Article

Occurrence of sea spider *Endeis mollis* Carpenter (Arthropoda: Pycnogonida) on the test panels submerged in Gulf of Mannar, southeast coast of India

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Abstract

Sea spiders (Pycnogonids) are exclusively marine arthropods with worldwide distribution. Pycnogonida remains one of the poorly investigated groups encountered in fouling communities. In the present study, distribution pycnogonid species *Endeis mollis* associated with the fouling community developed on test panels submerged at Kudankulam coast, Gulf of Mannar was studied for a period of two years. Throughout the period of investigation, *Endeis mollis* was observed on the test panels. A maximum of 55 individuals per square dm was observed during pre-monsoon season and a minimum of 9 individuals per square dm during monsoon season. Results of this study on seasonal distribution are of considerable interest because so little has been documented on the ecology of Pycnogonids in India.

Keywords arthropods; biofouling; fouling community; Pycnogonids; Kudankulam; *Endeis mollis*; biogeography.

1 Introduction

Sea spiders or pycnogonids are distinct group of arthropods, exclusively found in the intertidal to abyssal depths in all the marine waters of the world (Arango, 2003; Carranza et al., 2007; Fornshell, 2012). They are commonly found as epibenthic community on other invertebrates, algae, corals etc (Child and Harbison, 1986). They are seldom seen due to their small size and cryptic colouration (Bain, 1991). Occasionally they are observed as swimming in coastal surface waters (Clark and Carpenter, 1977) or in plankton samples collected from the surface waters. Pycnogonids have no obligate dispersive phase as they do not have planktonic larvae. Their dispersion is therefore severely restricted (Bamber, 1998) and the absence of a planktonic larval phase reinforces their provinciality and tends to contribute to high endemism, at least at the species level, in a particular region (Child, 1988).

From the evolution point of view, there is much debate and controversies about pycnogonids (Edgecombe et al., 2000; Giribet and Ribera, 2000). Some investigators consider them to be quite closely related to spiders and their kin, while others believe that they are the last living representatives of an ancient group of creatures who were the common ancestors of all the modern arthropods. On the morphology, pycnogonids have four to six pairs of legs for walking as well as other appendages that often resemble legs. They have an external proboscis which allows them to suck the nutrients from the soft bodied invertebrates.

There are about 1100 species are described from all over the world. In Indian waters, only 17 species were reported (Calman, 1923). Daniel and Sen (1975) made a comprehensive work on Indian Pycnogonids based on the available collections of the Zoological Survey of India. Other studies from the Indian region include Calman (1923), Kurian (1948, 1953), Rajagopal (1963) and Krapp (1996). However, most of the previous studies in Indian waters are mainly restricted to the taxonomy and species description. The temporal distribution pattern of pycnogonids is virtually unknown from the Indian waters. During the course of marine biofouling investigations at Kudankulam in the east coast of India, pycnogonid species *Endeis mollis* (Carpenter, 1904) was abundantly noticed on the test panels. In view of the lack of ecological information on Indian pycnogonids, an attempt has been made to observe their seasonal distribution in relation to the prevailing environmental conditions. The aim of the present study is to present quantitative data on the seasonal abundance of *Endeis mollis* in the fouling community developed on suspended test panels in order to assess its distribution in the Kudankulam coast of Gulf of Mannar.

2 Materials and Methods

The investigation was carried out at Kudankulam (8^o 9' N and 77^o 39' E) in the southeast coast of India for a period of two years, from June 2003 to May 2005. Kudankulam is located about 25 km northeast of Kanyakumari in the distal end of Gulf of Mannar (Fig. 1). The biodiversity rich core of Gulf of Mannar biosphere near Rameswaram is about 150 km away from the study area. The Gulf of Mannar is one of the biologically richest and important habitats for seaweeds, seagrass, coral reef, pearl banks, sacred chank bed, fin and shell fish resources, mangroves so also endemic and endangered species. Seasons at Kudankulam may be classified into pre-monsoon (June-Sep.), monsoon (Oct.-Jan.) and post-monsoon (Feb.-May). The study area gets southwest monsoon current during June –September and northeast monsoon current during October-January period. The wind direction is north-north easterly from June to December and changes to westerly during the rest of the period.

