

The Effects of Depth upon the Infauna  
Community of Ircina strobilina

A good polyp  
and disseminator

Catie Campbell  
Irby Lovette

Biology 52 Final Project  
March 7, 1990

## Abstract

This study took place at Discovery Bay Marine Laboratory, Discovery Bay, Jamaica from 25 February 1990 to 6 March 1990.<sup>1</sup> Sponges of the species Ircinia Strobilina were collected at two different depths, 30 feet and 60 feet, on the West Fore Reef. Infaunal communities were analyzed and compared between depths. Two sponges of the species Ircinia fasciculata were analyzed as well for an interspecific comparison. Brushes were put out at the same two depths to simulate sponges, and the infaunal communities colonizing them were analyzed as well. A significantly higher number of individual infauna per m<sup>2</sup> of sponge was found at shallower depths. It is proposed that this is due to higher primary productivity and greater food availability.

*B*  
*E*

2

for infauna at shallower depths.

Results from brush and  
other species of Trecia?

## Introduction

The interiors of sponges provide a unique microenvironment for a wide variety of small marine organisms. Both obligate and facultative sponge-dwellers derive an important refuge from predation by living inside sponges, and some may feed on the particulate matter in the water pumped by the sponge. (Westinga & Hoetjes, 1981) Some sponges harbor numerous parasites, especially polychaete worms. (Colin, 1978) Most infaunal organisms are microscopic, but a number of fish and echinoid species also utilize

Sponge interiors.

Sponge inffaunas have been extensively described (eg. Pearse, 1932; Hoetjes et al., 1976), but further studies have thus far been confined to a few topics. Several authors have used sponge inffaunas to test various predictions of island biogeography theory, and have shown that the number of inffauna taxa is logarithmically related to sponge volume. (Reicher & Bachman, 1979; Westinga & Hoetjes, 1981) Aside from these studies, most ecologically-oriented work on sponge inffauna has been directed towards comparatively large organisms like fish + brittlestars. (Tyler + Böhlke, 1972)

Merrens, 1987)

Published reports offer conflicting data on the responses of sponge infauna to depth. Pearse (1932) suggested that infaunal species richness and abundance increases with depth. Uebelacker (1977) and Hoetjes (1976) report that depth has no influence upon the presence or ~~abundance~~ of infauna taxa. Finally, Westinga & Hoetjes (1981) found that sponges in shallow water contain a higher infaunal biomass than do similarly-sized sponges from a greater depth.

In this study, we investigated the

effects of depth upon the infauna community  
of Ircina strobilina, a common Caribbean  
reef sponge. We predicted that both  
infauna abundance and richness will inversely  
correlate with depth due to the greater  
primary productivity and suspended particulate  
matter at shallow depths. Both factors  
should increase the amount of food available  
to shallow infaunal organisms and thus  
increase their numbers and diversity.

### Methods

This study was conducted during the ten day period 25 February to 16 March 1990 at Discovery Bay Marine Lab, Discovery Bay, Jamaica. Three sponges of the species Ircinia Strobilina were collected from 40' and three from 60' on the West Fore Reef near mooring one.

Bristle brushes ~~20~~ (glassware cleaning brushes) 20 cm high, with bristles approximately 5cm long were set out in bunches of three, three bunches at 35' and three at 60'. The bunches of brushes were tied tightly with a string to upright fragments of coral so as to project rigidly upright above the substrate. All brushes were collected after five days of exposure.

Two sponges of the species Ircinia fasciculata were collected from a depth of 45' in order to compare their fauna with that of the closely related I. strobilina.

