



Trophic diversity, size and biomass spectrum of Bay of Bengal nematodes: A study case on depth and latitudinal patterns



Kapuli Gani Mohamed Thameemul Ansari^{a,b,*}, Somasundharanair Lyla^a, Syed Ajmal Khan^a, Punyasloke Bhadury^b

^a Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai 608502, Tamil Nadu, India

^b Integrative Taxonomy and Microbial Ecology Research Group, Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata, Mohanpur, 741246 Nadia, West Bengal, India

ARTICLE INFO

Keywords:

Nematodes
Trophic diversity
Size and biomass spectrum
Continental shelf
Bay of Bengal
India

ABSTRACT

Depth and latitudinal patterns of nematode functional attributes were investigated from 35 stations of Bay of Bengal (BoB) continental shelf. We aim to address whether depth and latitudinal variations can modify nematode community structure and their functional attributes (trophic diversity, size and biomass spectra). Global trend of depth and latitudinal related variations have also been noticed from BoB shelf in terms of nematode abundance and species richness, albeit heterogeneity patterns were encountered in functional attributes. Index of trophic diversity values revealed higher trophic diversity across the BoB shelf and suggested variety of food resource availability. However, downstream analysis of trophic status showed depth and latitude specific patterns but not reflected in terms of size and biomass spectrum. The peaks at different positions clearly visualized heterogeneity in distribution patterns for both size and biomass spectrum and also there was evidence of availability of diversified food resources. Nematode biomass spectra (NBS) constructed for nematode communities showed shift in peak biomass values towards lower to moderate size classes particularly in shallower depth but did not get reflected in latitudes. However, Chennai and Parangipettai transects demonstrated shift in peak biomass values towards higher biomass classes explaining the representation of higher nematode abundance. Our findings concluded that depth and latitudes are physical variables; they may not directly affect nematode community structure and functional attributes but they might influence the other factors such as food availability, sediment deposition and settlement rate. Our observations suggest that the local factors (seasonal character) of phytodetrital food flux can be very important for shaping the nematode community structure and success of nematode functional heterogeneity patterns across the Bay of Bengal shelf.

1. Introduction

Ecosystem functioning involves numerous processes, such as primary and secondary production, organic matter consumption and decomposition, nutrient regeneration and energy transformation from lower to higher trophic levels. These ecosystem level processes are directly/indirectly regulated by intra- and inter-specific interactions between organisms and physical environment (e.g. Naeem et al., 2012). Particularly in marine ecosystem, this is exemplified by complex internal dynamics and can vary rapidly. Moreover, the responses are non-linear to multiple disturbances (de Young et al., 2008). In addition to organismal distribution and diversity, it is also dependent on other biological interaction, life histories, adaptability, physiological tolerance and dispersal rate within the ecosystem (e.g. de Young et al., 2008). The Ocean covers ca. 70% of the Earth and most ocean bottom is

covered by sediments, which makes the largest habitat on our planet and also extremely diverse spatially in terms of biodiversity (e.g. Lamshead and Boucher, 2003), despite they are mostly separated from the euphotic zone (Soetaert et al., 2002). Benthic biodiversity is often focused based on living habitat (e.g. epifauna and infauna) and size groupings (e.g. macro-, meio- and microfauna); indeed there are major differences between groups, in terms of structure (e.g. colonization, patchiness) and functions (e.g. Semprucci and Balsamo, 2012). Additionally benthic communities, in particular meiofaunal nematodes play a significant contribution in water and sediment column processes (e.g. mineralization of organic matter, associated nutrient regeneration, pollutant distribution and fate), sediment stability, production and transport (e.g. Snelgrove et al., 1997; review by Moens et al., 2013).

