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Cryptofaunal Associates of *Spirastrella inconstans* (Dendy) and *S. inconstans* var. *digitata* (Dendy), the Coral Reef Sponges of Palk Bay

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Abstract: The coral reef sponges such as *Spirastrella inconstans* (Dendy) and *S. inconstans* var. *digitata* (Dendy) collected from Gandhi Nagar (Palk Bay) coral reef area acted as living habitats for harbouring a wide variety of cryptofaunal associates. A total of 20 colonies were collected from coral reefs, from a depth ranging from 0.5 to 1.5 m. The numerical densities of cryptofauna were correlated with various parameters of the two species of host sponges. The volume, wet weight and dry weight of the host species recorded a positive correlation with the cryptofaunal density; whereas the length, height and width showed no significant correlation. Group of organism viz. amphipods, isopods, sea-anemones and crabs were significantly correlated ($p<0.001$) with the parameters like volume, wet weight and dry weight in *S.inconstans* var. *digitata*. In *S. inconstans*, group of organism like amphipods, isopods, brittle stars, gastropods and bivalves were significantly correlated ($p<0.001$) with the parameters in volume, wet weight and dry weight.

Key words: Cryptofauna, *S. inconstans*, *S. inconstans* var. *digitata*

INTRODUCTION

The term cryptofauna (Kryptos = hidden) is used for those faunal elements that live hidden within various substrates (Peyrot-Clausade, 1974). The sessile habit and porous construction of sponges offer a suitable substratum and an ideal shelter to a good number of other sessile organisms living as commensals. Sessile organisms like coelenterates, bryozoans, shrimps, barnacles, sea-cucumbers, hydroids, ascidians, algae and even other sponges live in association with the sponge colonies. Also some crabs, worms and brittle stars attempt to attach in and on the sponges. Since these small creatures do not harm the sponge, they are considered as commensals (Stella, 1997). Many marine invertebrates also use other organisms as habitat (commensals), or as both habitat and food (parasites, carnivores and herbivores). Most associations between marine invertebrates and their plant or animal hosts, however, remain poorly described and there are few quantitative data addressing host specificity (Poore *et al*., 2000).

Coral reefs are the most important ecosystems, harbouring thousands of species. Sponges form considerable part of the coral reef associates and in turn provide with abode to a wide range of organisms. Studies on the cryptofaunal communities are meagre, (Uebelacker, 1977; Voultsiadou-Koukoura *et al*., 1987; Martin *et al*., 1992; Klitgaard, 1995; Martin, 1996; Poore *et al*., 2000 and Neves and Omena, 2003) though they play a major role in the food chain of their ecosystem. Keeping this in mind, the present study was undertaken to observe the associated cryptofaunal groups, *Spirastrella inconstans* and *S. inconstans* var. *digitata* from the Palk Bay region (Lat. 90° 17' N Long. 79° 17'E) adjoining the Gulf of Mannar Biosphere Reserve, southeast coast of India.

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MATERIALS AND METHODS

Sponge specimens were collected from coral reefs by skin diving at Gandhi Nagar, Palk Bay region for a period of one year during September 2004 to August 2005. A total of 20 sponge colonies were collected from the depth ranging between 0.5 and 1.5 m. From this collection 10 specimen each of *S. inconstans* and *S. inconstans* var. *digitata* were selected for the study. Sponges were selected randomly, but with the purpose of obtaining a size range of individuals. Following collection all sponges were preserved in 4 to 5% formalin, with the exception of one individual preserved in 70% ethanol to avoid dissolution of the spicules necessary for sponge identification. Sponge volume was measured by following the displacement method of water. Following removal of each sponge from the volumeter, liquid from the plastic bags and from the volumeter was filtered through a 0.5 mm mesh screen to retain any animals which have become dislodged from the sponge. Each sponge was dissected microscopically under 12X stereo dissection microscope (Olympus) to obtain all inhabitants. The saturated wet weight (Ishida, capacity 2 kg, grade 10 g) height, length and width (using scale in cm) of each specimen were measured before dissection and the remains of the dissected sponge were weighed following thorough shade dry. All sponge associates were separated and sorted up to group level. The sponges were identified based on their morphology and structure of the spicules. The correlation analysis was made on total groups versus different parameters to evaluate the relationship between the variables. Correlation analysis were completed using the statistical version of Microsoft Excel Sheet (Uebelacker, 1977).

RESULTS AND DISCUSSION

S. inconstans is a cylindrical tubular sponge with upright erect branches, while *S. inconstans* var. *digitata* is a more flattened, shorter and amorphous species (Fig. 1). The total volume of 16.88 liters of *S. inconstans* var. *digitata* yielded 2705 cryptofaunal animals, whereas 9.01 Liters of

Spirastrella inconstants

Tylostyles

Spirasters

Spirastrella inconstants var. *digitata*

Tylostyle

Spirasters

Fig. 1: Morphological difference between two species of sponges

Table 1: Percentage composition of individual group of organisms

Organisms	*S. inconstans* var. *digitata*	Total No. of organisms	*S.inconstans*	Total No. of organisms
Barnacles	24.51	663	22.07	170
Brittle stars	25.61	693	21.11	75
Polychaetes	4.21	114	3.27	284
Amphipods	17.30	468	24.77	163
Isopods	11.97	324	16.03	197
Gastropods	13.20	356	10.10	183
Bivalves	0.81	22	0.90	148
Sea anemones	0.36	10	0.44	117
Pistol shrimps	1.18	32	0.51	137
Crabs	0.85	23	0.80	84
Total	100.00	2705	100.00	1558

Table 2: Number of individuals/litre of sponge and percentage composition of each group

	Spirastrella inconstans var. *digitata*		*Spirastrella inconstans*	
Groups	No. of individuals	% composition	No. of individuals	% composition
Barnacles	43.11	25.54	41.038	22.62
Brittle stars	44.96	26.65	36.491	20.11
Polychaetes	7.055	4.18	5.707	3.145
Amphipods	28.43	16.85	47.066	25.945
Isopods	19.09	11.31	28.639	15.786
Gastropods	21.12	12.52	18.24	10.054
Bivalves	1.26	0.75	1.4025	0.80
Sea anemones	0.46	0.27	0.677	0.373
Pistol shrimps	1.84	1.10	0.841	0.463
Crabs	1.40	0.83	1.305	0.719
Total	168.73	100.00	181.41	100.00

S. inconstans yielded 1558 cryptofaunal animals (Table 1 and 2). Since 10 samples were made for both the species of sponges, the degrees of freedom (n) is always 9.

Though the total numbers of organisms were collected more in *S. inconstans* var. *digitata*, the total number of organisms per litre of sponge was higher in *S. inconstans* (Table 2). During the present investigation, more number of animals was recorded in *S. inconstans* var. *digitata* than *S. inconstans*.

In this study, the group of cryptofaunal organisms found associated with the sponges were barnacles, amphipods, isopods, crabs, pistol shrimps, gastropods, bivalves, brittle stars, polychaetes and sea anemones. The percentage composition of cryptofaunal communities in the descending order is summarized as follows.

S. inconstans* var. *digitata

Brittlestars>Barnacles>Amphipods>Gastropods>Isopods>Polychaetes>Pistol shrimps>Crabs>Bivalves>Sea anemones

S. inconstans

Amphipods>Barnacles>Brittlestar>Isopods>Gastropods>Polychaetes>Bivalves>Crab>Pistol shrimps>Sea anemones

The surface area of a substrate plays a substantial role in determining the settlement of organisms on it. Considering equal volumes of both species of sponges, *S. inconstans* var. *digitata* had more surface area and consequently higher number of associate organisms. *S. inconstans* had a higher amount of free space within and this free space was occupied by many brittle stars. The pore size was higher in *S. inconstans* var. *digitata*, which probably could account for higher densities of barnacles and polychaetes per liter of sponge, than in *S. inconstans*.

In the previous study Voultsiadou-Koukoura *et al*. (1987) suggested that the macrofaunal organisms associated with the sponge *Verongia aerophoba* were examination of the elements of the

fauna in relation to sponge size showed no correlation between the volume of the host and the density, diversity and biomass of the associated fauna, but in the present study the parameters namely volume, wet weight and dry weight of the sponge colony are direct indicators of sponge size and all the three parameters were found to be highly significant ($p<0.001$) and correlated with that of the total number of organisms. Uebelacker (1977) also reported the size of the sponges as the main factor affecting the cryptofaunal species diversity.

In the earlier investigation Neves and Omena (2003) reported that the adults of the symbiotic species *Haplossyllis spongicola* were the most dominant sponge endobionts. Polychaete density was significantly greater in lobate sponges than in massive and encrusting forms. In the current revision the percentage composition of polychaetes were 4.21% in *S. inconstans* var. *digitata* and the total number of organisms of 114 animals were recorded; whereas the percentage composition of polychaetes were 3.27% in *S. inconstans* (Table 1). (Berquist, 1972) suggested a single specimen of *Spheciospongia vesparia* from florida was found to contain over 16000 shrimps belonging to the genus *Synalpheus*.

In the present study the dimensions like length, width and height of each sample were correlated with its volume. Significant correlation was noticed in *S. inconstans* var. *digitata*, but in *S. inconstans* it was insignificant. This suggests that the branching tubular nature of *S. inconstans* means that slight increase in volume results in substantially increase in the surface area. *S. inconstans* is a cylindrical tubular sponge with upright erect branches, while *S. inconstans* var. *digitata* is more flattened, shorter, oscules, large pore size and amorphous species, its may be the reason more number cryptofaunal organisms associated with this two species of sponges.

In the earlier investigation Uebelacker (1977) reported that the highly significant correlations occur between the size (mass, surface, area, length and circumference) of *Gelliodes digitalis* specimens and the number of cryptofaunal species associated with each sponge, but in the present study correlation analysis at groups levels showed that most of the groups were positively correlated with volume, wet weight and dry weight of two species of sponges *S. inconstans* and *S. inconstans* var. *digitata*.

In the present investigation highly significant correlation ($p<0.001$) was observed between volume and group of organisms like, amphipods, isopods, sea anemones, pistol shrimps and crabs in *S. inconstans* var. *digitata* (Table 3). In *S. inconstans*, highly significant ($p<0.001$) correlation was noticed between volume and group of organisms like amphipods, barnacles, brittle stars, isopods, gastropods, polychaetes and bivalves (Table 4).

In the present investigation, among the 10 groups of organisms recorded, from *S.inconstans* var. *digitata* the brittle stars were found to be the dominant group (26.65%) while sea-anemone contributed less (0.27%). The correlation coefficient (r) value between the number of brittle stars and total volume (0.6856) and the relationship was significant ($p<0.02$) while the total volume (0.8792)

Table 3: Correlation between parameters Vs Group of organisms in *Spirastrella inconstans* var. *digitata*

Group of organisms	Parameters					
	Volume	Wet weight	Dry weight	Length	Height	Width
Barnacles	0.6904***	0.6718***	0.7031***	0.5406^{Ns}	0.4742^{Ns}	0.6801***
Brittle star	0.6856***	0.6670***	0.7054***	0.4826^{Ns}	0.4721^{Ns}	0.7374**
Polychaetes	0.6711***	0.6862***	0.6868***	0.3734^{Ns}	0.6041***	0.9345*
Amphipods	0.8967*	0.9165*	0.8598*	0.8557*	0.9179*	0.7524**
Isopods	0.8775*	0.8938*	0.8617*	0.8495*	0.8977*	0.6828****
Gastropods	0.6074***	0.6590***	0.7108***	0.7108***	0.6027***	0.8049**
Bivalves	0.6074***	0.6590***	0.7108***	0.3668^{Ns}	0.6027***	0.8049**
Sea anemone	0.8792*	0.9055*	0.9000*	0.6804**	0.7473*	0.6942***
Pistol shrimps	0.8460*	0.9193*	0.9187*	0.7448**	0.7127*	0.5354^{Ns}
Crabs	0.8460*	0.7548**	0.7918**	0.5731^{Ns}	0.5170^{Ns}	0.4243^{Ns}

*$p<0.001$; **$p<0.01$; ***$p<0.02$; ****$p<0.05$; Ns-Not significant

Table 4: Correlation between parameters Vs Group of organisms in *Spirastrella inconstans*

