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DIVERSITY OF MEIOBENTHIC NEMATODES ALONG THE COAST OF THIRUVANANTHAPURAM, SOUTHWEST COAST OF INDIA

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ABSTRACT
Nematodes are the most abundant groups among marine meiobenthos. The study highlights the community structure of meiobenthic nematodes at two intertidal sandy shores along the coast of Thiruvananthapuram, Kerala (latitudes $8^0$20'- $8^0$30' north and longitudes $76^0$55'- $77^0$03' east). A total of 12 species of meiobenthic nematodes such as *Anticoma acuminata*, *Pontonema valviferum*, *Viscosia haustromi*, *Cyatholaimus ocellatus*, *Sabatieria abyssalis*, *Desmodora inflexa*, *Desmodora extensa*, *Metepsilonema* sp., *Leptolaimus* sp., *Pterygonema ornatum*, *Desmoscolex* sp. and *Theristus alternus* were recorded. Meiobenthic nematode species diversity index along the coast of Thiruvananthapuram annually varied between 0 and 1.563; species richness index between 0 and 0.7143, species evenness index between 0 and 0.8777 and species dominance index fluctuated from 0 to 1. Moderate values for the indices were noted at both the stations and the values showed its minimum figures during the monsoon season coincided with a fall in the density of total meiofauna.

KEYWORDS: Meiofauna, nematodes, diversity indices, Thiruvananthapuram coast.

INTRODUCTION
Benthos represents a major component of the marine environment and plays a vital role in the overall food chain in the sea. Meiofauna is the most rewarding group of benthos not only because they are rich and forms the link between detritus and higher trophic level but also because they are the key indicators which reflect general health of the benthic habitat. Sandy beaches are profusely inhabited by microscopic interstitial organisms belonging to lower and higher invertebrate taxa and the sandy beaches have attracted the attention of numerous marine biologists.

Free living nematodes are usually the most abundant metazoans of marine benthic habitats, often representing more than 90% of the meiobenthos. An important characteristic of nematode community is its species richness most often higher than that of any other benthic taxa(Platt and Warwick, 1980; Heip *et al*., 1985; Schratzberger *et al*., 2006; Annapurna *et al*., 2012). Many studies have reported the dominance of nematodes in meiofaunal population in the Indian beaches and coastal habitats (Damodaran, 1973; Varshney, 1985; Sarma and Wilsand, 1994; Ansari and Parulekar, 1998; Chinnadurai and Fernando, 2006; Sajan and Damodaran, 2007; Anila Kumary, 2008; Sajan *et al*., 2010; Priyalakshmi and Menon, 2014; Sinu J. Varghese and Miranda, 2015). The present investigation reveals the diversity and abundance of meiobenthic nematodes in the interstices of the sandy beaches along the coast of Thiruvananthapuram, Kerala on the southwest coast of India.

MATERIALS AND METHODS
The study was carried out along the coast of Thiruvananthapuram, the capital district of Kerala on the southwest coast of India. Samples of sediment were collected using a steel corer of 5.5 cm inner diameter and 25 cm long from two selected beaches, station I located at Poonthura coast and station II at Adimalathura coast lying between latitudes $8^0$20'- $8^0$30' north and longitudes $76^0$55'- $77^0$03' east. 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 species level under binocular microscope. 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

The purpose of measuring community diversity is usually to judge its relationship either to other community properties such as productivity and to stability or to the environmental conditions to which the community is exposed to (Pielou, 1975). Species diversity is a matter of concern because low diversity is often linked to some problems of environmental disturbances. The species diversity has a number of components which may respond differently to geographical, developmental or physical factors. Various theories based on time, spatial heterogeneity, competition and predation have been proposed to explain the difference in animal diversity in various environments (Simpson, 1964; Williams, 1964; Paine, 1966). Differences in substrate type and tidal exposure are reported to be reflected in obvious differences in the community structure of interstitial organisms (Kastoro *et al*., 1989).

Invertebrate community structure and dynamics in aquatic habitats are generally analysed by several methods. The quantitative indices offer an effective tool in understanding their organization. Indices such as diversity, richness, evenness and dominance are useful in the critical analysis of the distribution of meiobenthic populations in space and time.

Species composition

The present study reveals spatio- temporal variations in the structural pattern of meiobenthic nematodes along the coast of Thiruvanthapuram. The meiobenthic nematode fauna of Poonthura beach was composed of 10 species while that of Adimalathura beach was composed of 8 species. *Anticoma acuminata, Viscosia haustromi, Cyatholaimus ocellatus, Leptolaimus sp., Pterygonema ornatum* and *Theristus alternus* are the nematode species common to both beaches. The nematode species recorded and their contribution (%) to the density of total nematodes at the two beaches are presented in Table I. *Pterygonema ornatum* was the predominant nematode species in the Poonthura coast followed by *Theristus alternus* whereas *Sabatieria abyssalis* followed by *Desmodora extensa* and *Pterygonema ornatum* formed the predominant components nematode community in the Adimalathura coast. *Theristus alternus* was the only species of nematode community present in all the seasons of the year at both the stations.

