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Species diversity of Polychaete in coral reef ecosystem of Great Nicobar Island, India

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Abstract. *Sekar V Rajasekaran R, Sachithanandam V, Sankar R, Sridhar R, Kingsley PW. 2016. Species diversity of Polychaete in coral reef ecosystem of Great Nicobar Island, India. Nusantara Bioscience 8: 71-76.* Crypto fauna inhabiting the shelves of the coral reefs in Great Nicobar Islands are affected by bio-erosion caused by grazing and boring of organisms, hence present study revealed on two major components the opportunistic and true borers. Samples were collected from four stations from three different coral types (live coral, highly degraded & rubble) of the Great Nicobar Islands. Of the total 401 individuals of Polychaetes collected from various sites 8 taxonomic species namely *Terebella ehrenbergi*, *Idanthyrsus pennatus*, *Lysidice ninetta*, *L. collaris*, *Pseudonereis variegata*, *Perinereis cultrifera*, *P. nigropunctata*, *Eurythoe complanata* were identified from the aforementioned three coral type sources. Among these *P. variegata* and *L. collaris* which accounted for 32.01% and 28.5% respectively, were the most dominant cryptic groups; whereas *I. pennatus* and *T. ehrenbergi* were the least records in all three habitats which accounted for 1.75%. In this study, the observations revealed that degraded corals were found in greater abundance than rubble and live corals. The species composition was observed maximum in Laxmi Nagar due to the availability of degraded coral patches than other stations. The study to evaluates the baseline knowledge of the coral inhabiting Polychaete distribution, it would be a pathway for forthcoming researchers on particular group taxonomy, and towards better understanding & utilization of coral reef ecosystem of the Great Nicobar Islands.

Keywords: Abundance, Cryptofauna, degraded coral, Great Nicobar, Polychaete

INTRODUCTION

Coral reefs are the earth’s most biologically diverse ecosystem in the marine realm (Reaka-Kudla 1997). Most of the living organisms of marine environments are associated directly or indirectly (mutualism + commensalism + parasitism) with other invertebrates. Based on their living performance the crypto-fauna are classified into two major components - ‘opportunistic species’ and ‘borer species.’ The opportunistic species utilize cracks and crevices and live at the base of long coral branches where they are completely hidden. Whereas, borers make cavities in the calcareous layers thus increasing the surface for colonizing on organisms such as sponges, bivalves, crustaceans, sipunculans and Polychaetes (Hutchings et al. 1992).

Marine Polychaetes play a major role in the marine food web serving as a major source of food for the predatory gastropods of the coral reefs ecosystem (Kohn 1978). The cryptic fauna is assumed to be an important prey for fish and macro invertebrates in coral reefs (Glynn 2006; Takada 2012). However, despite the known significance of small invertebrates as grazers, they are the initial colonizers of degraded coral substrates by making short to long, straight to sinuous bore holes into the coral substrate (Hutching 1986). Not all cryptic Polychaetes are borers, the boring patterns of coral borers clearly illustrates that traces of boring pattern of Polychaetes (Bromley 1978).

According to Glasby et al. (2000) the total number of Polychaetes species globally is 8,500 belonging to 1,100 genera including, approximately, 400 species from India (Misra 1991). As per the Indian Museum collections, the Polychaetes of Andaman and Nicobar Islands were described by Fauvel (1932), and subsequently incorporated 90 species in the Fauna of India (Fauvel 1953). Further, Tampi and Rangarajan (1964) recorded 43 species including 21 new records in Andaman and Nicobar Islands and 2 species new to Indian waters. Subsequently Daniel and Ghosh (1964) described 8 species of Polychaetes of which the 2 from Little Andaman are new to the waters of Andaman. During the Indian Ocean Expedition (1963-1964), in the islands of Andaman, Hartman (1974a,b) described 11 species. Soota and Rao (1977) have described 26 species from the intertidal regions of Andaman and Nicobar Islands including 8 new species to Andaman and Nicobar Islands and 5 species new to Indian waters. In addition, Soota et al. (1980) recorded 24 species including 4 new to these groups of islands, and listed 161 species hitherto known from this region. Moreover, in the post-tsunami years Rajasekaran and Fernando (2012) have recorded 30 species belonging to eight families and 23 genera, of which 15 species are new records to the Indian waters. Hence, this study was undertaken to investigate the ecological distribution of important cryptofaunal groups of Polychaetes associated within exposed coral habitats like coral rubbles, high degraded corals, and live corals of Great Nicobar Island, India during April, 2012 and March, 2013.