Group of organisms	Parameters					
	Volume	Wet weight	Dry weight	Length	Height	Width
Barnacles	0.9331*	0.8618*	0.9098*	0.3256^{Ns}	0.5858^{Ns}	0.2056^{Ns}
Brittle star	0.9036*	0.7926*	0.7354**	0.1225^{Ns}	0.5149^{Ns}	0.0696^{Ns}
Polychaetes	0.7932**	0.7067**	0.7525**	-0.1064^{Ns}	0.6912***	0.0947^{Ns}
Amphipods	0.9752*	0.9030*	0.8950*	0.3018^{Ns}	0.5721^{Ns}	0.0753^{Ns}
Isopods	0.849**	0.8071*	0.9187*	-0.1234^{Ns}	0.4178^{Ns}	-0.2336^{Ns}
Gastropods	0.9110*	0.7814*	0.9188*	-0.028^{Ns}	0.5085^{Ns}	-0.0331^{Ns}
Bivalves	0.8872*	0.8702*	0.8648*	0.2648^{Ns}	0.5246^{Ns}	-0.1986^{Ns}
Sea anemone	0.7848**	0.7431**	0.6726****	0.3900^{Ns}	0.8520*	0.3645^{Ns}
Pistol shrimps	0.7019***	0.6559***	0.7077***	0.3033^{Ns}	0.3171^{Ns}	0.1917^{Ns}
Crabs	0.8012**	0.8180**	0.7142***	0.41668^{Ns}	0.8810*	0.1004^{Ns}

*p<0.001; **p<0.01; ***p<0.02; ****p<0.05; Ns- Not significant

and the relationship was highly significant (p<0.001) in sea anemone. Other parameters are also presented (Table 3). Similarly, in the case of *S. inconstans*, the barnacles and amphipods were found to be the dominant groups (22.62 and 25.95%) while pistol shrimps constituted less (0.463%). The correlation co-efficient (r) value between the number of barnacles, amphipods and total volume (0.9331, 0.9752) and the relationship was significant (p<0.02) while the total volume (0.7019) and the relationship was highly significant (p<0.001) in pistol shrimps (Table 4).

In the earlier investigation Riberio *et al*. (2003) have been studied the macrofauna associated to the sponge *Mycale microsigmatosa*. A total of 2235 individuals (over 1 mm long) of 75 invertebrate species were found to 19 specimens of the sponge. The most abundant and diverse taxa were the crustaceans (83%, 31 sp.), polychaetes (10%, 18 sp) and molluscs (3.7%, 15 sp). Cnidarians, platyhelminthes, ascidians, echinoderms, pycnogonids, bryozoans and sponges were also represented. Amphipods crustaceans were the dominant group, comprising 61% of all individuals collected. Species richness and abundance of associated fauna were highly correlate with sponge volume.

In the current revision amphipod one of the dominant groups from *S. inconstans* (25.94%) while *S. inconstans* var. *digitata* (16.85%) in per liter of sponge and brittle star was dominant groups in *S. inconstans* var. *digitata* (26.65%) while *S. inconstans* (20.11%) in per liter of sponge (Table 2). It is supporting this in the earlier study Poore *et al*. (2000) was reported by the diverse amphipod fauna (56 species) was associated with 12 species of sponge host. The most common amphipod families collected were the Icilidae (36% of the total number of individuals collected), Leucothoidae (28%), Colomastigidae (6%) and Eusiridae (4%).

SUMMARY

In the present study cryptofaunal associates from coral reef sponges of the Palk Bay was carried out for a period of one year during September 2003 to August 2004.

The number of cryptofaunal species associated with twenty colonies from the 2 species of coral reef sponges in *S. inconstans* and *S. inconstans* var. *digitata*. Species number is most highly correlated with sponges volume, wet weight and dry weight in both the species. In this study, 10 groups of cryptofaunal organisms like barnacles, amphipods, isopods, crabs, pistol shrimps, gastropods, bivalves, brittle stars, polychaetes and sea-anemones were recorded.

Brittle stars (26.65%) one of the dominant groups from the sponge *S. inconstans* var. *digitata* while amphipods (25.95%) were dominant groups from the sponge *S. inconstans*. In the present study total number of organisms were collected more in *S. inconstans* var. *digitata* than *S. inconstans* because of the *S. inconstans* var. *digitata* is a more flattened, shorter and amorphous species.

A total of 16.88 L of the species *S. inconstans* var. *digitata* yielded 2705 cryptofaunal animals, whereas 9.01 L of the species *S. inconstans*, yielded 1558 cryptofaunal animals.

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