Each sponge was placed in a zip lock bag as soon as it was cut from the substrate. In the lab, the seawater in the ziplock was separated from the sponge, preserved with 50% ethyl alcohol, and strained through a 280μm screen. The sponge itself was then soak in a fresh water and 50% ethanol solution. After approximately one hour of soaking, the soak water /alcohol combination was strained through the 280μm filter, and the ~~filtered material~~ preserved in alcohol and fresh water. The sponge was then weighed on a balance to the nearest gram, and the volume was determined through the displacement of water in a graduated cylinder. This water ~~displaced~~ was strained through the filter as well. The sponge was then cut into

slices approximately 2 cm thick and  
the slices were then agitated with  
forceps in fresh water and alcohol. This  
solution was then strained. At this  
point the sponge was labeled and set  
out in the sun to dessicate. After  
several days the sponge was placed in  
a dessicator for twelve hours at 50°C  
and then weighed to the nearest gram.  
all of the ~~filtered~~<sup>filtered material</sup> was then placed in a  
gridded petri dish and analyzed under  
a dissecting microscope. All fauna  
individuals were counted and assigned  
to the most accurate taxa possible with  
our limited experience. Efforts were made  
to distinguish between closely related  
organisms. Organisms too damaged

to identify specifically were assigned to a "general" category. Each ~~taxon~~<sup>on</sup> was assigned an identity code and named. Some, unidentifiable, were given names of our own invention. Individual representatives of most classifications were collected and saved for future reference.

Bristle brushes were collected by first placing a plastic bag over the brushes and then cutting the string holding them to the substrate. The bags were then sealed. The sea water in the bag was strained, as was the fresh water then used to rinse the inside of the bag. The brushes were then rinsed under the faucet to remove as much substance from them as was visible. This runoff water was caught

in a tub and strained through the 280μm <sup>filtered material</sup> filter. The ~~filter~~ was analyzed and quantified with a dissecting microscope and gridded petri dish as above.

*M.J.*

The water content of a sponge is one measure of space available for colonization by infauna. Water weight was calculated from the difference between the weight of the sponge before and after dessication.

For each sponge, number of individuals and number of taxa were corrected for volume and water content by dividing these values by the measure of volume and water weight respectively.

A diversity index was calculated for each sponge and brush using the formula

$$H = \sum P_i \sqrt{P_i} \quad (\text{John Gilbert - pers.com})$$

This indicates amount of space available of infauna

"H" is the diversity index and  $P_i$  is the number of individuals of each species divided by the total number of individuals in a sponge. This was slightly different from a formula  $H = P_i \log_2 P_i$  given to us by John Gilbert.

Extent of taxon overlap between depths of strobillinae and brushes as well as within depth categories between brushes and sponges was calculated by determining Czekanowsky's coefficient. (Westinga and Hoetjes, 1981)

The formula used was ( $\alpha = \frac{2W}{A+B} \cdot 100\%$ .

Here W is the total number of shared taxa, A is the total number of taxa in group A, and B is the total number of taxa in group B.

Finally Student's T tests were used to test the null hypothesis of no difference between: ① number of individuals found

inStrobilina at 30' versus 60' (2) The number of  
taxa found inStrobilina at 30' versus 60' (3) The  
number of individuals per ml sponge at 30' versus 60'  
(4) The number of taxa per ml sponge at 30' versus 60'  
(5) The number of individuals per g of H<sub>2</sub>O at 30' versus  
60' (6) The number of taxa per g of H<sub>2</sub>O at 30'  
versus 60' (7) The number of individuals per ~~ml~~/brush  
at 30' versus 60' (8) The number of taxa per a brush  
at 30' versus 60'

per brush or per set  
of 3 brushes?

## RESULTS

The number of I. strobilina infaunal individuals ranged from 111 to 1701; with means of  $191 \pm 110$  for the 35 foot sample and  $988 \pm 693$  for the 60 foot sample.

(Table 1) No significant difference was found in the overall abundance of infauna individuals between the two depths. (Student's t-test;  $t = 1.961, .02 > p > .1$ ) However, the sponges from 35 feet contained significantly more infaunal individuals per ml of sponge than did the 60 foot sponges. (Figure 1; Student's t-test:  $t = 3.18, .05 > p > .02$ ) The two depths did not differ significantly in the number of infaunal organisms per gram of sponge water content. (Table 1; