

Temporal variation in macroinvertebrates associated with intertidal sponge *Ircinia fusca* (Carter 1880) from Ratnagiri, West coast, India.

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Temporal variation of macrofauna associated with a marine sponge, *Ircinia fusca* was studied from a tropical rocky shore along the West coast of India. Triplicate sponge samples (~100 g) were collected from January to December 2010 from Bhagwati Bandar area, Ratnagiri. A total of 22 macrofaunal taxa were found to be associated with the sponge. The community was dominated ($\geq 80\%$) by the juvenile ophiuroid, *Ophiactis savignyi*. *Syllis* sp., Sipuncula and Bivalvia were the other dominant taxa. Presence of *O. savignyi* juveniles during most of the time in the year indicates a major recruitment in March and minor recruitment during rest of the year. Present study suggest that the *O. savignyi* utilize the surface area of sponge as a perfect settling and recruiting ground. It infers that the sponge *Ircinia fusca* is used as a breeding ground by the brittle star, *Ophiactis savignyi*.

[**Keywords:** *Ircinia fusca*, *Ophiactis savignyi*, Macroinvertebrates, Seasonality, Tropical, Rocky shore, West coast, India]

Introduction

Sponges are an important source of biogenic structure where they dominate the benthic ecosystem¹. Sponges with their complex morphology often harbour abundant fauna providing shelter and food²⁻⁶. Most of the studies on the sponge-associated fauna have been carried out from the temperate region⁶. Studies on the sponge-associated organism from Indian coast focussed primarily on microbes and their antimicrobial activity⁷. Further, very few studies have looked into the temporal variation in the distribution of macrofauna associated with sponges.

The demospongiae, *Ircinia fusca* (Carter 1880) is a common sponge on the intertidal rocky shores of Ratnagiri, west coast of India. Although, the seasonal variation of bacteria associated with *Ircinia fusca* was studied⁸, there are no studies on the macrofauna associated with the sponge. Therefore, to understand the associated fauna in *Ircinia fusca*, the present investigation was carried out. The objective was to investigate the diversity of macrofauna and influence of temporal changes on the distribution of the associated fauna.

Materials and Methods

Sampling and laboratory analysis

The sponge, *Ircinia fusca* were collected from tide pools of Bhagwati Bandar area (16°59'N 73°16'E; Fig. 1), Ratnagiri, West Coast of India. This rocky



Fig. 1—Sampling site along the west coast of India

shore area is directly exposed to sea and inhabited by diverse flora and fauna. *Ircinia fusca* is a jet black, thick encrusting to massive, sometimes irregular sponge found commonly on the intertidal rock pools of Ratnagiri.

Ircinia fusca was collected monthly in triplicates from January to December 2010. Sponges were removed from the rocks with a scalpel and quickly transferred to plastic bags to prevent the escape of fast-moving associated fauna. In the laboratory, the sponge was macerated to remove the macrofauna present in the pores. Sample was washed on 0.5 mm sieve. Fauna retained on the sieve were sorted and preserved in 10% neutralized formalin. The fauna were identified to lowest possible taxa using literature⁹⁻¹¹. Sponges were dried and weight was recorded.

Disk diameter of brittle star was measured on the aboral surface to the nearest 0.01 mm using an ocular micrometer under stereomicroscope. Measurements were taken from the base of an arm midway between the outer edges of the two radial shields to a point on the disk perimeter directly opposite¹².

Data analysis

One-way ANOVA analysis was performed to find out the significance temporal variation of biological parameters. Margalef's species richness (d)¹³, species evenness (J'), and the Shannon and Weiner¹⁴ for species diversity (H' loge) were calculated for the associated fauna. Biological data were $\log(x+1)$ transformed and used for multivariate analyses. Temporal pattern of associated fauna was analysed by hierarchical agglomerative clustering with group-average linking on the Bray-Curtis coefficient¹⁵. Non-metric multidimensional scaling (nMDS) was also performed using the Bray-Curtis similarity matrix to produce an ordination plot. Similarity percentage programme (SIMPER) was then used to identify the species contributing to within group similarity. A similarity profile (SIMPROF) test was carried out for detecting statistically significant cluster¹⁶⁻¹⁷. Analyses were carried using Primer 6 and Statistica 10 software packages.

