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On the vertical distribution of marine nematodes from the shelf sediments off west coast of India with focus on their community structure

S. Sajan and R. Damodaran

Department of Marine Biology, Microbiology and Biochemistry, School of Marine Sciences, Cochin University of Science and Technology, Fine Arts Avenue, Cochin 682 016, India

Abstract

The vertical distribution of free living marine nematodes off the west coast is discussed with focus on the community structure. Three transects were selected and vertical profiles of the most abundant taxon nematoda, was studied to the lowest taxonomic scale. Both nematodes and total meiofauna were found to decline with increase in sediment depth. The diversity decreased towards the lower sediment layers. Nematodes belonging to 12 families were found to occur in the upper and 11 in lower sediment layers. Certain families (Siphonolaimidae, Eurystominidae, Microlaimidae, and Sphaerolaimidae) were represented only in lower sediment layer. The results showed that salinity, temperature, depth and dissolved oxygen as the most important factors defining the existing nematode abundance in the vertical profile of sediment core.

Key words: Nematodes from shelf sediments, community structure, west coast of India

Introduction

Several workers (Damodaran, 1972; Ansari, 1978, 1998) have studied the vertical distribution of meiofauna in sediments from shallow waters of Indian coast. All of them have called attention to the decline in numbers of organisms with increasing depth in the sediment. The literature on the vertical distribution of nematodes up to 200m depth in shelf regions is scarce and the present study calls attention to the species composition and also to their community structure.

Materials and methods

The present study was conducted in the western continental shelf of India extending from Lat. 08°03'96 N-21° 56'99 N and Long.77° 21'96 E to 67° 57'69 E (Fig.1). Materials for the study were collected onboard the Fishery and Oceanographic Research Vessel *Sagar Sampada* from the shelf waters off the west coast of India during February 2001. Altogether 3 transects with 12 stations were covered (off Vadanapilly, off Coondapore and off Dabhol). Samplings were made from 30, 50, 100 and 200m depths from each station to study the depth wise structure of the meiofauna.

Hydrographical data for temperature, salinity and dissolved oxygen were collected from each station by using SeaBird CTD onboard FORV *Sagar Sampada*. Modified Smith McIntyre grab (0.1m^2) was used for collecting sediment samples (Table 1). Immediately after hauling the grab, the undisturbed nature of the sediment was ascertained and sub samples were taken for meiobenthos by using a glass corer with an internal diameter of 2.6cm, and a length of 30cm. The core samples were sliced onboard into upper 4 and lower 4-5 cm and transferred to 250ml plastic bottles and fixed in 5% buffered formalin. Duplicate samples were taken from each station as far as possible from separate grabs to understand sampling variation. In the laboratory, the core samples were washed through a set of 500μm and 63μ sieves. The sediments retained in the 63μ sieve was used for meiofauna extraction by the classic method of decantation. All meiofaunal organisms were sorted and enumerated under a stereomicroscope. Identification of the major group viz., nematoda was carried out to the species level,

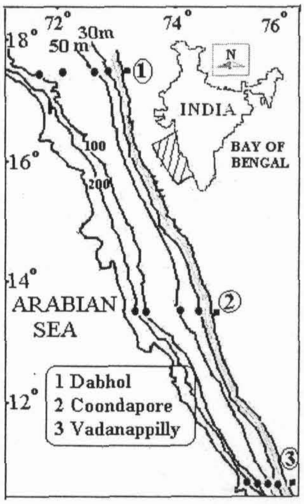

Fig. 1. Map showing the location of sampling stations

whereas the other groups were identified to group level only.

Statistical analysis (Linking environmental parameters with meiofauna) BIOENV was performed with Primer software.

Results and discussion

During the present study, the vertical distribution of nematodes were studied from the three selected transects viz., off Vadanapilly, Coondapore and Dabhol. The identification of these organisms was carried out and the results are presented in Table 1. The meiofauna and nematode densities declined with sediment depth in all the stations. The spatial distribution of meiobenthos within the sediment is driven by a complex combination of biotic and abiotic variables.

The study of the vertical distribution of marine animals aims at linking a certain mode of distribution with a vertical gradient prevailing in the sea water or on the sediment, e.g. a gradient of temperature, salinity, or content of oxygen, etc. The most important of these factors is the shape of the substrate, especially for meiofauna, plays utmost to their composition (Giere, 1993). McLachlan (1977) observed the occurrence of nematodes in deeper layers of sediments. Shirayama (1984) studied their vertical distribution in bathyal to hadal stations in the western Pacific. He noticed that meiofauna was most abundant in the top few centimeters and declined exponentially with depth in the sediment. Soetaert (1983) also found a surface maximum for meiofauna in deeper waters (350-1600m) of Mediterranean.