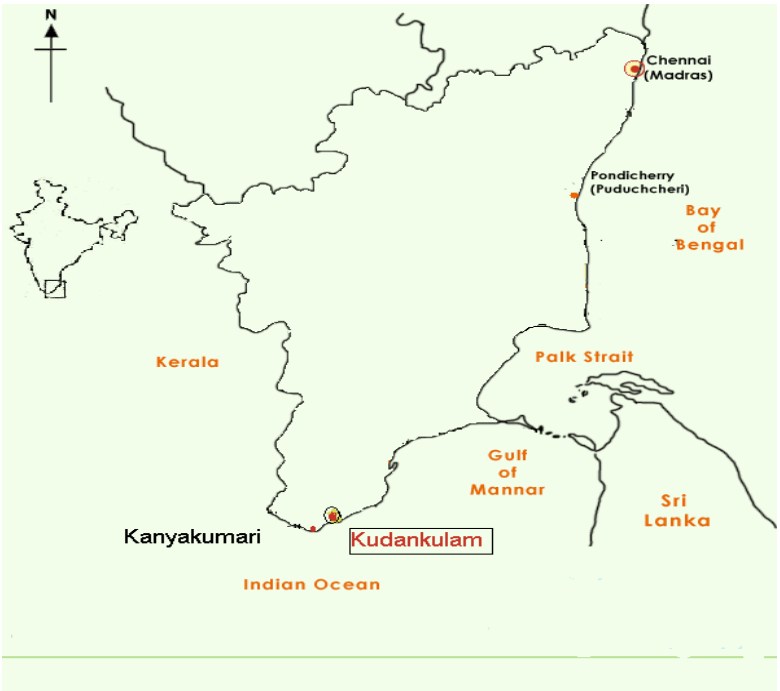

Fig. 1 Map showing the study area. Kudankulam is located about 25 km northeast of Kanyakumari in the distal end of Gulf of Mannar. The Gulf of Mannar biosphere near Rameswaram is about 150 km away from the study area.

Teakwood panels (10×10×3 cm) were fitted onto a wooden raft and submerged in the coastal waters 2 meter below the mean sea level. The experiment was conducted on monthly and seasonal basis. The monthly distribution study was conducted from June 2003 to May 2004. Test panels (in duplicate) were submerged during the first week of each month and retrieved at the end of that month. For the seasonal abundance study, test panels (in replicate, n=6) were submerged during the first week of a season and retrieved during the end of the season, in such a way so as to keep the panels in the coastal waters for 110 days in each season. The seasonal distribution was observed for a period of two years. The panels removed were preserved in 5% neutral formalin for further study. The abundance of *Endeis mollis* on the test panels was made manually by counting the number of individuals after separating them into different species or groups. The abundance was expressed as number of individuals (mean± standard deviation, n=6) dm^{-2} of the panel surface. Two-way ANOVA was applied to find the seasonal variation of abundance. For this season and year were considered as the factors. Simultaneously, hydrobiological parameters of the coastal waters were analysed during the study period and the results were reported in Satheesh and Wesley (2009).

3 Results and Discussion

Results showed that the abundance of *Endeis mollis* was high during May (55 dm^{-2}) followed by June (44 dm^{-2}). The abundance was very low from September to March (Fig. 2). This indicates that the distribution of *Endeis mollis* was low during monsoon and post-monsoon months. The seasonal abundance of *Endeis mollis* in the fouling community for a period of two years is given in Fig. 3. The total number of *Endeis mollis* found on the panels submerged at the beginning of June 2003 and retrieved at the end of September 2003 (pre-monsoon) was 43 individuals dm^{-2}. The panels submerged during the succeeding pre-monsoon season (June to September 2004) showed a density of 55 individuals dm^{-2}. The abundance of *Endeis mollis* on test panels submerged during the monsoon season (Oct-Jan) was 9 individuals dm^{-2} in 2003-04 and 16 individuals dm^{-2} in 2004-05. The test panels submerged during February-May period (post-monsoon season) showed a density of 21 and 27 individuals dm^{-2} during 2004 and 2005 respectively. In general, the abundance was high during the pre-monsoon and low during the monsoon seasons. Two-way ANOVA showed significant variation in relation to season and year (Season F=134, d.f=2, P<0.05; Year F=20.16, d.f=1, P<0.05, Table 1).

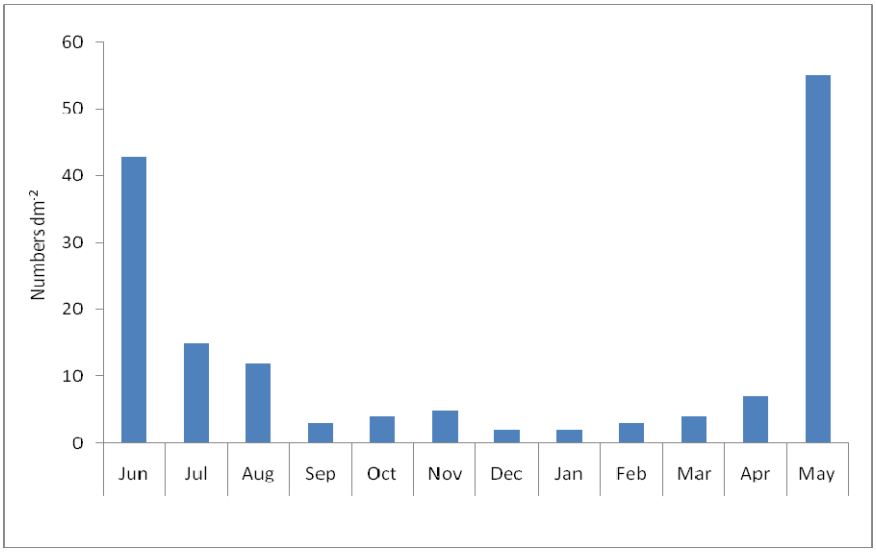

Fig. 2 Month-wise abundance of *Endeis mollis* on the test panels. Test panels were submerged in the coastal waters during the first week of each month and retrieved at the end of that month from June 2004 to May 2005.

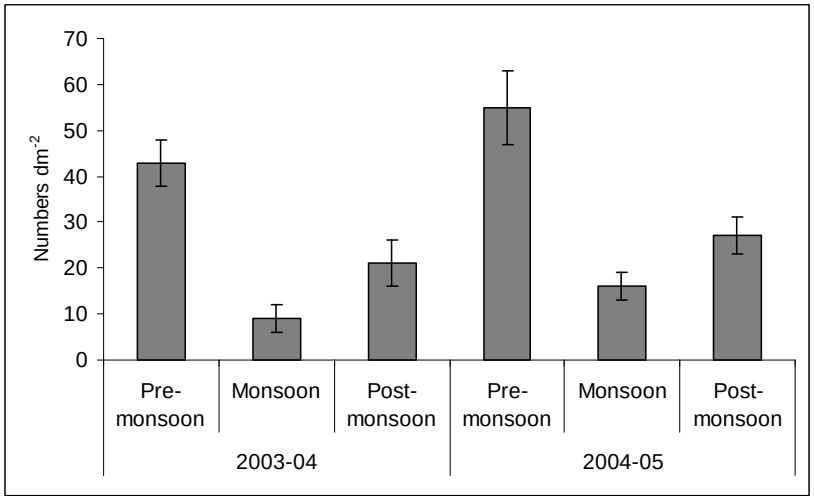

Fig. 3 Seasonal distribution of *Endeis mollis* in the fouling community on test panels. (mean ± standard deviation, n=6). Test panels were submerged in the coastal waters during the first week of a season and retrieved during the end of that season.

Table 1 Analysis of variance (two-way) of *Endeis mollis* abundance during the study period. Season and year were considered as factors.