Results

The sponge, *Ircinia fusca* was the dominant sponge in the area hence used to study the temporal variation of associated fauna. *Ircinia fusca* has a lamellar growth on the intertidal rocky shores⁸. Abundance of the associated fauna was highest during March 2010 (3277 ind 100 g⁻¹ sponge) and lowest recorded during February (243 ind 100 g⁻¹ sponge). However, one-way ANOVA showed that the temporal variation in abundance was not significant.

The most abundant fauna in the sponge was the brittle star, *Ophiactis savignyi* (Muller and Troschel 1864) which contributed to 87% of the total abundance. Highest abundance of *O. savignyi* was observed during March (3193 ind 100 g⁻¹ sponge; Fig. 2 and 3) and lowest in February (190 ind 100 g⁻¹ sponges). *Syllis* sp. (6%) abundance ranged from 3-239 ind 100 g⁻¹ sponge, recorded during July and September, respectively. Sipuncula (3 %) showed high

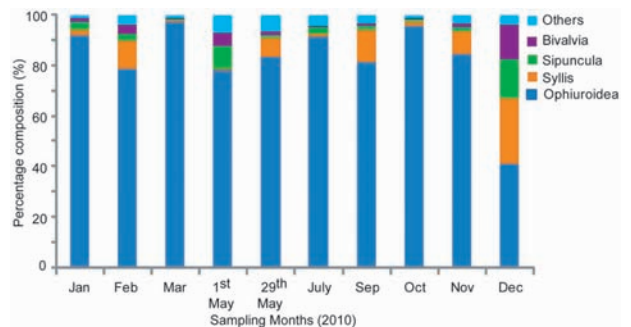


Fig. 2—Monthly variation in the composition (%) of macrofauna associated with sponge *Ircinia fusca*.

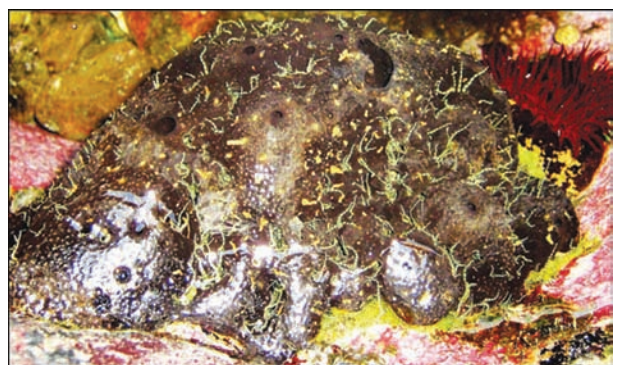


Fig. 3—Sponge *Ircinia fusca* in the natural environment with dense association of brittle star *Ophiactis savignyi*.

abundance during December 2010 (77 ind 100 g⁻¹ sponge) and low during February (6 ind 100 g⁻¹ sponge). *Bivalvia* (2%) showed high abundance during December (69 ind 100 g⁻¹ sponge) and lowest during July (6 ind 100 g⁻¹ sponge).

Bray-Curtis percentage similarity and the corresponding nMDS based on the faunal abundance grouped the sampling months into three major clusters (Fig. 4). However, the SIMPROF test showed that clustering observed in the nMDS were not statistically significant and hence retaining the null hypothesis. Retention of null hypothesis in SIMPROF indicates the similarity of the macrobenthic community during the study period.