Species diversity

A diversity index is a measure of the way in which individuals of an ecological community are distributed among species. Species diversity index of nematodes in the Poonthura coast annually varied between 0.4505 and 1.563 while the index values of the Adimalathura coast was between 0 and 1.452. Maximum annual mean of diversity index was also at the Poonthura coast. The post monsoon season (Oct –Jan) witnessed higher indices at both the stations. In the monsoon season, increased wave action and the uprooting of the substratum resulted in poor density of meiobenthic fauna in these intertidal habitats. Such a decline in diversity values associated with drastic changes in the beach configuration has been reported from other Indian beaches and coastal habitats (Chandran *et al*., 1982; Jagadeesan and Ayyakkannu, 1992; Sajan and Damodaran, 2005; 2007; Chandra and Chakraborty, 2008; Ansari *et al*., 2014; Priyankalakshmi and Menon, 2014; Sinu J. Varghese and Miranda, 2015). Monthly fluctuations in species diversity index of nematodes at the two stations are shown in Fig.1.

Species richness

Species richness index of meiobenthic nematodes annually varied between 0.1183 and 0.7143 at station I and between 0 and 0.5589 at station II (Fig.2). Species richness index is the ratio between the total number of species and total number of individuals. Index of species richness tends to increase with the occurrence of several species without allowing a single species to dominate the community completely (Redding and Cory, 1975). Values of species richness were more at the Poonthura coast than at the Adimalathura coast. The lowest values of species richness were during the period of monsoon rains at both the stations. Table II explains the relationship between various diversity indices at the two stations. Nematodes were totally absent at station II during July registering zero values for all indices at the station.

Species evenness

Species evenness index is the expression of abundance of various species, that is, how equally the various species are distributed. High evenness occurs when species are equally distributed or virtually equal in abundance (Chandra and Chakraborty, 2008; Sinu J.Varghese and Miranda, 2015). Evenness index varied between 0.4586 and 0.8723 at station I and between 0 and 0.8777 at station II (Fig.3). Evenness index was comparatively higher during the post monsoon period at both the intertidal sandy beaches of the Thiruvananthapuram coast which reveals that the coast is more healthy during the post monsoon period. At other periods evenness values clearly indicated the uneven distribution of meiobenthic nematodes. The evenness of distribution of individuals among species may be the result of competition under optimum conditions or may be a response to unfavourable conditions (Patrick, 1971).

Species dominance

Dominance index has been defined as the opposite to equitability component and whenever dominance index is maximum, the evenness index is minimum and the *vice versa*. It is an important component of biodiversity used to identify the main species (Rosenberg, 1975). The values of the index of dominance was comparatively high at station I. The dominance index of meiobenthic

nematodes varied from 0.1666 to 0.7221 at station I and from 0 to 1 at station II (Fig.4). The peak dominance index value 1 at station II during April was due to the complete dominance of the species *Pterygonema ornatum*.

Moderate values were obtained for the indices of diversity, richness and evenness of meiobenthic nematodes at the two stations of Thiruvananthapuram coast. Various factors such as hydrological extremes, tidal influx and exposure, sediment characteristic etc. influence faunal diversity and density of intertidal habitats. Differences in substrate type and tidal exposure are usually reflected in obvious differences in community structure. Extremely low organic matter is recorded in the intertidal sandy beaches of Kerala (Priyankalakshmi and Menon, 2014) and the moderate meiofaunal abundance along the coast of Thiruvananthapuram may be related to a combination of these environmental variables.

Table I. Composition (% of species density) of meiobenthic nematodes in the Thiruvananthapuram coast

Species	Poonthura beach	Adimalathura beach
Anticoma acuminata	13.49	2.2
Pontonema valviferum	11.10	0
Viscosia haustromi	0.38	3.18
Cyatholaimus ocellatus	2.92	2.0
Sabatieria abyssalis	0	32.63
Desmodora inflexa	5.69	0
Desmodora extensa	0	25.06
Metepsilonema sp.	0.07	0
Leptolaimus sp.	7.52	5.7
Pterygonema ornatum	38.91	20.41
Desmoscolex sp.	0.08	0
Theristus alternus	19.84	8.82

Table II Relationship between various diversity indices of meiobenthic nematodes in the Thiruvananthapuram coast