MATERIALS AND METHODS

Study area

Great Nicobar is the largest group of the Nicobar Islands of India, north of Sumatra, the southern-most Island of this archipelago; also the southern-most land piece of India, is situated between 6°45’ - 7°15’N lat. and 93°38’ - 93°55’E long (Figure 1). The study was conducted at three different habitats of the degraded, live coral and rocky patches of the well exposed littoral region of Great Nicobar Island. Based on the availability of degraded coral patches in the low tide region, the selected sampling stations were (i) Campbell Bay (CB) is the gate way of Great Nicobar Island, (ii)Vijay Nagar (VN), (iii) Lakshmi Nagar (LN), (iv) Sastri Nagar (SN). The selected sampling stations along the coast of the Great Nicobar Island are bordered with sand and a rock, spread across 24 km from south of Campbell Bay.

Sampling strategy

The samples of cryptofauna were picked using forceps after breaking them into smaller fragments by using hammer and chisel from the degraded corals without damaging their colony. Before fixation, cryptic Polychaetes and other associated fauna were transferred to concentrated alcohol, to have their pharynx reverted and assist in the identification of the groups. After this process they were fixed in 10% formalin and later transferred into a plastic containers containing 70% ethanol and labeled for further studies.

Laboratory studies

Collected sample were sorted and classified to their respective family level by fixing with rose bengal for capturing comprehensible images under compound microscope. Meanwhile, stained samples were examined for their species identification using binocular microscope (Olympus- CX41) and were photographed as well as using the fixative, alcohol or water, for detailed study of parapodia, setae, and the whole animals. The species level identification of Polychaetes except the organisms like crab, poganophore, slug etc, was done by the support of standard books written by Fauvel (1953) and Day (1967). The main ecological indices (abundance, number of species, species richness and diversity index) were calculated using the statistic software package PRIMER. 7 (Clarke and Gorley 2006).