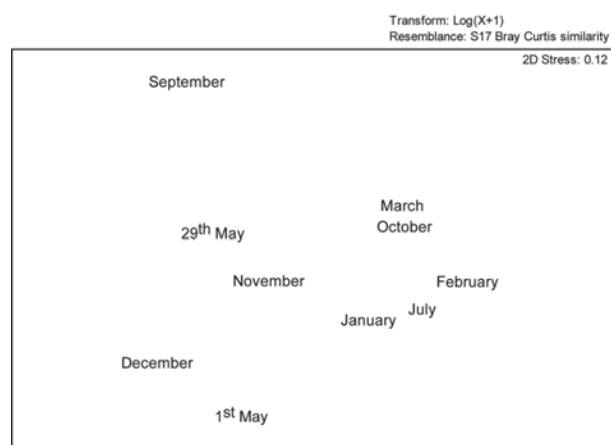


Fig. 4—nMDS based on macrofaunal abundance.

A total of 22 taxa were collected in *Ircinia fusca* during the study. Species number was highest during 29th May (12 taxa) and October (11 taxa) while lowest of 6 taxa was reported during January (Table 2). Margalef's species richness (d) varied from 0.80 to 1.53 with the highest value observed in May. Species evenness J' varied from 0.076 to 0.659, with the higher values recorded for December. Shannon – Wiener Diversity H' varied from 0.16 to 1.4 (Table 2). Highest H' values were observed in December sample. One-way ANOVA showed that diversity indices did not show significant temporal variation.

Pearson's correlation between sponge dry weight and associated faunal parameters (abundance, species diversity indices and dominant taxa abundance) did not show statistically significant relationship.

Table 2—Species diversity indices of macrofauna associated with sponge *Ircinia fusca*

Sampling date	S	H'	J'	d
29 th January 2010	6	0.37	0.23	0.73
24 th February	8	0.82	0.39	1.38
21 st March	9	0.14	0.10	0.61
01 st May	9	0.48	0.25	0.99
29 th May	12	0.66	0.30	1.61
13 th July	9	0.53	0.27	1.20
24 th September	9	0.60	0.34	0.97
10 th October	11	0.66	0.33	1.25
22 nd November	9	0.80	0.47	1.00
05 th December	9	0.93	0.62	0.85

Size structure of dominant sponge associated brittle star species (Ophiactis savignyi).

A total of eight size classes were observed for *Ophiactis savignyi* and ranged from 1-5 mm (Fig. 5). Smallest sized specimens were dominant during March (1.0-2.5 mm) and contributed to 83% of the population. In May the highest size classes was observed with largest specimen measuring to 5 mm. The Figure 6 represents the progression of the disc size with smallest recorded in March (avg. 2 mm) and largest during July (avg. 3.5 mm).

Discussion

Sponges are rightly considered 'living hotels' as they are commonly found in association with abundance of marine fauna on rocky shores⁴. *Ircinia fusca* is a common sponge found on the rocky shores of Ratnagiri, along the west coast of India. Most studies on the sponge associated fauna are from the temperate regions and very few are from the tropical marine environment⁴. Aim of the present study was to investigate the temporal variation in the macrofaunal distribution associated with the sponge, *Ircinia fusca* from a tropical rocky shore.

A total of 22 taxa were found in *Ircinia fusca* during the study, which is a poor association compared to other sponges studied. *Mycale microsigmatose* and

