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Research Article

Abundance of the onuphids polychaete *Onuphis eremita* in Tranquebar, Southeast coast of India

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Abstract. The results of the present study describe observations about the distribution of the intertidal polychaete *Onuphis eremita* along sandy shore of Tranquebar coast, southeast India. The samplings were collected from three different water levels during one year. In sandy shores the beach worms were crowded. The tidal exposure and percentage composition of sediment particles and organic matter were the main factors influencing the animal abundance. Highest density was 15.66/m^2 in low water mark (LWM) in summer and lowest density occurred during monsoon (4/m^2) at high water mark (HWM). The larger animals (32.6 cm) were collected at low water mark and smallest animals (9.2 cm) at mid water mark levels. The environmental parameters showed significant variation with respect to the polychaete distribution. In general the low water mark level harbored a larger range of size and number of individuals than the mid water mark and high water mark levels. In addition, these worms had got importance in this region due to their use as bait for more common edible fishes like Sea boss, Groupers, Siver Sillago, Snappers, Rabbitfish and other smaller carangids.

Key Words: Tranquebar, intertidal, *O. eremita*, population density, sandy shores.

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Introduction

Polychaetes represent a well defined community among the total macrofaunal groups in most marine and estuarine benthic environment in terms of numbers and individuals (Quiroz-Martinez *et al* 2011). They also dominate the intertidal and sub tidal macro fauna constituting 60–80% of the faunal abundance (Hutchings 1998; Ingole *et al* 2002).

Taxonomically, the polychaetes are known to be not taxonomically but phylogenetically polychaetes which are dominant benthic fauna in the marine environment; these marine worms are multi-segmented annelids with parapodia and they are often the most important group in soft bottom communities in terms of species, individuals and biomass (Knox 1977). Distribution of polychaete species is mainly linked to the sediment particle size in which they are residing and constitute the largest faunal assemblage on earth and the biomass in these sediments (Diaz Castaneda & Harris 2004).

The Eunicidae is a diverse group of annelids from intertidal to abyssal depths and is characterized by possessing a set of sclerotized and powerful jaws, which are usually employed to predate upon smaller crustaceans and other animal forms inhabiting the sandy substrates. Apparently, they have chemo receptors as indicated by their ready response to the crab juice sprinkled on the sand which induces them to come near the surface (Copeland 1930). The onuphids are common in intertidal and shallow sub tidal areas of all major oceans although the trend to be better represented in warmer waters. It was found to occur up to 2 meters depth in the intertidal sandy beaches (Fauchald 1982) and distribution of this species mainly linked to the sediment particle size. Onuphis eremita Audouin and Milne Edwards, 1833 is a typical carnivore and is highly attractive to fisherman and professional collectors who use it as bait for fishing, due to its large and muscular body and its response to food stimuli is well documented (Chapman 1915).

Little attention has been paid by the earlier workers (Balasubramaniyan 1964; Srikrishnadhas 1977; Rajathy 1985) on the distribution study of *O. eremita* from the intertidal region along southeast coast of India. As onuphids of Indian waters have not been studied in detail so far, the present investigation is aimed to analyse the abundance of *O. eremita* with respect to the environmental parameters seasonally. An emphasis is also made to study the taxonomy of the beach worms. Further, the value of distributional studies lies in the fact that it gives an excellent opportunity to evaluate the entire spectrum of the physical and biological environment to which these polychaetes are adapted. This information is a pre-requisite for the evaluation of the productivity of a particular area.

Material and Methods

Study area

Tranquebar is located (11º 02' N; 79º 52' E) in Nagapattinam district in the Indian state of Tamilnadu, 15 km north of Karaikal, near the mouth of distributaries of the Kaveri River. The slippery rocks cover the coastline along the beach towards sea, between the stretches of the firm rock shore habitat formed by the damaged temple and old 17th century forts. The wave beaten cliffs along the beach cover a distance of 20-30m and extend into the sea for about 5-10m below the low tide mark. The boulders and brick-blocks locater at the mid-littoral zone are subjected to considerable wave action and water movements during the ebb and flow of tides (Figure 3).