In the present observation the vertical distribution of nematodes showed that 80% of the individuals inhabited the uppermost 4 centimeters of the sediment (Fig.2). Most sub littoral meiofauna has been reported to be concentrated in the upper few centimeters of deposit, and in some cases most of the animals were even restricted to the top 2 cm (Wieser and Kanwisher, 1961; Thiel, 1966; Damodaran, 1972). In deeper waters, penetration of nematodes into the sediment diminishes. In mud stations off the Belgian coast, 93% of the nematodes were found in the upper 4 cm, but in a sandy station the penetration was much deeper and maximum density was found between 6 and 10 cm (Heip *et al.*, 1979).

While analyzing the nematodes in the upper sediment layers, it is of interest in focusing attention on the genera or families that are present in top sediment layers and their feeding strategies. Accordingly the dominant species in different transects are given in Tables 2 & 3. The Hills diversity indices of nematodes in the stations are given in the Table 4. The diversity indices showed comparatively richer diversity in all the depth levels even though a decline was noticed beyond 150m depth level. The average diversity indices showed that higher diversity occurred in the upper sediment (0-4cm) whereas in lower sediment (beyond 4cm) the diversity was very low (Fig 3).

Table 1. *Environmental parameters of the three transects, west coast of India*

Stations	Depth (m)	Temp-erature (°C)	Salinity (psu).	D. Oxygen (ml/l)	Org. matter	Sand	Silt	Clay
Vadanapilly	36	28.4	34.7	3.3	1.0	85.2	10.2	4.6
-do-	52	28.2	35.3	3.1	1.8	72.2	20.7	7.1
-do-	103	25.4	35.6	2.5	1.4	71.7	20.5	7.8
-do-	197	17.2	35.2	0.2	1.6	71.9	21.2	6.8
Coondapore	33	28.5	34.6	3.9	4.3	1.6	69.9	28.5
-do-	53	28.3	35.6	3.5	0.5	97.2	2.4	0.4
-do-	104	25.9	35.8	2.3	0.9	93.6	5.1	1.3
-do-	193	16.0	35.3	0.1	1.6	83.4	11.6	5.1
Dabhol	35	26.4	35.7	3.9	3.8	0.9	38.0	61.1
-do-	57	26.7	35.6	3.7	4.9	0.5	44.0	55.5
-do-	95	25.7	35.7	2.3	4.8	53.3	33.9	12.8
-do-	94	26.1	36.0	3.4	0.7	95.2	3.4	1.4

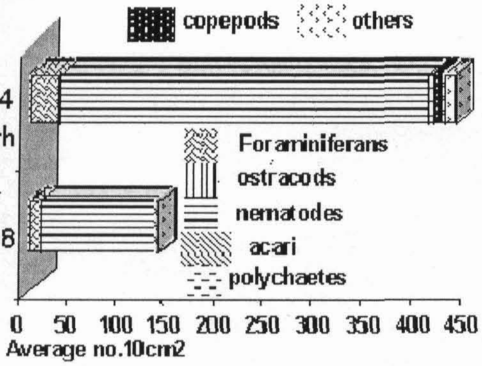

Fig.2. Vertical distribution of meiofauna in selected stations

The nematode composition of the present study showed the occurrence of 12 families in upper and 11 in lower sediment layers while certain families (Siphonolaimidae, Enchellidae, Microlaimidae, and Sphaerolaimidae) were represented only in lower layers (Table 5).

Nematods in the surface 4 cm layers belonged to Oxystominidae, Oncholaimidae, Desmoscolecidae, Comesomatidae, Xyalidae, Cyatholaimidae, Linhomoeidae Aegioloalaimidae, Desmodoridae, Chromadoridae Ceramonematidae and Selachinematidae. Vivier (1978) found Araeolaimidae, Desmodoridae and Desmoscolecidae living in the surface layers together with Enoplida (Oxystominidae), Chromadoridae, Cyatholaimidae and Choanolaimidae. The Comesomatidae were present in all layers of the fluid red muds studied (108-580 m).

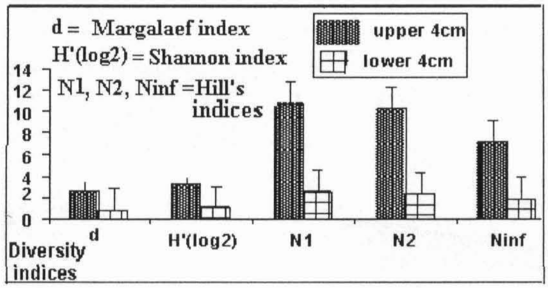

Fig. 3. Average diversity indices of nematodes in upper and lower 4cm of the sediment core

The faunal concentration in the upper sediment layers is thought to result from the availability of oxygen, as well as the concentration of food material at the deposit surface (McIntyre, 1969; Damodaran, 1972). The deeper penetration of nematodes is due to their ability to exist anaerobically for long periods (Fenchel and Riedl, 1970; Damodaran, 1972). Wieser (1959) also set the grain size barrier and suggested that median particle size of 120m might be the finest in which interstitial life including nematodes can live on.