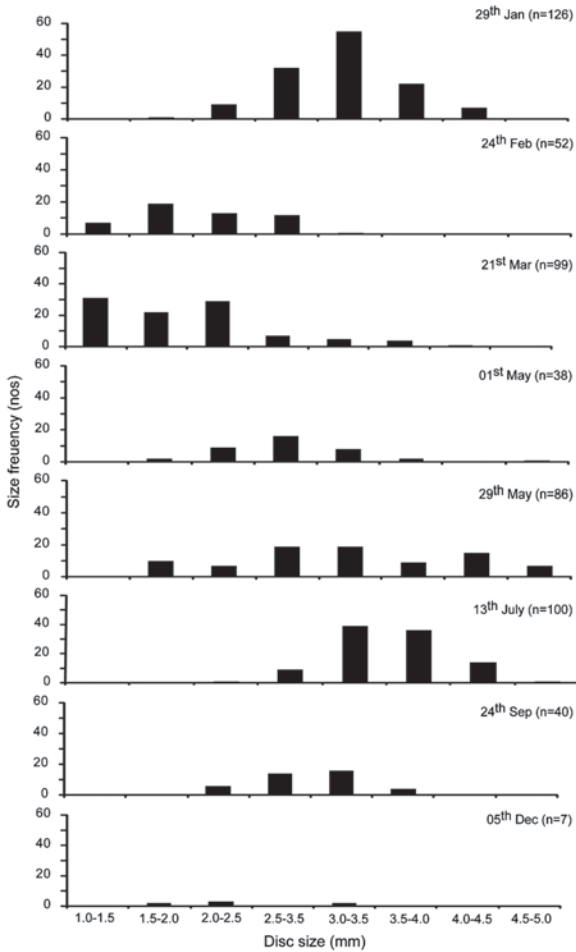


Fig.5—Monthly disc Size variation in *O. Savignyi*.

M. angulose from Brazil harbours 75 and 92 species, respectively^{2,4} while *Aplysina lacunose* in the Caribbean had 139 associated fauna¹⁸. On the other hand only three taxa were reported from *Aulospongia schoemus*¹⁹ and 24 taxa in the *Haliclona* sp.²⁰. Morphology of the sponge is important for the diversity of taxa associated with it. Sponges with large ossicles and internal space are known to harbour more diverse fauna²². However, high diversity has been found in sponges with small internal spaces and less volume^{4,21}. Therefore, it is still not clear why some sponges have a very poor associated macrofauna, whereas others harbour a rich fauna.

The brittle star, *Ophiactis savignyi* dominated the associated fauna and is consistent with previous study². However, many studies have reported Crustacean as the single dominant taxa in most sponge

species^{4,6}. Polychaeta was the next dominant taxa followed by Bivalvia. However, the polychaeta, *Haplosyllis spongicola* was the most dominant taxa in the sponges of south eastern United State²² and northeast Brazil³. Therefore, it can be concluded that most sponge species are dominated by single taxa.

High abundance of macrofauna during March was due to the recruitment of *Ophiactis savignyi*. Small temporal variation observed in the macrofauna was due to the changes in the abundance of *O. savignyi* due to the recruitment process. *Ophiactis savignyi* showed two peak abundance periods dominated by juveniles. In March the first major recruitment period (Fig. 4) was observed followed by second minor recruitment from September–November. Size histogram figure (Fig. 6) also indicates the juveniles dominated the brittle star population. A sudden decline of *Ophiactis savignyi* was observed on 1st May (89%). High post-settlement mortality is a common phenomenon in benthic invertebrates²³. The presence of juveniles during the most of the time in the year indicates that *O. Savignyi* has major recruitment in March followed by minor recruitment during rest of the year. These results are consistent with earlier studies on ophiuroids. Ophiuroid, *Ophiothrix fragilis* showed the main recruitment during late spring–early summer in Blanes, Spain²⁴. Atlantic population of *Ophiothrix fragilis* showed 4 recruitment periods²⁵ while larvae in plankton samples were observed during late spring and autumn from the French Mediterranean²⁶. Complete dominance by the brittle star resulted in the low diversity of other associated fauna.

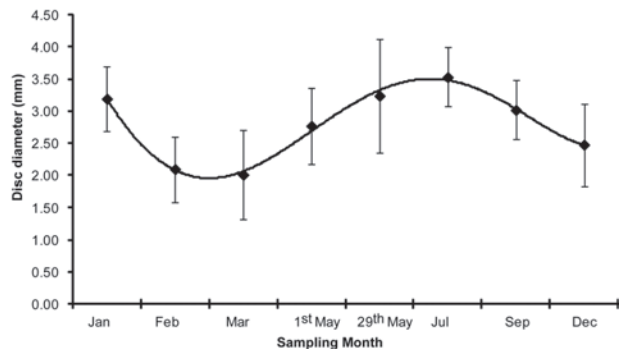


Fig. 6—Modal progression mean in the disc size.