Among benthic organisms, meiofauna is more diverse (24 out of 35 animal phyla), and abundant (10^5 to 10^8 ind./m²) than any other

* Corresponding author at: Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai 608502, Tamil Nadu, India.
E-mail address: kgmt.ansari@gmail.com (K.G.M.T. Ansari).

component of benthic realm (see review by Balsamo et al., 2010). In particular, free-living nematodes, often representing 60–90% of total meiofaunal abundance with estimated species richness can vary largely (see review by Appeltans et al., 2012). They are extremely ubiquitous and differ extensively among various habitats, due to direct/indirect complex interactions among different biogeochemical processes (Moens et al., 2013 for review). Moreover, there has been a marked increase on the number of studies on marine meiofauna, especially on nematode community structure and their ecology in recent decades (e.g. review by Schratzberger and Ingels, 2017) with a particular focus on ecosystem monitoring (see Semprucci et al., 2015; Zeppilli et al., 2015 and references therein). Morphological features, for example feeding guilds, tail morphology, size and shape as well as life history strategy of free-living nematodes provide a better understanding of ecosystem level status and also in terms of their functions (see Schratzberger et al., 2007 and references therein). Moreover, frequent modification in nematode feeding guild classifications often alters the functional complexities such as flexibility in feeding modes and food availability which can changes ecosystem processes such as organic matter consumption and decomposition, nutrient regeneration and energy transformation (see review by Moens et al., 2013).

Depth-related patterns in size structure of marine benthic communities have been focused since 1950s which led to several hypotheses (Udalov et al., 2005 references therein). In general, the input and settlement rate of organic matter (i.e. food availability) can play a major role in structuring benthic communities towards the depth-profile (Gambi et al., 2017 references therein). However, depth and latitude-related patterns of nematode size spectra and their mechanisms are still not clearly understood (Soetaert and Heip, 1989; Vanhove et al., 1999; de Bovée et al., 1990; Soltwedel et al., 1996; Rex et al., 2001; Lamshead et al., 2002; Mokievsky and Azovsky, 2002; Soetaert et al., 2002, 2009; Mokievsky et al., 2007; Wu et al., 2016). Danovaro et al. (2002) denoted that the depth-related patterns of nematode body size and shape are majorly controlled by food availability and physical disturbances (i.e. water pressure). However, Udalov et al. (2005) found an evidence of significant linear variation between nematode individual biomass and depth profile, but unimodal relationship in nematode abundance and species richness. Nematode biomass pattern is known to be essential for understanding the nematode communities in an ecosystem such as standing stocks (Moens et al., 2013), respiration rate (Franco et al., 2010) and/or estimates for carbon demands (Ingels et al., 2010). In general, nematode individual biomass decreases with increasing water depth, neither there is linear (Udalov et al., 2005) nor exponential (Soetaert et al., 2009) relationship, which may vary from region to region based on amount of organic matter flux, settlement rate and sediment texture.

The knowledge on nematode community patterns have been widely studied in most of the ocean margins (e.g. Vanreusel et al., 2010; Semprucci and Balsamo, 2012; Ingels and Vanreusel, 2013), whereas information from biogeographically significant Indian Ocean region is generally very sparse (Ansari et al., 2016 references therein). The Indian Ocean (IO) has a distinctive geography amongst the world's oceans; it being the only partially enclosed ocean basin in the world (Rais, 1986). Moreover, bio-physical, bio-chemical and bio-geographical processes of the IO region are not well known compared to the Pacific and the Atlantic Oceans (Alpers, 2013). The knowledge on biogeochemistry of the IO is closely linked to seasonally reversing summer and winter monsoonal winds particularly in the northern IO (Bay of Bengal and Arabian Sea). The transition seasons (e.g. spring and fall inter-monsoons) make this region further interesting with stratification of upper layers creating niche specificity. This may provide new bio-available nitrogen which can subsequently settle-down to bottom providing organic rich benthic layer especially in the Bay of Bengal (BoB) (e.g. Mahadevan et al., 2016).

