during the monsoon season while at station II the peak dominance of certain species were during the premonsoon season. The values of dominance index were higher at station II when compared to other stations of the estuary.

Numerically nematode abundance and diversity varied appreciably at the different stations and at different seasons. The high numerical abundance and diversity were coincided with high and stable salinity conditions during the pre and post monsoon season and the low abundance with low and fluctuating salinity in the south west monsoon season. Changes in species composition of a community are capable of providing a more sensitive and clear measure of pollution disturbances. The pressure on the natural habitat associated with increasing anthropogenic stress like waste disposal and retting will have an impact on the distribution and abundance of nematode population in the estuary. Meiobenthic population tend to increase with moderate organic input while excessive organic load create stress conditions (Ansari *et al*., 2014). The application of

diversity indices to biological monitoring is based on the premise that communities under stress undergo reduction in diversity. A reduction in species diversity was observed in the area of the estuary exposed to prolonged state of pollution

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Table I: Species composition of nematodes in the Adimalathura estuary

Order	Family	Genus	Species
Enoplida	Thoracostomopsidae	Enoploides	E. labiatus
		Mesacanthion	M. armatus
	Oncholaimidae	Oncholaimus	O oxyuris
		Pontonema	P. valviferum
		Viscosia	V.haustromi
	Enchelidudae	Euristomina	Euristomina sp
Chromadorida	Cyatholaimidae	Cyatholaimus	C.ocellatus
	Comesomatidae	Sabatieria	S.intermissa
	Desmodoridae	Desmodora	D. extensa
Monhysterida	Xyalidae	Theristus	T.alternus

Table II: Composition (% of species density) of meiobenthic nematodes at the different stations of Adimalathura estuary

Species	Station I	Station II	Station III
1Enoploides labiatus	22.5	8.28	12.05
Mesacanthion armatus	14.23	22.23	2.8
Oncholaimus oxyuris	0	0.99	2.69
Pontonema valviferum	0	0	0.88
Viscosia haustromi	0	0	0.16
Euristomina sp	1.26	0	0
Cyatholaimus ocellatus	0	0	4.13
Sabatieria intermissa	15.62	9.36	16.02
Desmodora extensa	46.39	59.14	54.19
Theristus alternus	0	0	7.08

Table III: Seasonal and annual mean values of diversity indices in the Adimalathura estuary

Season	Stations	Shannon and Weaver index(H') of diversity	Margalef Species richness index(d)	Dominance Index of Simpson(C)	Species evenness index of Pielou(e)
Premonsoon	I	0.8938	0.4071	0.4043	0.7567
	II	0.6914	0.2282	0.6250	0.4627
	III	1.2168	0.5985	0.3958	0.8440
Monsoon	I	0.5896	0.3380	0.4797	0.5641
	II	0.5095	0.2103	0.5196	0.3569
	III	0.8524	0.4025	0.4447	0.6758
Postmonsoon	I	0.8699	0.3502	0.4539	0.7426
	II	0.7307	0.2913	0.4196	0.6651
	III	1.1670	0.5223	0.4372	0.7174
Annual mean	I	0.7844	0.3651	0.4460	0.6878
	II	0.6439	0.2433	0.5214	0.4949
	III	1.0787	0.5078	0.4259	0.7457

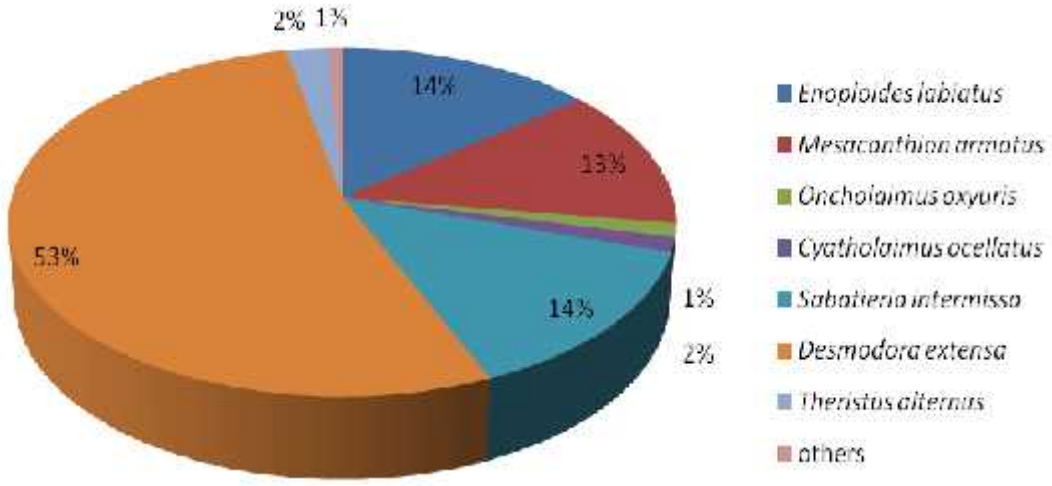

Fig. 1 Percentage composition of meiobenthic nematodes in the Adimalathura estuary