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Composition and Seasonal Fluctuations of Nematodes in Palk Bay, Southeast Coast of India

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Abstract: The present study aimed to investigate nematode community structure and to find out the effect of seasonal environmental conditions. The community structure of nematodes showed a significant variability both spatially and temporally. The sampling was made for the period of six months from two different stations. Species richness, evenness, diversity, density, percentage compositions were scrutinized. Totally 33 species was recorded, which includes 5 species belongs to Desmodoridae, 4 species to Chromodoridae, 3 species to Tripyloididae, 3 species to Oncholaimidae, 4 species to Xylaidae, 5 species to Leptolaimidae, 4 species to Oxystominidae and 5 species to Diplopeltidae. In which 12 species were recorded only in station I and 9 species were observed only from station II. Here the influences of season and nature of sites show remarkable variations in the nematode community composition. Meiofauna have been widely used in similar investigations of benthic community responses to contamination or physical disturbance under field and experimental conditions. There is no such kind of studies in the present study site leads to the present investigation and this is a much needed prerequisite for future meiofaunal studies in Indian waters.

Key words: Meiofauna · Free-living nematodes · Community structure · Palk Bay · India

INTRODUCTION

Meiofauna has been regarded as an important component in benthic ecosystems due to their small size, high abundance and fast turnover rates [1, 2]. Marine nematodes may keep the bacterial colonies in active growth phase by feeding on them, thus enhancing the recycling of nutrients [3 -5]. The importance of meiofauna as environmental indicators has also been recognized from last century [6], especially on the study of the effects of anthropogenic activities and pollution on meiofauna and nematodes recently [7- 9].

Meiofauna is the major metazoan component of benthic ecosystem and its production is equal or higher than macrofauna in shallow waters to deep sea [1, 2, 10, 11]. Meiofauna facilitates biomineralization of organic matter (OM) and enhances nutrient regeneration [3, 5]. They serve as food for a variety of higher trophic levels and exhibit high sensitivity to anthropogenic inputs making them excellent environmental indicators [12- 14]. To date there have been many benthic studies undertaken in and around Indian waters. However, most of them have been on macrobenthos and information on the meiofaunal communities of the Indian shelf sediment is relatively insufficient. Preliminary investigations on nematodes were carried out by Timm [15-17] from the Bay of Bengal region and Gerlach [18] from the Maldives Islands.

Meiofauna organisms are very efficient in utilizing the available food resources and appear to be bottom-up controlled [19] by the concentration of food. Moreover, because of their small size, high abundance and the high number of major taxa [20], they are a good tool to reflect changes of environmental disturbance [21], both spatially and temporally [22]. The most diverse and abundant group of the meiobenthos, the free-living nematodes, were not studied at all prior to the ecosystem changes. As to the spatial distribution of major meiobenthos taxa, to date, very little information is available [23]. Many of the studies were carried out on nematodes in both east and west coast of India and which includes Ansari and Parulekar [24] in Zurai estuary and Sultan Ali *et al.* [25] in Pitchavaram mangroves. Nematode families have

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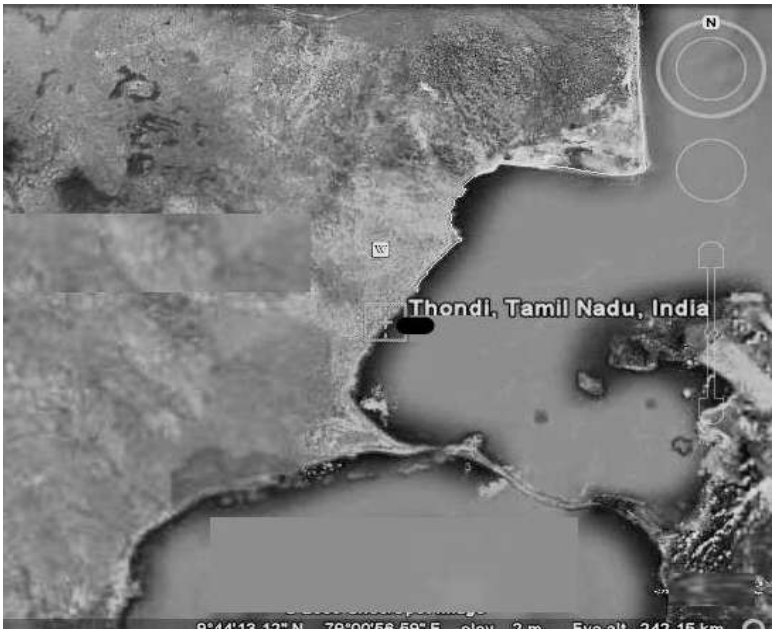