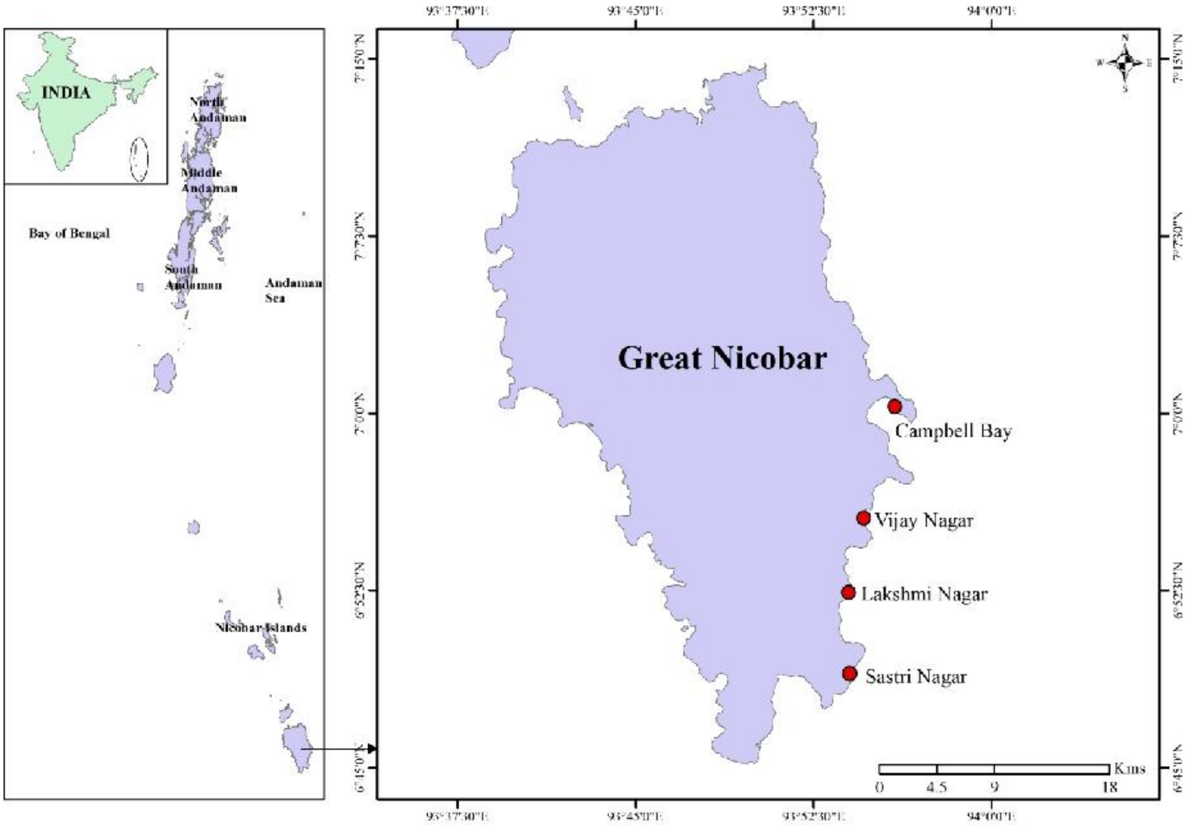

Figure 1. Map of Great Nicobar Island, India showing sampling stations

RESULTS AND DISCUSSION

A total of 401 individuals of coral cryptic Polychaetes were identified from four study sites in the Nicobar Island areas. Among them some of the specified groups recognized as cryptofauna belonging to 8 species namely *T. ehrenbergi*, *I. pennatus*, *L. ninetta*, *L. collaris*, *P. variegata*, *P. cultrifera*, *P. nigropunctata*, *E. complanata* miscellaneous cryptic animals were mentioned as others groups. Among these *P. variegata* account for 32.01% and *L. collaris* 28.5%, being the most dominant cryptic groups relative to *I. pennatus* and *T. ehrenbergi* accounting to 1.75%, remaining five species under the least numbers (Figure 2).

Among the four stations, with three different habitats, the mean abundance of rubble is maximum 1.88±1.0 at Campbell bay, minimum at Sastri Nagar, whereas the degraded coral was maximum 6.75±2.8 at Vijay Nagar and minimum 2.25±0.4 at Sastri Nagar followed by the live coral extant was maximum 1.88±0.7 at Vijay Nagar and minimum 0.62±0.2 at Sastri Nagar. The mean value of three different habitats from the study area is given in the Table 1.

In the cluster and Multidimensional Scale (MDS) diagram (Figure 3) represent the analyses of the cryptofauna similarity, recorded at the four different stations; shows one main cluster combined 6 clusters representing one subcluste. In the cluster analysis the first was observed *L. collaris* and *P. variegata* at 90.57 % similarity level, third cluster of other groups (78.21 %) and fourth cluster of *P. cultrifera* (80.39%) was formed at 79.71 % level. *P. nigropunctata* joined with main cluster 80.39% level at 63.39% similarity.

Table 1. Total mean abundance of cryptofauna in study sites

Type	Mean abundance (cm^2) and stations			
	Campell Bay	Vijay Nagar	Lashmi Nagar	Sastri Nagar
RUB	1.88±1.0	1.13±0.6	0.5±0.3	0.5±0.2
HD	4.13±1.7	6.75±2.8	4.25±1.7	2.25±0.4
LIP	1.5±0.7	1.88±0.7	0.63±0.4	0.62±0.2

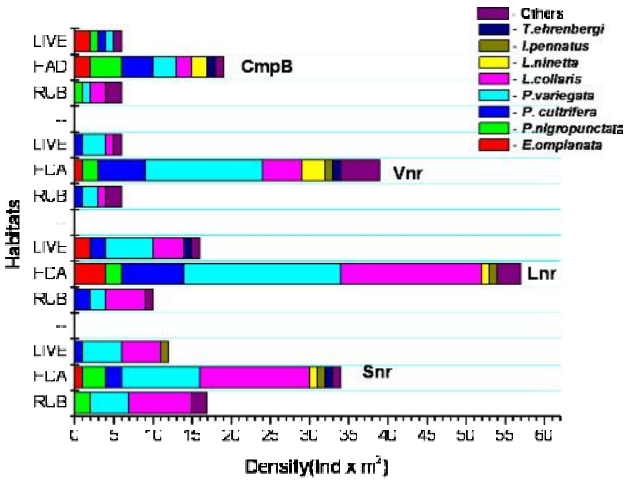

Figure 2. Cryptofaunal abundance of polychaetes and others in Great Nicobar coastal areas. Note: * RUB - Rubble, HAD - Highly degraded, LIP - Live coral patches, CmpB- Campbell Bay, Vnr-Vijay Nagar, Lnr- Lakshmi Nagar and Snr- Sastri Nagar

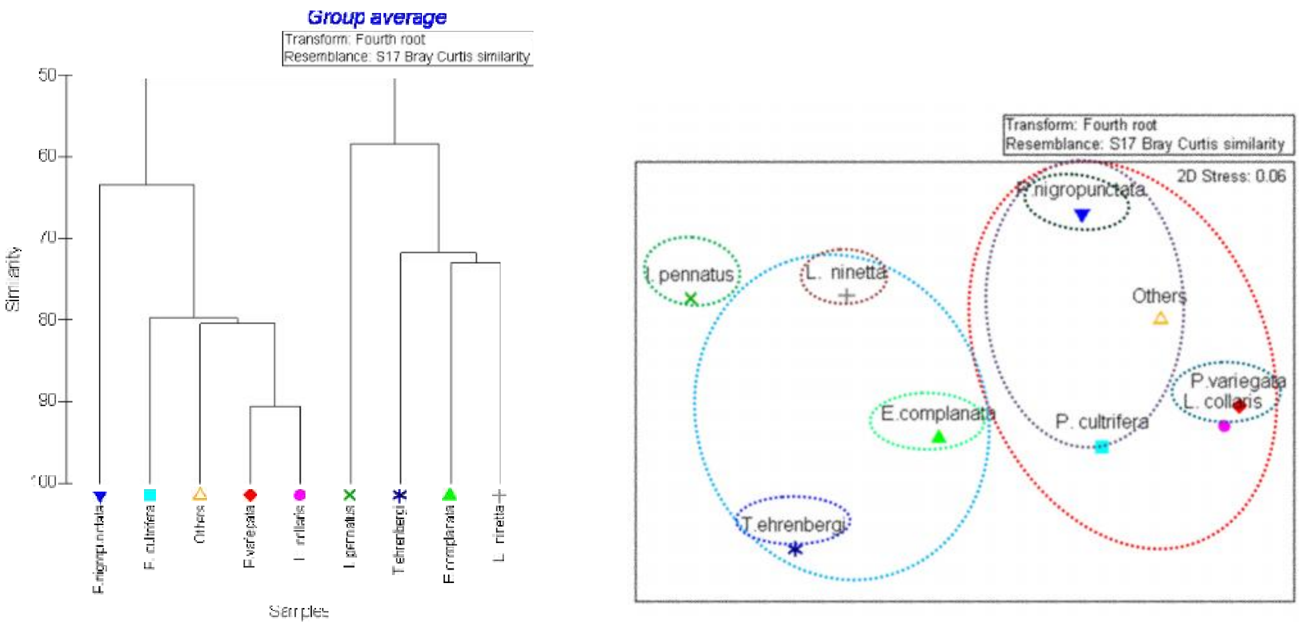

Figure 3. Hierarchical clustering and MDS analysis of the species showing assemblage at various similarity levels