Field survey

The sampling strategy is aimed to assess physiochemical parameters like temperature, salinity, dissolved oxygen, pH and sediment texture and organic matter content. The temperature was measured using a standard centigrade thermometer, salinity was estimated with the help of a refractometer and pH was measured using an Elico pH meter (model L-120). Dissolved oxygen was estimated by the modified Winkler's method. The percentage composition of sand, silt and clay in the sediment sample were determined by the combined sieving and pipette method of Krumbein & Pettijohn (1938). Total organic carbon content (TOC) was measured by the chromic acid oxidation method followed by titration with ammonium ferrous sulfate (Wakeel & Riley 1956). The polychaete samples were collected in a square meter area of the intertidal region at randomly placed quadrant (0.01 m^2), and three replicates were taken from each water level. The collection of more animals was not successful due to bad weather, high wave action and heavy rolling of beach sands. The collection strategy of animals to be caught was as follows: the shore crab *Ocypode* sp. on the beaches were crushed alive by hand and splashed over the surface level of shore with seawater, which is immediately sensed by these worms that protruded out from the intertidal region for over 6 cm height and the polychaete were collected at the same time. The collected samples were brought to the laboratory in live condition and were preserved in 5% buffered formalin in seawater. Total length were measured and weighed to finally calculate their density (ind.m^2).

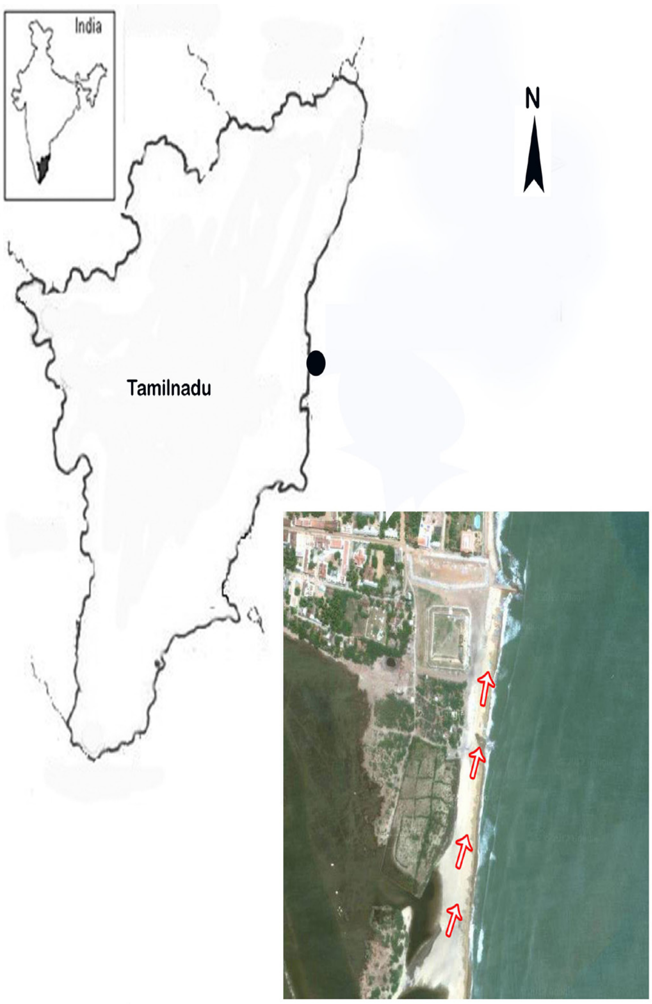


Figure 3. The map showing the collection area of the Tharangambadi coast.

Taxonomic identification followed Day (1967).
The polychaete densities were analyzed at each sampling using the formula:

Density = Total Number of Animals /Area of sampling unit

The percentage occurrence and relative numerical abundance of polychaete were also estimated.

Data Analysis

Relationship between polychaete abundance and their density variations in relation to the intertidal water levels and environmental variables at sampling periods were statistically analysed using analysis of variance (ANOVA). In order to find out any significant relationship between polychaete density and water and sediment characteristics, correlation coefficient analysis was done. Data regarding the polychaete mean density at different water levels and in all the seasons were subjected to univariate data display (box-plots) statistical analysis (Orgin 61).