Fig. 1: Showing the study area

reported in western Kutch mangroves by Sesh Serebiah [26]. So far there is no work contributed to nematodes taxonomy and ecology in Palk Bay. Hence, the present investigation was taken to initiate the further detail exploration of nematodes ecology in the vicinity. The purpose of the present investigation was, therefore: (1) to investigate the composition, abundance and diversity (2) to identify the key variables that affect the nematode community structure and composition in relation to seasons and environmental factors and the biodiversity of nematodes in the coastal waters of Thondi.

Description of Study Area: Thondi (Lat. 9° 43' N: Long. 78° 49' E) is a major fish landing village in the coastal belt of Palk bay (Fig. 1). It influence the inshore sea water always in turbid and gradually reduce after 50m towards seaward side. Station I was fixed exactly on the river mouth and the station II made in towards sea which is one kilometer away from 1st Station.

MATERIALS AND METHODS

Monthly sampling was made in two different stations for a period of six months from September 2005 to February 2006. In each station triplicate samples were made randomly in a 10-meter quadrate. The water temperature was measured in the quadrate using a standard centigrade thermometer. Water salinity was estimated with the help of salinity refracto meter. The water pH was measured using weather tronics pH meter. Dissolved oxygen was estimated by the modified Winkler's method [27]. The sediment samples for nematodes were collected using a 15cm long corer samples with a diameter 3.8 cm and sharpened at one end to form a cutting edge. A cork piston was introduced in to the lower end of the tube and the core extruded. On retrieval, the corers were placed in small polythene bags and stored in iceboxes. The collected samples were brought to the laboratory and sieved through 62µm. The samples were persevered 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 diversity of nematodes was calculated by using Shannon Wiener's index (H`) (Shannon and wiener, 1949). Species richness (SR) was calculated using Margalef Index and Species evenness index (J`) (equitability) was calculated by using the formula of Pielous [28].

RESULTS

Water Temperature: The surface water temperature at station I varied from 27 to 29°C. Minimum (27°C) was recorded during the monsoon (December 2005) and maximum (29°C) during the premonsoon (January 2006). In station II, the surface water temperature fluctuated from 26.5 to 29.5°C. The lowest value (26.5°C) was recorded during monsoon (December 2005) and highest value (29.5°C) during premonsoon (September 2005).

Table 1: List of nematodes recorded in St. I and St. II.

FAMILY	STATION I	STATION II
DESMODORIDAE		
Metachromadora macroutera	*	
Desmodora sp.	*	*
Spirina sp.	*	*
Desmoora luticola	*	*
Chroma pirina		*
CHROMADORIDAE		
Acontiolaimus zostericola	*	
Neochromadora izhorca	*	*
Spilophorella papillata	*	*
Prochromadorella brachyura	*	*
TRIPYLOID		
Tripyloides gracilis	*	*
Bathlaimus inermis	*	*
Gairlenema sp.		*
ONCHOLAIMIDAE		
Oncholaimus fuscus	*	*
Filoncolaimus sp.		*
Viscosia viscosa	*	*
XYLAIDAE		
Cobbia sp.	*	*
Daptonema conicum	*	
Daptonema oxycera	*	*
Theristus pertenuis	*	
LEPTOLAIMIDAE		
Dagda sp.		*
Procamacolaimus sp.		*
Stephanolaimus sp.		*
Onchium sp.	*	
Leptolaimoidus	*	
OXYSTOMINIDAE		
Nemanema sp.	*	
Paroxytomina sp.	*	
Wiesera sp.		*
Halalaimus gracillis		*
DIPLOPELTIDAE		
Areolaimus tongicauda	*	
Diplopetis sp.	*	
Camplaimus sp.	*	
Sabptieria sp.		*
Synonchus fasiculates	*	

Salinity: Salinity varied at station I from 25.5 to 29 ppt. Minimum (25.5 ppt) was recorded during the monsoon (December 2005) and the maximum (29) during postmonsoon (February 2006). In station II, the salinity fluctuated from 26 to 29.5 ppt. The lower value (26ppt) was measured during monsoon (November 2005) and higher value (29.5 ppt) was during postmonsoon (February 2006).

pH: Water pH at station I varied from 8.2 to 8.4. Lower value (8.2) was recorded during late monsoon (November 2005) and the higher value (8.4) during postmonsoon (February 2006). At station II, the water pH varied from 8.1 to 8.5. The minimum (8.1) was recorded during monsoon (November 2005) and the maximum (8.5) was recorded during postmonsoon (February 2006).

Dissolved Oxygen: Dissolved oxygen concentration at station I, found to be vary from 3.9 to 4.8 mgl^{-1}. Minimum (3.9 mgl^{-1}) was recorded during the premonsoon (September 2005) and maximum (4.8 mgl^{-1}) was during monsoon (December 2005). In station II, dissolved oxygen concentration fluctuated from 3.7 to 4.9 mgl^{-1}. The lower value (3.7 mgl^{-1}) was recorded during premonsoon (September 2005) and the higher value (4.9 mgl^{-1}) was during postmonsoon (January 2006).

Total Organic Carbon: The total organic carbon content in the sediment ranged from 0.71% (November 2005) to 3.28% (January) at station I and 0.42% (October) to 2.89% (January) at station II.

Monthly variation of species composition, percentage composition, population density and diversity indices of nematodes were investigated for a period of 6 months in Thondi, estuarine area. The nematodes in two stations were represented by 8 families of Desmodoridae, Cromodoridae, Tripyloididae, Oncholaimidae, Xylaidae, Leptolaimidae, Oxystominidae and Diplopeltidae.

Species Composition: A total of 33 species of nematodes were recorded during the present study. Of this 5 species belongs to Desmodoridae, 4 species to Choromodoridae, 3 species to Tripyloididae, 3 species to Oncholaimidae, 4 species to Xylaidae, 5 species to Leptolaimidae, 4 species to Oxytominidae and 5 species to Diplopeltidae.

At station I, 24 species of nematodes were encountered of this 12 species were restricted to station I. At station II, 21 species were recorded of this 9 species were restricted to station II. Check list of nematodes recorded in stations are given in the (Table 1).

Percentage Composition: At station I, percentage composition (Fig. 2) of Desmodoridae, ranged between 14.2 and 18.1%. The minimum (14.2%) was recorded during postmonsoon (November 2005) and the maximum (18.1%) was recorded during premonsoon (October 2005). Percentage composition of Chromodoridae ranged from 7.1 and 20.0%. The minimum (7.1%) was recorded during the post monsoon (January 2006) and maximum (20.0%)

was recorded during postmonsoon (February 2006). The percentage composition of Tripyloididae ranged between 11.1% and 28.5%, the minimum (11.1%) was recorded during the premonsoon (September 2005) and maximum (28.5%) was recorded during the postmonsoon (January 2006). The percentage composition of Oncholaimidae ranged between 11.1% and 28.5%. The minimum (11.1%) was recorded during the premonsoon (September 2005) and the maximum (28.5%) was recorded during the postmonsoon (January 2006). The percentage composition of Xylaidae, ranged between 7.1% and 30.0%. The minimum (7.1%) was recorded during the monsoon (December 2005) and the maximum (30.0%) was recorded during the post monsoon (February 2006). The percentage composition of Leptolaimidae ranged from 5.5% and 14.2%. The minimum (5.5%) was recorded during the premonsoon (September 2005) and the maximum (14.2%) was recorded during the monsoon (November 2005). The percentage composition of Oxytominidae ranged between 16.6 and 28.5%. The minimum (16.6%) was recorded during the premonsoon (September 2005) and maximum (28.5%) was recorded during the monsoon (November 2005). The percentage composition of Diplopeltidae ranged between 3.0 and 9.0%. The minimum (3.0%) was recorded during the premonsoon (October 2005) and maximum (9.0%) was recorded during the premonsoon (October 2005).

At station II, the percentage composition (Fig. 3) of Desmotoridae ranged between 7.6 and 33.3%. The minimum (7.6%) was recorded during the premonsoon (October 2005) and maximum was recorded (33.3%) during postmonsoon (January 2006). The percentage composition of Chromadoridae ranged between 7.6% and 15.3%. The minimum (7.6%) was recorded during the postmonsoon (February 2006) and maximum (15.3%) was recorded during the premonsoon (October 2005). The percentage composition Tripyloides ranged between 8.3 and 25.0%. The minimum (8.3%) was recorded during the postmonsoon (January 2006) and the maximum (25.0%) was recorded during the monsoon (November 2005). The percentage composition of Oncholaimidae ranged between 10.0 and 50.0%. The minimum (10.0 %) was recorded during the monsoon (December 2005) and the maximum (50.0%) was recorded during the monsoon (November 2005). The percentage composition of Xylaidae ranged between 7.6 and 15.3%. The minimum (7.6%) was recorded during the postmonsoon (February 2006) and maximum (15.3%) was recorded during the premonsoon (October 2005). The percentage composition of Leptomidae ranged between 10.0 and 30.7%. The minimum (10.0%) was recorded during the monsoon (December 2005) and maximum (30.7%) was recorded during the postmonsoon (February 2006). The percentage composition of Oxytominidae ranged between 10.0 and 25.0%. The minimum (10.0%) was recorded during the postmonsoon (January 2006) and maximum (25.0%) was recorded during the monsoon (November 2005). The percentage composition of Diplopeltidae ranged between 0 and 10%. The minimum (0%) was recorded during the postmonsoon (January 2006) and maximum (10%) was recorded during the monsoon (December 2005).

Population Density: At station I, the benthic nematodes population density (Fig. 4) varied from 18 to 7 individuals/10cm^2. The minimum 7 species were recorded during monsoon (November 2005) and maximum 18 were recorded during postmonsoon (January 2006). At station II benthic nematodes density varied from 14 to 4 individuals/10 cm^2. The minimum 4 was recorded during monsoon and postmonsoon (November 2005) and maximum 14 was recorded during post monsoon (January 2006).

Shannon and Wiener's Diversity Index (H'): At station I, diversity index (Fig. 5) varied from 1.04 to 1.879. The minimum (1.04) was recorded during the monsoon (November 2005). The maximum 1.879 was recorded during early postmonsoon (January 2006). At station II diversity index fluctuated from 1.72 to 20.25. The minimum 1.21 and maximum 1.94 were recorded monsoon (Noevember 2005) and postmonsoon (January 2006) respectively.

Margalef Index: At station I species richness (Fig. 6) varied from 1.14 to 2.27. The minimum 1.14 was observed during monsoon (November 2005) and the maximum 2.27 was observed during post monsoon (January 2006). At station II, the species richness varied from 1.95 to 3.04. The minimum 1.95 and the maximum 3.04 were recorded during monsoon (November 2005) and during postmonsoon (January 2006).

Pielous Evenness Index (J'): At station I species evenness index (Fig. 7) varied from 0.84 to 0.97. The minimum 0.84 was observed during postmonsoon (February 2006) and maximum 0.97 was during premonsoon (September 2005). At station II, evenness values fluctuated from 0.92 to 0.97. The lowest 0.92 and highest 0.97 evenness were recorded during premonsoon (October 2005) and postmonsoon (January 2006), respectively.