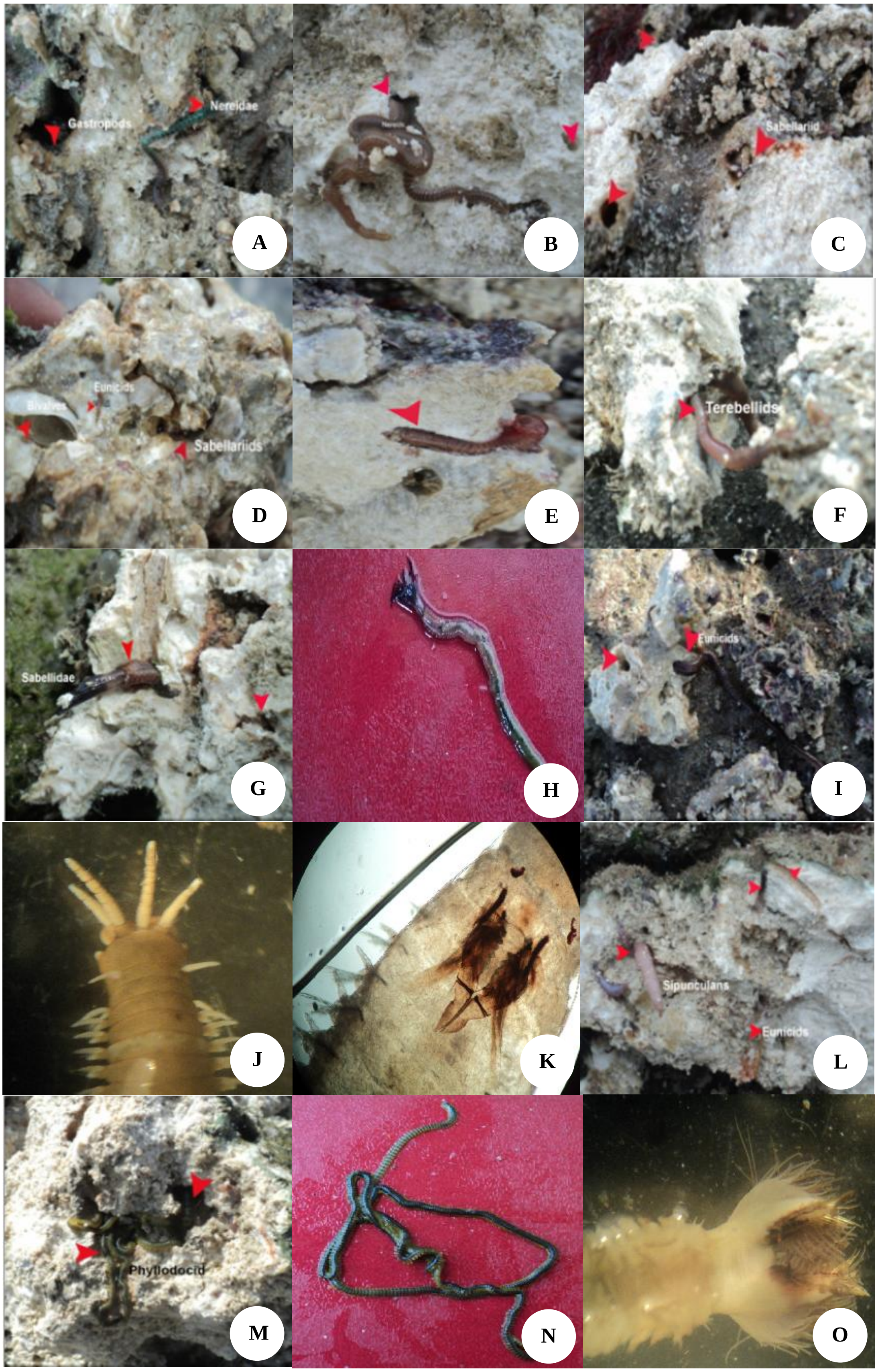

Figure 4. Cryptofaunal Polychaetes diversity observed in study sites A. Gastropod and Nereidae; B. Eunicids; C. Boring traces of Sabellarids; D. Eunicids with bivalve shell; E-F. Cryptic Terebellids Polychaete; G-H. Sabellarids; I-J. Eunicids; K. Eunicids teeth; L. Boring Sipunculans; M-N. Phyllocids; O. Serpulidae

Discussion

In the coral reef ecosystem, the coral reefs have complex biotope where a variety of interacting processes result in diverse community patterns. The present study demonstrates variations in the composition of crypto faunal communities at four different sites which was affected by tsunami and lead degraded coral patches of the Great Nicobar Island. It also investigated ecological interactions between corals and associated organisms, which was very difficult to establish due to the absence of earlier studies and to perform observations of the livings organisms (Garcia et al. 2008). The major issue in studying the cryptofauna of coral reefs was extracting the Polychaetes from the coral colony without damaging them, which will render it difficult for identification. Unlike many of the earlier studies on the cryptofauna (Richter and Wunsch 1999; Richter et al. 2001; Duyl et al. 2006), the present efforts have been taken to identify several groups of motile organisms (Polychaetes, pogonophora, crab etc.,) within the overall assemblage of Great Nicobar Island ecosystem.

Ecologically, the habitat heterogeneity is the cornerstone; it provides more niche and diverse ways of exploiting resources for their higher species diversity (Tews et al. 2004). Corals, the foundation for the tropical reef ecosystems and symbionts, are also likely to circuitously affect many other reef organisms (Wootton 1994). This study demonstrated that species accessibility is maximum in degraded coral patches followed by coral rubble and live coral patches observed.

The depth and exposure of corals are continuously modified by nature and anthropogenic disturbances, which in turn have consequences for associated faunal assemblages (Kiene 1988). According to Clark (1956) among one third of commensal Polychaetes reported as many as 100,000 are reef-dwelling species (Spalding et al. 2001), and more than 21 Polychaete species found are associated to boring species (Hutchings 1986). Tube dwelling associates bore into the coral matrix and build a calcareous tube on the coral surface (Dai and Yang 1995).