The BIOENV analysis showed that salinity, temperature, dissolved oxygen and depth were the factors controlling the observed pattern of nematodes abundance. The temperature and dissolved oxygen content were found

Table 2. *Dominant species contributing similarity in different layers of sediment at selected depths.*

Depth (m)	Dominant species contributing ~50% similarity in upper layer	Dominant species contributing ~50% similarity in lower layer
30	*Dorylaimopsis* spp., *Paralinhomeous pachyamphis* and *Eurystomina* spp.	*Paralinhomeous* and *Dorylaimopsis* spp.
50	*Metacyatholaimus* spp., *Terschellingia longicaudatus, Sabatieria* spp.	*Sabatieria* and *Terschellingia longicaudatus*.
100	*Halalaimus* spp., *Sabatieria* spp., *Metacyatholaimus* spp.	*Latronema* spp.
150	*Quadricoma* spp., *Viscosia* spp., *Halalaimus* spp., *Oxystomina clavicaudata*	*Spirinia* spp. and *Promonhystera* spp.

Table 3. *The dominant nematode species in each transects*

Transects	Dominant species contributing ~50% abundance in sediments
Vadanapilly	*Dorailaimopsis* spp., *Metacyatholaimus* spp., *T. longicaudatus* and *Theristus* spp.
Coondapore	*Dorailaimopsis* spp., *Metacyatholaimus* spp., *Halalaimus* and *Tricoma* spp.
Dabhol	*Sabatieria* spp., *Halalaimus* spp. and *Metacyatholaimus* spp.

Table 4. *The diversity index of free living nematodes from three transects, west coast of* India

Stations/Depth	Margalaef index	Shannon index	Hill's index.N1	Hill's N2	Hill's Ninf
Vadanapilly					
30m	4.91	4.32	19.93	18.13	10.29
Coondapore					
30m	1.70	2.83	7.11	6.36	4.07
Dabhol					
30m	2.48	3.44	10.83	10.67	8.00
Vadanapilly					
50m	2.13	3.30	9.82	9.63	6.80
Coondapore					
50m	3.57	3.66	12.60	11.46	6.33
Dabhol					
50 m	2.85	3.68	12.78	12.57	9.57
Dabhol					
175m	1.47	2.40	5.28	4.59	2.73
Dabhol					
75m	1.36	2.27	4.82	4.69	3.80
Vadanapilly					
100 m	3.58	3.78	13.77	12.76	8.33
Coondapore					
100m	2.31	3.08	8.44	8.00	5.33
Vadanapilly					
150 m	2.28	3.22	9.34	8.84	5.78
Coondapore					
150m	2.61	3.33	10.02	8.44	4.25

to decrease with increase in depth. The density of total meiofauna and nematodes were found to fall towards deep waters in agreement with increasing water depth and decreasing dissolved oxygen and temperature. The reason for the tendency of nematodes to penetrate deep into the sediment layers is not known. One possible explanation is the larger mobility of longer nematodes enabling them to penetrate into the more compact deeper layers (Soetaert

Table 5. *Nematode families present in the upper and lower sediment layers at different depth ranges (m) from 3 transects, west coast of India*

Family /Depth (m)	30-50	51-75	76-100	101-150	>150
Core (upper 4 cm)					
Oncholaimidae	A	P	A	A	P
Oxystominidae	P	P	P	P	P
Comesomatidae	P	P	P	P	P
Selachinematidae	A	A	A	A	P
Desmodoridae	P	P	A	P	P
Desmoscolecidae	P	A	P	A	P
Aegialolaimidae	A	A	A	P	A
Chromadoridae	A	A	A	P	A
Cyatholaimidae	P	P	P	P	P
Ceramonematidae	A	A	A	P	A
Xyalidae	P	P	P	P	P
Linhomoeidae	P	A	A	A	A
Core (lower 4 cm)					
Oxystominidae	P	P	A	P	A
Enchellidae	A	P	A	A	A
Comesomatidae	P	A	P	A	A
Selachinematidae	P	P	A	P	A
Desmodoridae	A	A	A	A	P
Microlaimidae	A	A	P	A	A
Cyatholaimidae	P	A	A	A	A
Sphaerolaimidae	A	A	A	A	P
Xyalidae	A	A	P	A	P
Linhomoeidae	P	P	A	P	A
Siphonolaimidae	A	P	A	A	A

P = present, A = Absent

and Heip, 1995). Results from the recent studies (Vanhove *et al.*, 1998; Steyaert *et al.*, 1999) show that nematode species tend to distribute vertically mostly to a pattern similar to the vertical distribution of trophic sources rather than to the redox chemistry of the sediment. The relation between body size and width was well correlated with the food sources in the sediment (Soetaert *et al.*, 2002). Ansari, 2000 reported that in central Indian basin the relation between meiofaunal vertical distribution and the vertical profile of the total organic matter and total labile matter was positive. More studies on the vertical profile of the organic matter and sediment grain size will possibly unravel the ecology of vertical distribution. It might be concluded that fine scale vertical distribution of nematodes is the result of combination of physical factors and biological interaction in the sediments.

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