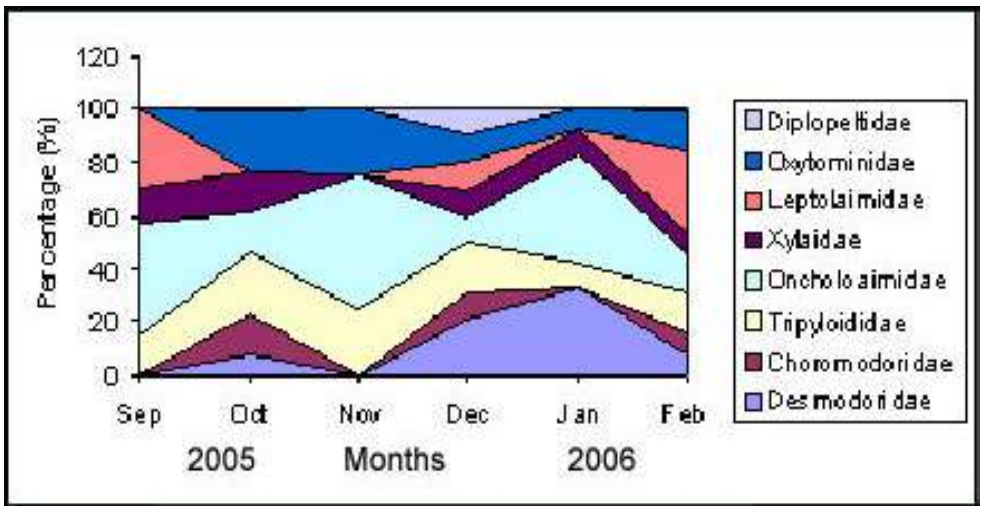

Fig. 2: Percentage Composition of Nematodes at station I

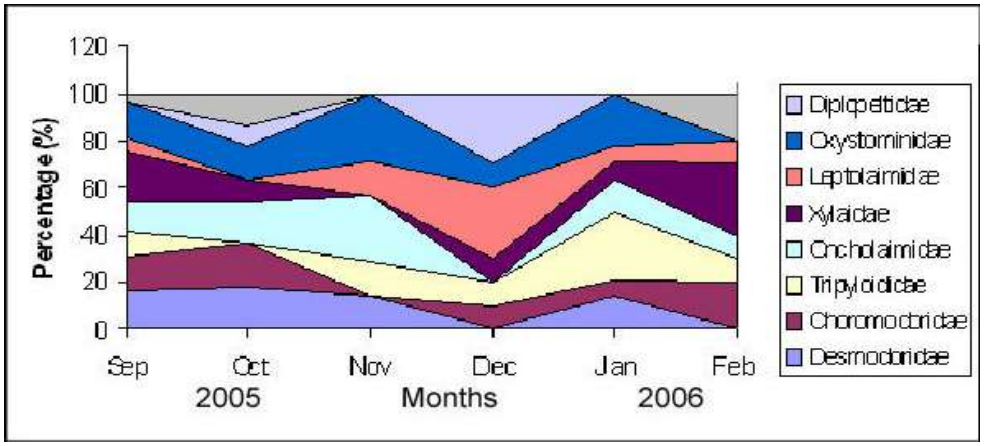

Fig. 3: Percentage Composition of Nematodes at station II

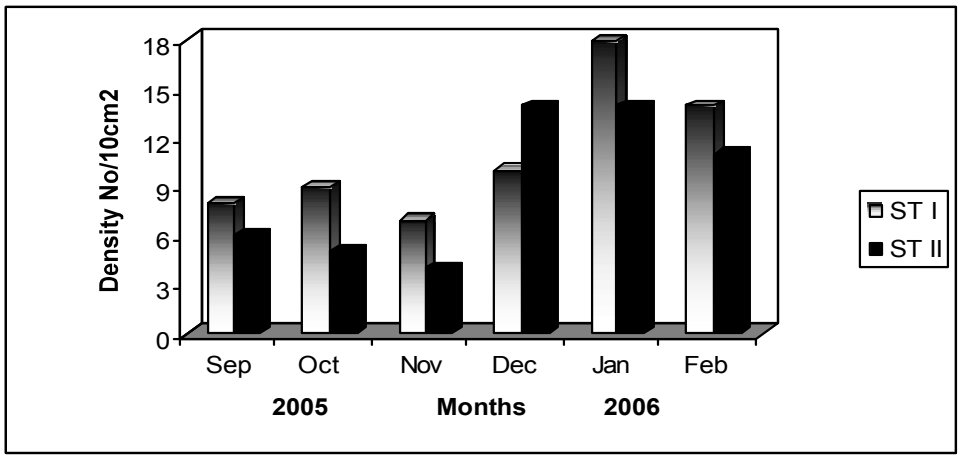

Fig. 4: Population density of Nematodes

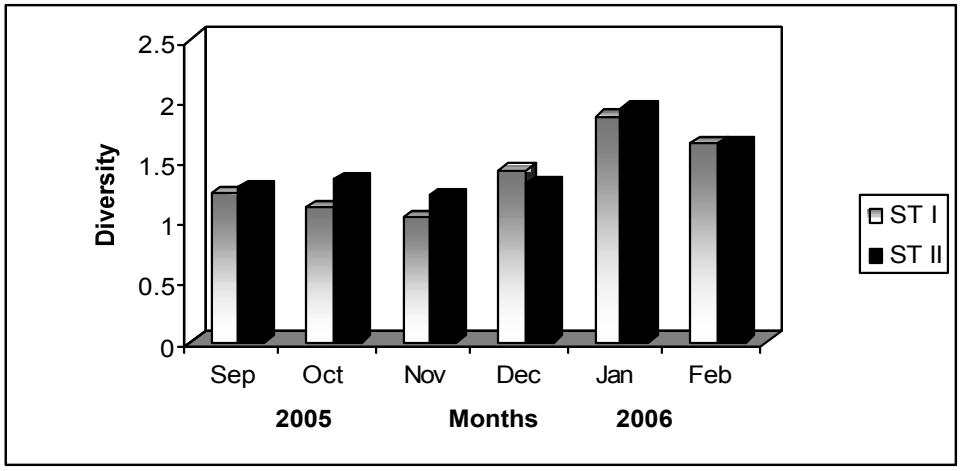

Fig. 5: Diversity of Nematodes

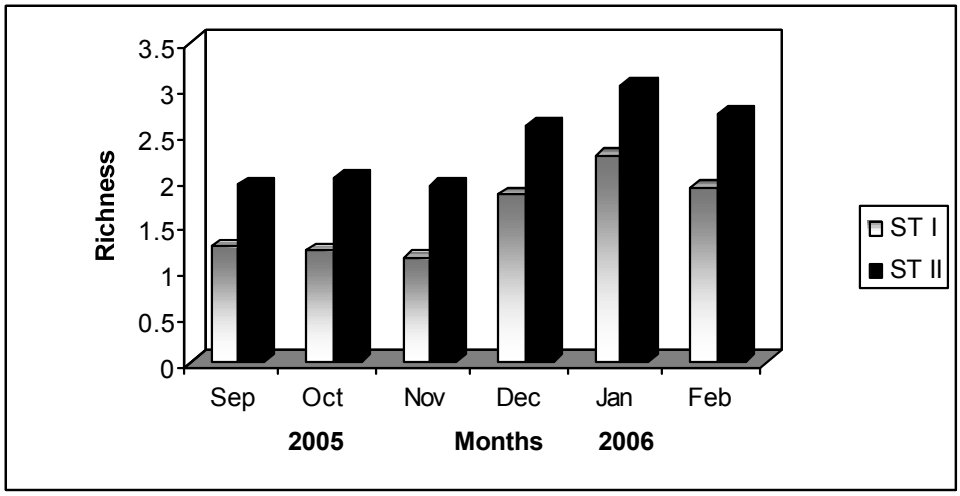

Fig. 6: Species richness of Nematodes

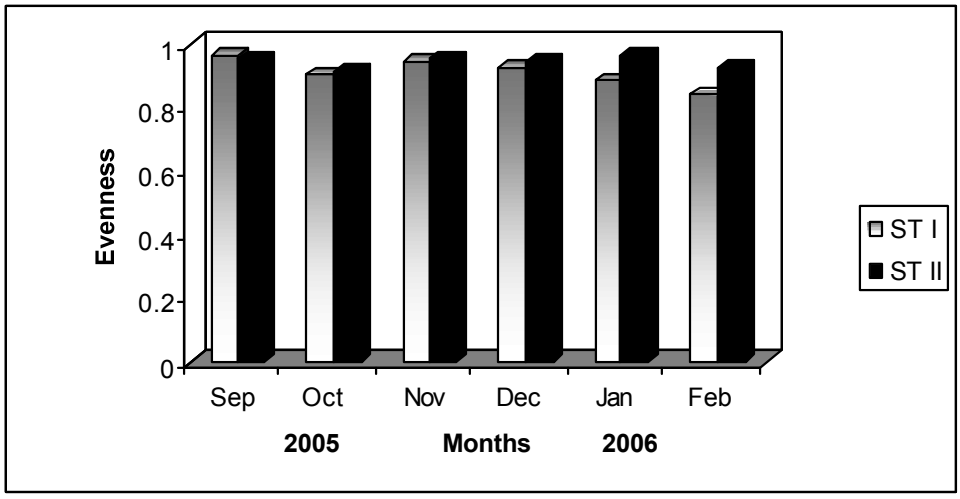

Fig. 7: Species evenness of Nematodes

DISCUSSION

In the present study it could be seen that there are characteristic temporal and spatial variation noticed in nematodes structural patterns. The variations seem to have influenced by physico chemical and biological characteristics prevailing in the environment. In the present study nematodes families recorded were Desmodoridae, Chromadoridae, Tripyloididae, Oncholaimidae, Xylaidae, Leptolaimidae, Oxystominidae and Diplopeltidae. Similar nematode families have reported in western Kutch Mangroves by Sesh Serebiah [26], Ansari and Parulekar [24] in Zuari estuary and Sultan Ali *et al.* [25] in Pitchavaram Mangroves. Among the 8 families 33 species were identified of this *Desmodora* sp. *Spirina* sp. *Neochromadora izherica, Tripyloides gracilies, Viscosia Viscosa, Cobbia* sp. *Dagda* sp. *Wieseria* sp. *Diplopetis* sp. are found to be dominance.