The BoB (6°N and 80°E to 22°N and 94°E) is a moderately productive (ca. 150–300 g C m⁻² y⁻¹) large marine ecosystem (LME) situated in

the northern most part of IO. The Bay is highly influenced by regional (tropical) climatic conditions such as huge quantity of freshwater influx (Kumar et al., 2005), nutrients concentration (Gordon et al., 2002), organic load (Khan et al., 2012), sediment load (Chandramohan et al., 2001) and hydrocarbon deposits (e.g. Lyla et al., 2012) from the major rivers (Ganga-Brahmaputra-Magna and others) originating from surrounding land mass along with frequent formation of cyclonic gyre owing to monsoonal belt (e.g. Mahadevan et al., 2016). These frequent physico-chemical influences can strongly influence the BoB biological communities, particularly benthic communities which is yet to be extensively explored (e.g. Khan et al., 2016; Ansari et al., 2016 references therein). However, previous studies (Ansari et al., 2012a, 2012b, 2016) provide a detailed account of free-living nematode community structure across BoB shelf region but nematode functional attributes such as trophic diversity, size and biomass spectrum have not been studied. In particular, only limited number of studies globally have investigated ecosystem changes using nematode community with respect to functional attributes such as trophic diversity, body size and individual biomass (e.g. Soetaert et al., 2002, 2009; Vanaverbeke et al., 2003; Udalov et al., 2005; Rex et al., 2006; Armenteros and Ruiz-Abierno, 2015; Kalogeropoulou et al., 2015; Grzelak et al., 2016; Jouili et al., 2016).

Furthermore, nematode trophic diversity, size, shape and biomass spectrum have been more extensively investigated in deep sea and or continental margin (Udalov et al., 2005; Soetaert et al., 2009) whereas continental shelf (< 200 m depth) is largely unexplored. The continental shelf ecosystem is known to be rich in resource availability as well as affected by various form of physical disturbances (Moens et al., 2013). In view of the above, the present study was focused in Bay of Bengal continental shelf region with the aim of addressing the hypothesis 'does depth and latitudinal variations modify the nematode community structure and their functional attributes?' To address this hypothesis, two questions have been answered as part of this study (1) whether depth and latitudinal differences can influence the nematode trophic status? and (2) does changes in nematode size spectra can leads to alter the production in terms of biomass?

2. Materials and methods

2.1. Study location and sampling strategy

Sediment samples were collected onboard the *FORV Sagar Sampada* during December 2008 (post-monsoon) conducted along the BoB shelf regions (10° 34.03' – 15° 14.48' N and 079° 52.13' – 080° 53.87' E) as part of the research project on 'Marine Benthos of Indian EEZ'. Thirty-three stations were distributed along 6 transects north to south (Singarayakonda – S, Tammenapatanam – T, Chennai – C, Cheyyur – Cy, Parangipettai – P and Karaikal – Kingarayakonda – Singarayakonda – S, Tammenapatanam – T, Chennai – C, Cheyyur – Cy, Parangipettai – P and Karaikal – K, Tammenapatanam – T, Chennai – C, Cheyyur – Cy, Parangipettai – P and Karaikal – K) and two stations have been sampled in the transect Cuddalore-SIPCOT – Si (owing to the presence of an industrial cluster - State Industrial Promotion Corporation of Tamil Nadu). The sediment samples were collected at standard depths (30–50, 50–75, 75–100, 100–150, 150–175, > 176 m) along with geographical positions of the stations and water depth which are detailed in Fig. 1 and Table 1. Sediment samples were collected in triplicates using a Smith McIntyre grab (having a bite area of 0.2 m²) from each station. Grab sampler has been carefully examined for the watertight capacity prior to deployment so as to avoid superficial sediment losses during retrieving. Immediately after grab hauling and ascertaining that the sediment was undisturbed, three sub-samples were collected using a glass corer (with an internal diameter of 2.5 cm, and a length of 30 cm) from the middle of each grab sample. The core samples were fixed in Rose Bengal (1 g/l) followed by 4% buffered formaldehyde. The replicate core samples were processed separately for downstream

Download English Version:

<https://daneshyari.com/en/article/5764534>

Download Persian Version:

<https://daneshyari.com/article/5764534>

[Daneshyari.com](https://daneshyari.com)