Results

Environmental variables

The results of environmental parameters analysed at sampling periods are summarized in Table 1. The data clearly indicate a significant variation in physico-chemical parameters tested ($p < 0.05$). At shallow depth station of Tranquebar, atmospheric temperature varied from 26.2°C to 32.1°C at monsoon and summer, respectively. The salinity ranged between 34.3 ppt to 33 ppt, pH range varied from 7.25 to 8. The dissolved oxygen fluctuated from 3.6 mL L^{-1} (summer), to 6.8 mL L^{-1} (monsoon). The organic carbon in sediment ranged from 5.6 to 8.5% along the sampling site (Figure 1a-e) (Table 1). The percentage of sand was higher than silt and clay along the coast with the minimum (73.63%) and maximum in summer and monsoon (95.83%), respectively. The percentage variation of silt content was between 2.93 and 14.66%, similarly the clay content varied from 1.23 to 11.7%. The species *O. eremita* inhabited with a wide distribution in the exposed beach and these worms are found to be available throughout the year. In faunal abundance, a total of 538 different sized individual specimens were collected at three water levels. The maximum mean density of the animals observed at the low water mark was 8.39 ± 4.17. It was represented by 3.75 ±1.99 in mid and 1.57 ± 1.06 in high water mark levels respectively, in all the seasons (Figure 2) (Table 2).

The relationship between environmental parameters and onuphid abundance showed a greater correlation with temperature and substrate soil pH at all the water levels than other parameters. Substrate parameters were significantly correlated with the animal abundance in MWL and HWL, whereas the LWL was strongly correlated with MWL. A positive relationship existed between salinity and water levels. All the biotic variables significantly correlated with the mean density of onuphids. Over the tide level, the abundance was higher in summer and post monsoon, with regard to vertical distribution and abundance was found to be higher in the superficial sediment level (Table 3).

Taxonomic characteristics of *Onuphis eremita*

Systematic positions

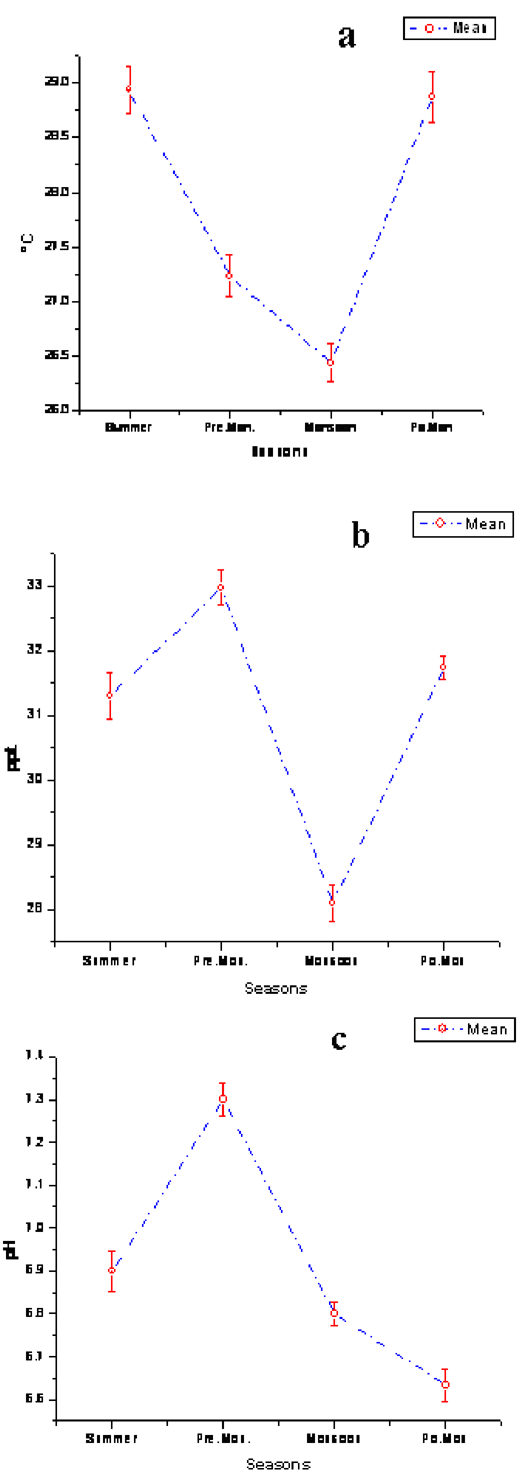
Phylum	-	Annelida Lamarck 1809
Class	-	Polychaeta Grube 1850
Order	-	Eunicida Uschakov 1955
Superfamily	-	Eunicoidea