Desmodoridae occurred in high percentage in station II, were as its occurrence in station I is minimum. It might be due to the species belongs to Desmodoridae prefer station II instead of station I. Apart from it considered to be narrow fluctuated tolerance species, but the species belongs to tripyloious found to be survive in both stations reveal withstand all fluctuations in the environment. The species belongs to Oncholaimidae, Oxytominidae, were observed in high level in station I. These species were considered as prefer estuarine condition, which with fluctuated frequently. The species belongs to Xylaidae in the present study found to be surviving estuarine condition alone showed high tolerance against fluctuation.

Environmental factors such as temperature, salinity pH and dissolved oxygen are the main factor influencing in the distribution of nematodes in tropical mangroves as well as estuarine habitat. The environmental parameters in which a species is exposed have significant impact on its physiology distribution and its population density [26, 29]. Temperature is considered to be an important factor controlling the nematode density and distribution in the present study. High temperature was observed in premonsoon season caused low faunal density. Eventhough the low temperature was observed in November. Heavy down pour caused floods change the salinity level might be hindrance for nematode density. The little elevation in salinity level at late monsoon and early postmonsoon seasons showed high faunal density might be suitable for enrichment of nematodes. High dissolved oxygen content is positively correlated nematode density in estuarine conditions was well established in the present study.

High density of nematodes was observed in the present study correlate with nematode diversity. Comparatively high diversity was recorded in station II followed by station I. It might be due to preference of non-fluctuated sheltered and calm area. These species richness also coincide with diversity and population density of the nematodes. The maximum species evenness in November might be due to low diversity of nematodes species by unfavorable environment. Heavy rain in November caused unfavorably to the nematodes was observed clearly in the present investigation.

In conclusion, this is the first extensive study on nematodes carried out in the Southeast coast of India and provides preliminary base-line information on the community structure of free-living marine nematodes in this area. We have demonstrated that the Thondi coast is inhabited by different nematode groups. High spatial variability of the abundance of nematodes and also to some extent other groups, can, at this stage, mainly be attributed to different environmental characteristics.

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