The maximum adult size observed was 4 mm and very few of them were observed on the sponge. Further, during March few adult with mature gonads were also observed. According to Turon *et al.*,²², since the ophiuroids are suspension feeders, the short arm of the juveniles cannot efficiently capture food and hence depend upon the current generated by the sponge. Later, with growth the brittle star abandons the sponges. Protection could also be another reason for the abundance of juveniles, which seems unlikely in the present case, since *O. savignyi* were observed on the exposed sponge surface. Several studies have

shown the presence of matured adults and juveniles of invertebrates harbouring sponges¹¹. Such association could be a temporary opportunistic relationship used by the invertebrates during the most vulnerable period of their life cycle⁶.

The association of juveniles of *Ophiactis savignyi* with *Ircinia fusca* indicates that the sponge is used as a breeding ground by the ophiuroid. Sponge provides abundant food through its internal current to the short-arm juveniles of *O. Savignyi*, enhancing its survival. Therefore, sponges are important biogenic structures and play a vital role in maintaining the biodiversity

Table 1—Monthly variation in invertebrates abundance (ind 100 gm⁻²) associated with *I. fusca*

Taxa	Jan	Feb	Mar	1 st May	29 th May	Jul	Sep	Oct	Nov	Dec	Mean	SD
Polychaeta												
<i>Nereis</i> sp.	0	0	0	0	6	11	0	2	0	0	1.8	3.57
<i>Syllis</i> sp.	12	27	16	3	100	7	239	16	107	131	65.9	77.21
<i>Eunice</i> sp.	0	0	0	4	0	0	4	0	9	0	1.7	3.05
<i>Lumbrineris</i> sp.	0	0	7	3	6	0	0	6	4	3	2.9	2.76
<i>Lysidice</i> sp.	0	0	0	15	2	0	0	0	0	0	1.7	4.81
<i>Amage</i> sp.	0	0	0	0	4	0	0	0	0	0	0.4	1.35
<i>Sabellaria</i> sp.	0	2	0	0	2	0	4	0	0	0	0.8	1.51
Sabellidae inden.	0	0	0	0	0	0	0	0	4	0	0.4	1.39
Crustacea												
Cirripedia	2	0	0	0	3	0	0	0	0	0	0.5	1.20
Tanaid	0	2	0	0	0	0	31	0	0	0	3.3	9.90
Paguroidea	0	0	6	0	0	0	0	2	0	0	0.8	2.03
Mysidae	0	0	0	0	0	0	0	0	0	1	0.1	0.40
Copepoda	0	0	0	0	0	0	0	0	0	5	0.5	1.61
Brachyura	0	0	0	0	0	1	0	1	2	0	0.4	0.70
Amphipoda	0	2	3	0	0	2	9	1	0	0	1.9	2.88
Ophiuroidea												
<i>Ophiactis savignyi</i>	465	190	3193	354	1126	529	1490	1240	963	207	975.7	902.43
Gastropoda	0	0	0	4	13	2	9	0	0	6	3.4	4.65
Bivalvia	10	9	11	24	16	6	16	8	17	69	18.6	18.53
Polyplacophora	0	0	0	0	0	0	0	1	0	0	0.1	0.35
Nematoda	2	5	12	4	51	7	0	1	15	3	10.0	15.24
Zoanthidae	0	0	4	0	0	0	0	0	0	0	0.4	1.30
Sipuncula	14	6	25	41	17	14	29	15	18	77	25.6	20.50
Total	505	243	3277	452	1346	579	183	1293	1139	502	1117	1077

of a region. Studies on the sponge associated fauna are important for conservation and management purpose. Since most sponges are harvested in large quantity due the bioactive compound. Therefore, while exploiting sponges, the potential impact on the associated fauna should be considered.

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