Family - Onuphidae Kinberg 1865
Genus - *Onuphis* Audouin & Milne Edwards 1833
Species - *O. eremita* Audouin & Milne Edwards 1833

Diagnosis

Body thin 80-350 mm long with red brown bands, prostomium bearing five dorsal occipital tentacles, a pair of palps located on the ventral sides; occipital tentacles are anterior lateral 11 mm long to 8 mm, posterior lateral pair smaller 3 mm. Eyes are absent, single achaetous segment present behind the prostomium; parapodium didentate, pseudocompound, bidentate compound hooks and unidendate chaetae; dorsal cirri filiform, ventral cirri pad like structure; gills originate in first foot simple; mid foot bidentate acicular and hooded setae, wing capillary setae, gills pectinate with six filaments (Figure 4a-d).

The candidate species of *O. eremita* was common in sandy beach and traditionally used as baits for fish catching. In Tranquebar coastal area, the people have involved in the small scale fishing methods of hook line fishery with help of these beach worms. The first recorded of the species *O. eremita* was from the Gulf of Mexico and Caribbean Sea, and it was placed in the family Onuphidae. This particular species is distributed in Indo-China, Madagascar, Suez-Canal and Atlantic Ocean; in India: Madras and Parangipettai and other sandy shore regions of south east coast of Tamilnadu.



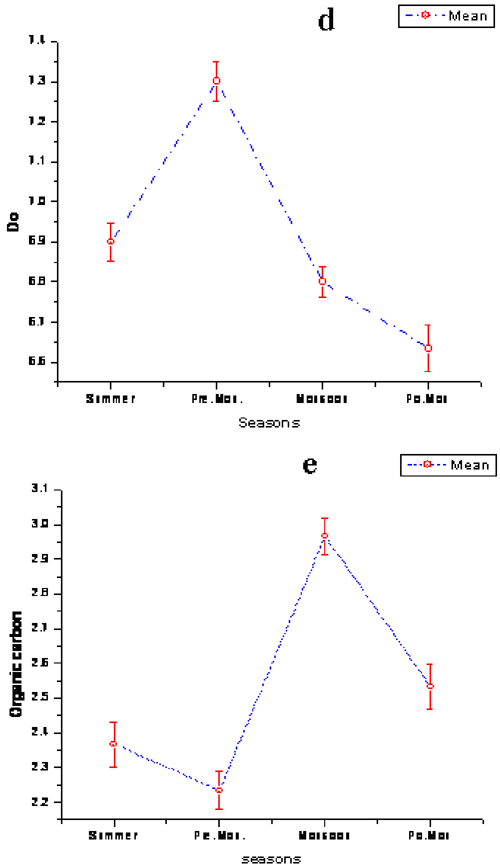


Figure 1. Seasonal mean value of environmental parameters: (a) temperature, (b) salinity, (c) pH, (d) Do, (e) organic carbon

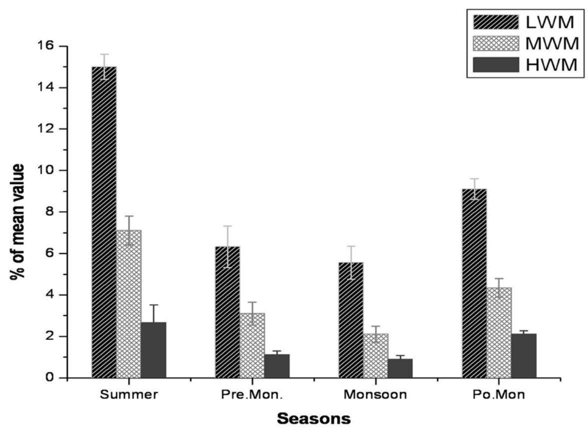


Figure 2. Data presented a mean animal abundance in different water level LWM (low water mark), MWM (mid water mark), HWM (high water mark).

Table 1. Seasonal mean of physico-chemical parameters, sediment characteristics

Parameters	Seasons			
	Summer	Premonsoon	Monsoon	Postmonsoon
Salinity	34.5±0.21	33.2±0.84	29.3±0.07	33.1±0.98
Temperature	29.9±0.21	27.9±0.63	28.4±0.28	29.3±0.77
pH	8±0.28	8±0.14	7.65±0.63	7.25±0.91
Dissolved oxygen	4.7±0.70	4.1±0.28	4.35±0.77	4.35±0.77
Organic carbon	2.5±0.14	2.25±0.21	2.35±0.07	2.12±0.03
Sand	90.5±0.49	74.2±5.65	96.2±0.07	75.3±1.27
Silt	7.3±0.56	13.8±2.33	2.7±0.14	13.2±1.27
Clay	2.15±0.07	11.95±3.32	1.05±0.21	11.5±0.14

Table 2. Mean values of animal abundance

Tidal Level	Seasons			
	Summer	Premonsoon	Monsoon	Postmonsoon
LWL	14.6±0.94	5.83±0.70	5.33±1.88	11.6±3.30
MWL	6.33±1.88	2.66±0	2.33±0	5.66±047
HWL	2.5±2.12	1.16±0.23	0.83±0.24	2.66±0.47

Table 3. Correlation coefficient between *Onuphids* distribution and physicochemical parameters

	Salin.	Temp.	Soil pH	Water pH	Do	Sand	Silt	Clay	Oc	LWM	MWM	HWM
Salin.	1											
Temp.	0.849	1										
Soil pH	0.949	.972*	1									
Water pH	0.903	.991**	.992**	1								
Do	-0.354	-0.79	-0.629	-0.721	1							
Sand	-0.148	-0.622	-0.435	-0.514	0.877	1						
Silt	0.244	0.708	0.53	0.611	-0.935	-.989*	1					
Clay	0.05	0.523	0.332	0.407	-0.802	-.990*	.958*	1				
Oc	0.934	0.668	0.813	0.76	-0.151	0.167	-0.05	-0.279	1			
LWM	0.433	0.761	0.643	0.677	-0.772	-0.921	0.915	0.909	0.092	1		
MWM	0.424	0.788	0.656	0.703	-0.843	-0.949	.953*	0.925	0.096	.993**	1	
HWM	0.143	0.585	0.41	0.475	-0.8	-.988*	.961*	.994**	-0.197	0.948	.957*	1

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Discussion

The results of the present study show that both water and sediment properties have a clear seasonal pattern and it may be assumed as a reason for distribution of polychaetes of *O. eremita* with respect to the current ecological status of intertidal area of Tranquebar. The physicochemical changes by the heavy rainfall due to southeast monsoon bring considerable changes in the intertidal environment and near shore waters. Results of the creek study also showed strong relationship between the physico-chemical parameters and the distribution of organisms. This indicates the ability of the organisms to survive under favorable and unfavorable environmental conditions as previously reported (Tyokumbur *et al* 2002). During the present survey maximum density was 15.66 ind/m^2 in low water mark in summer and minimum density was occurred in monsoon (4 ind/m^2) at high water mark in relation to the temperature there was a rapid increase observed after monsoon and varied between 22.3 and 36.7°C. This is in contrast with the earlier works reported (Ayyakannu 1974; Achuthankutty *et al* 1978). According to Achuthankutty *et al* (1978) the temperature fluctuation in the sandy beaches of India is rather narrow, with the maximum in summer and the minimum after monsoon rains.

The present study support the view that salinity is one of the important factors that maintain the distribution and abundance of onuphid populations (Srikrishnadhas *et al* 1987). In general, salinity varies which recorded a reduction as a result of monsoon in several regions of the Indian coast (Ansell *et al* 1972). During the present study the salinity level was high in summer (36.10 ppt) compared to the monsoon season, and animal abundance is high in summer due to increased salinity. This is in good agreement with the fact that this species is purely marine and widely inhabits the exposed beach in high saline areas reaching high numbers of animal available (12 ind/m^2).

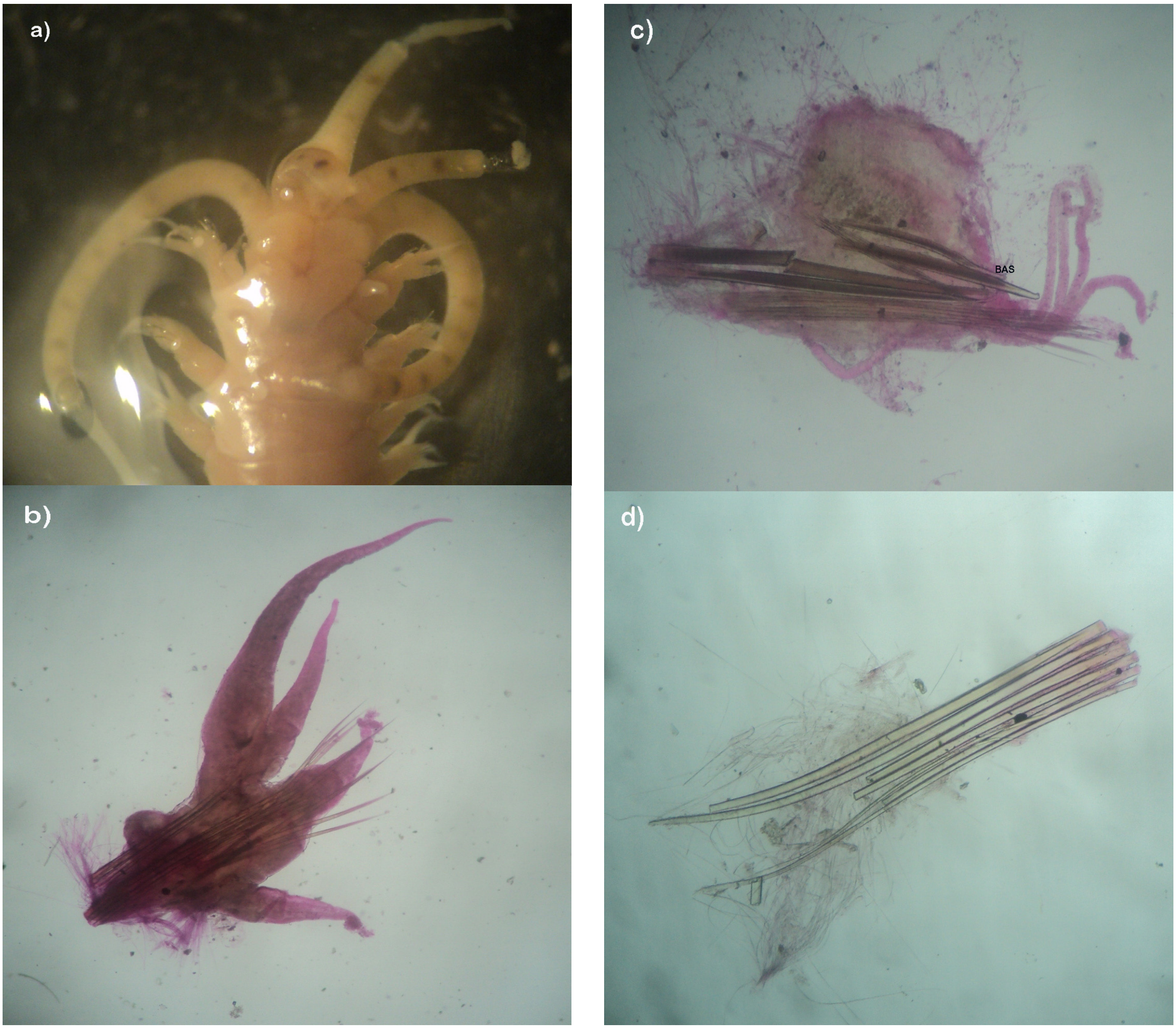


Figure 4. *Onuphis eremita*: (a) head, (b) anterior foot, (c) posterior foot with bidendate acicular setae, (d) group of setae

Coarser deposits are highly mobile under exposed conditions and finer deposits are relatively stable with only the surface layer being disturbed by wave action, may account for the dominance of polychaetes in the less disturbed environment. Mean particle diameter and percentage of fine sediments were found as the main environmental characteristics, resulting in richness and abundance of this benthic fauna, and usually becoming the principal factor of the morphodynamic state and physical variables that are control the intertidal benthic fauna in exposed sandy beaches. Similar views are shared by several other workers (Newell 1979; Huz & Lastra 2008).