Source of Variance	SS	df	MS	F	P
Season	1393	2	696.5	134.8065	0.007363
Year	104.1667	1	104.1667	20.16129	0.046191
Error	10.33333	2	5.166667		
Total	1507.5	5			

Most of the specimens were found associated with the barnacle *Amphibalanus amphitrite* (= *Balanus amphitrite*) or the colonial ascidians *Didemnum* spp. The occurrence of *Endeis mollis* in the fouling community on the test panels, which comprised of barnacles, ascidians, tubeworms and seaweeds, throws light on their ecology. Previously, Bamber (1998) reported pycnogonids from the epifaunal fouling communities on ship's hulls and drift weeds. Rajagopal et al. (1997) also reported a pycnogonid species associated with the fouling community at Kalpakkam (East coast of India).

There was a strong variation in the abundance of *Endeis mollis* between seasons as reflected in the ANOVA. The variation in the abundance over the temporal scale may due to the durations of reproductive cycles, hydrographic conditions or feeding preference of *Endeis mollis*. During this study period, barnacles were abundant on the test panels during the pre-monsoon season and ascidians dominated the fouling community during the post-monsoon season (Satheesh, 2006). Regarding their feeding activity, most of the pycnogonids are carnivores mainly feeding on hydroids, soft corals, sponges, anemones, or bryozoans. Some pycnogonids also feed on microorganisms or algae that grow on bryozoans and hydroids, or they feed on detritus. Interestingly, during this period of study, hydroids were observed only in the monsoon season panels and macro-algae were observed throughout the study period (Satheesh, 2006).

The detected variations may also due to the relative abundance of this species in the study area. The seasonal distribution patterns at Kudankulam coast indicated that *Endeis mollis* breed throughout the year like most of the tropical marine organisms. According to Edgar (1983) 'the biology of a particular species, i.e., their reproductive strategy, life cycle, incubation period and fecundity may also contribute to the temporal variations in the abundance'. However, our knowledge about the reproductive biology of this peculiar group is limited and it is not clear about the durations of the reproductive cycles in Indian waters.

The important abiotic factors that may influence the distribution of epifaunal assemblages are tidal rhythm, wave action, water current, light, temperature, salinity, pH, concentration of nutrients and dissolved gases. In the present study area, most of the hydrobiological parameters of the coastal waters were not varied much except during January- May 2005 due to the tsunami (Satheesh and Wesley, 2009). Due to the absence of planktonic stages in Pycnogonids, they depend on drifting or oceanic currents for dispersal (Bamber, 1998). Hence, water current and wind speed are the other potential factors, which may influence the temporal distribution. Gulf of Mannar region is characterized by a complex hydrographic regime and high biological productivity. Since, this region receives southwest monsoon current during June to September (pre-monsoon), the higher abundance of pycnogonids during this period indicated that the hydrodynamic conditions of the coastal waters strongly influence the distribution.

Earlier records of *Endeis mollis* in the Indian region are from the Andaman Nicobar Islands (Tikadar et al., 1986) and Madras coast. *Endeis mollis* has been also recorded in the Indian Ocean region from Sri Lanka (Bamber and El-Nagar, 2007). Moreover, the most part of information on pycnogonids in Indian waters is scattered in many short reports and papers. Hence, it is not clear whether *Endeis mollis* has been previously reported from the Gulf of Mannar region.

Results of the present study confirm that *Endeis mollis* is abundantly distributed in Gulf of Mannar region. The abundance of sea spiders in the fouling community certainly deserves more attention in relation to predation and competition within fouling assemblages. Selective invertebrate predation could provide another viable hypothesis for explaining the colonization and succession patterns reported from the epibenthic assemblages. The very particular pycnogonid species abundance of the small investigated area (test panel) showed its importance in biodiversity of this region. The observed results of the present study also provides additional and new information on the dynamics of the pycnogonid, *Endeis mollis* in relation to prevailing environmental conditions in general and the hydrographical regime of Gulf of Mannar in particular. Further investigations are also needed to the adjacent Gulf of Mannar Biosphere Reserve to know new details on the ecology as well as taxonomy and biogeography of these peculiar arthropods.

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