Species Index	Station I		Station II	
	Minimum	Maximum	Minimum	Maximum
Diversity	0.4505(July)	1.563(June)	0(July)	1.452(June)
Richness	0.1183(Dec)	0.7143(June)	0(July)	0.5589(June)
Evenness	0.4586(Feb)	0.8723(June)	0(July)	0.9021(June)
Dominance	0.1666(June)	0.7221(July)	0(July)	1(April)

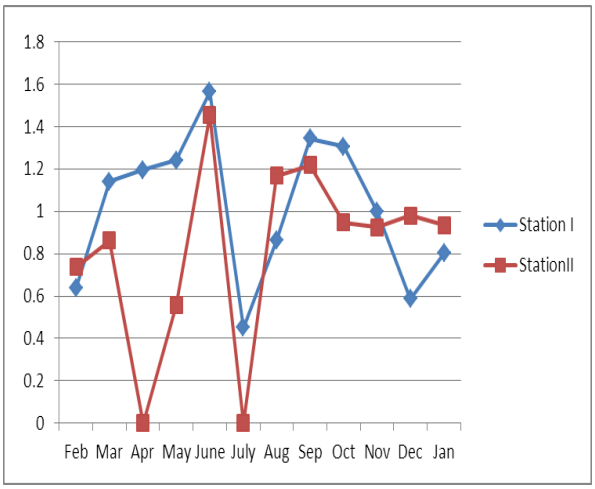

Fig.1. Monthly variations in species diversity index of meiobenthic nematodes along the coast of Thiruvananthapuram

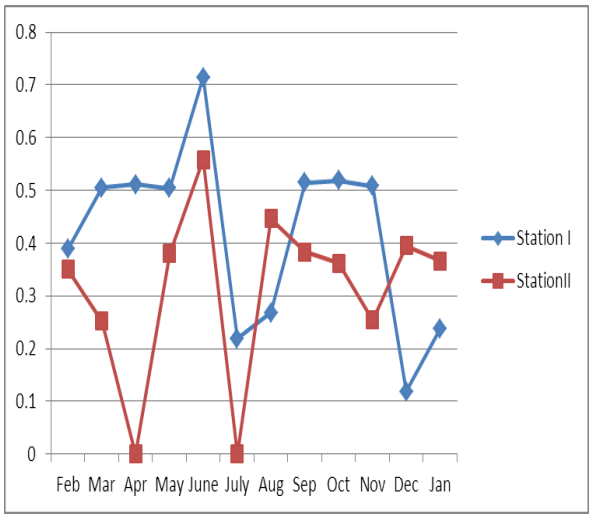

Fig.2. Monthly variations in species richness index of meiobenthic nematodes along the coast of Thiruvananthapuram

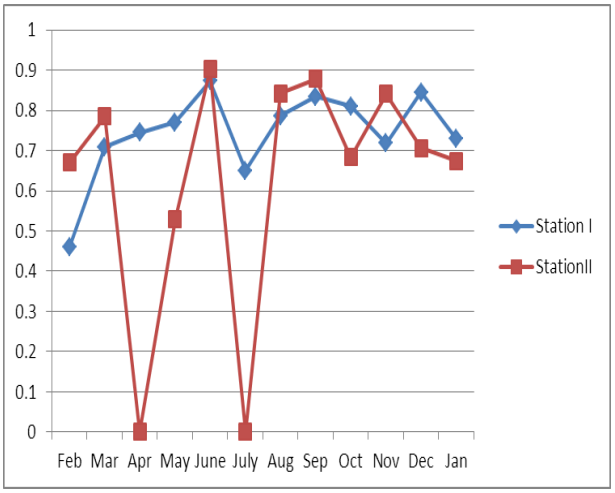

Fig.3. Monthly variations in species evenness index of meiobenthic nematodes along the coast of Thiruvananthapuram

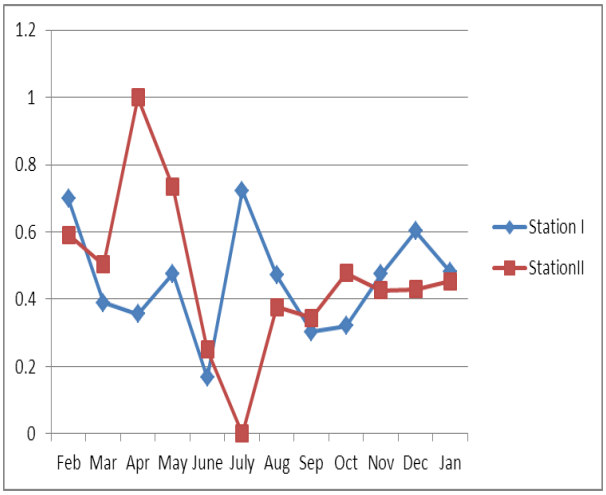

Fig.4. Monthly variations in species dominance index of meiobenthic nematodes along the coast of Thiruvananthapuram

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