The texture of the sediment was found to be sandy in nature in all tidal levels tested. However in the LWM sediment up to 8 cm depth, sand is formed in monsoon and the silt content was found to be higher than that of the other seasons. This may be due to the influence of silt depositions, by flooding estuaries during monsoon. In statistical analysis performed on the data collected for sediment composition the sand appeared to have a significant positive correlation with total polychaetes. Hence, the increase in the sand composition is associated with increases in numbers of polychaetes and for this reason it showed a significant positive correlation. The onuphid abundance is found to be high at the low tidal level and this observation is in contrast with reports given by Rosa Filho *et al* (2011) who showed that in sandy beaches, the number of major taxa and abundance of macrofauna increase towards sea.

Organic detritus plays an important role as a food source in intertidal communities; the beaches are supposed to filter large volumes of sea water during tidal rhythms depending upon the degree of wave actions, nature and influences of tides. The maximum organic content was observed during the monsoon seasons and which may be due to the deposition of silt by fresh water flow. Similarly, Ansell *et al* (1978) observed high values of organic matter content in sand and surf waters resulting from heavy rains. Organic matter level was found to be more at HWM which decreased towards the LWM. In sheltered beaches the organic matter was high at low water mark and in open beaches low at high water mark due to high wave action. The value of organic matter content was found to be high on the top surface layer and it decreased with increasing depth, and this may be one of the reasons for the faunal aggregations in the upper layers. The reports are in agreement with earlier workers (Ayyakannu 1974; Ansari *et al* 1982). In the present observations the numbers of individuals was poor during the monsoon and subsequently were recognized during the postmonsoon and summer to recover higher diversity, indicating the necessity of a relatively stable substrate with a suitable range of environmental conditions that fluctuates only over a narrow range. After the monsoon period the detritus was deposited on the surface of the sediments and the nutrient level was high due to the nutrient availability for the animals being high in post monsoon (Ansell *et al* 1972). In general, faunal density observed in summer is due to the influence of increased water temperature (Feder & Paul 1980), and lowest values in monsoon may be due to the beaches having been washed along with inhabiting fauna flood in estuary. The faunal densities are also probably large depending on the availability of flood. Whereas maximum number in LWM compared to the HWM may be attributed to the reservoir of water saturation in the upper levels and also the high rigidity of the nature of substratum in the HWM. Degraer & Volckaert (2003) showed that sandy beaches harbor a diverse abundance of faunal assemblage, from high tide to low tide level. The oxygen tension may be responsible for the decrease in number of organisms with increasing depth in the sediments from all the water marks observed (Ganapati & Rao 1962). The diversity of macrofauna increased from high water to low water at all the stations, as described by a typical pattern by Eltringham (1971) because of greater stability, less desiccation, smaller temperature range and increased feeding time. This observation is different from the report given by Srinivasa Rao & Rama Sarma (1983), which showed that though tidal level seemed to have barrier on distribution; the organisms had a preference for lower tide level. The density of these onuphids observed in summer might be due to optimum conditions like high salinity mid wave action and water currents. The interaction and combination of these three factors act together in influencing the population of the onuphids in summer. The decreasing trend in the distribution of onuphids was observed during monsoon which is mainly due to low salinity, high wave actions and heavy water currents. The elevation of the beach and substrate characteristics is also found as the dominant factors that control community structure of macrofauna (Lastra *et al* 2006; Rodil & Lastra 2004).

Conclusion

The baseline information of *O. eremita* in Tranquebar region was to know the diversity and abundance at all the water levels of intertidal area. While it is true that the physicochemical conditions in the environment control the overall nature and distribution of the organisms living in the intertidal zone, it is equally true that biological factors may profoundly influence conditions in the habitat. The intention was also made on, evaluating how the high density of this polychaete might help organism going to improve the livelihood for fishing communities, by the way of employing these worms as bait for fishing. Coming to the hatchery bred fish species, the importance of live prey enrichment is very essential nowadays. In this regard, the present study findings may also find a tool for using onuphid polychaetes as live prey, due to their high profile fatty acid contents and which have to be done in the future step.

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