Polychaetes are the important boring animals in coral rocks (Ebbs 1966) and are the common fouling communities on hard surfaces (Uebelacker and Johnson 1984). The Polychaetes of Serpulidae family was restricted to live coral colony of *Porites* sp. and the burrows they form make the host colony weak and thus more susceptible to breakage by the wave actions, typically hard substrate dwellers, since they are tube-dwelling calcareous (Roy et al. 2008). Commonly, Eunicidae Polychaetes are large worms living in crevices of rocks and corals between algae in shallow and deep waters, occasionally inhabiting soft bottoms (Hartman 1964; Fauchald 1992; Sahin and Cinar 2009). Hence the present study is revealed between the 8 major species of family belonging to Eunicidae and Sabellidae create new habitats in the already existing cavities in the corals.

Nereidae is another abundant family of Polychaetes that live on the upper few centimeters of the substrate. Hutchings (1985) observed that this group is of the initial settlers of coral blocks. The tight fit of these animals into their boreholes suggests that these groups are true borers (Hutching 1986). Based on the present observation on Nereidae, it is presumed that at least some of the species of this family are true borers, bearing in mind that no other Polychaetes, to that of small eunicidaes and Sabellidae, are capable of making identical bore holes. Thorough study on the diversity of host preferences and distribution of coral associates reveals the dynamics and settlement preferences of taxonomic significance and evolution of these cryptic forms.

In the present study of 8 Polychaete species belonging to five genera were important groups in the degraded coral substrates of Great Nicobar namely, *Lysidice, Pseudoneries, Perinereis, Idanthyrsus* and *Terebella.* Family Eunicidae were recorded large number of species from highly degraded coral patches and the less numbers occurred on loose sediments and/or compact dead rubble. This family is made straight to long sinuous and complex network of boreholes at a time with more than one opening to the outside, and with two canal diameters, the one was narrower where the worms enter and retreat back without doubling up (Namboothiri 2004).

In the present study of the Eunicidae the borehole is highly inter connected with tunnels to smaller tunnels that ranged from 6 to 11 mm in diameter. The genus *Lysidice* made shallow ‘U’ shaped bore holes. Sabellidae was represented by a single boring species, *I. pennatus*, and it was found on the sides and undersides of small coral rocks with eroded base. *I. pennatus* preferred submerged substrates, small tidal pools with coral boulders supported large populations and were found very rarely in the intertidal regions. Sabellidae also made identical long narrow boreholes reaching deep into the substrate. In substrates that provide large area for boring (5cm in depth), the boreholes were long and straight, and in thinner substrates (5cm) the boreholes became slightly arched to nearly ‘U’ shape but never convoluted. Among the non-boring associated Polychaetes, the common occurrence were aphroditids, nereids, perinereis, phyllodocids, and amphinomids which occupied boreholes made by other borers (Sipunculans, bivalves and barnacles). Majority of them were present in the upper few centimeters (0-3cm) of the substrate; the tubes or holes they inhabited exactly matched the size of the organism. The holes were always more or less parallel, or at an angle to the surface of the substrate. Other tube dwelling forms such as some Serpulidae and probably *Eunice indica* colonized the surface of corals. Many micro and macro Polychaetes were found to inhabit the surface layer of the substrate living within the algal cover and using the small excavations made by boring sponges or other organisms. Long phyllodocids reaching up to 50 cm occupied large cavities that were probably made by pistol shrimps. The worms curled up within these cavities were observed in study sites.

The present study revealed that coral associated crypto fauna play a significant role in altering the structure of the host. Boring sponges were common on degraded coral substrates of Great Nicobar Islands, but rare on live-corals. Whereas the cryptic mollusks in branched degraded coral were higher than live branched corals (Jeyabaskaran et al. 1996). In this study the availability of cryptic fauna diversity is high in degraded coral patches than in live-corals.

Significant differences occurred among all the sampling sites and patterns of faunal abundance increased in certain places. Namboothiri and Fernando (2012) observed that the number of bioeroders were more in east side of Nicobar than in the west side due to the large amount of sediment and sand infill. With increasing exposure the abundance of Polychaetes, but the diversity, increased. Though the present observation is in general agreement with the observation, the percentage of cryptofauna was fairly high in degraded corals patches when compared to rubble and live coral colonies (Figure 4). Natural disasters, climate change, and anthropogenic factors that threaten coral reefs also threaten these invertebrates, including symbiotic Polychaetes, which could further exacerbate the loss to reef form and function (Stella et al. 2011). The ecosystem health can be determined based on the abundance, distribution, and diversity of the Polychaetes of the particular ecosystem as indicators. Thus polychaetes play a significant role is analyzing the extant of environmental damage caused either by natural or unnatural disturbances.

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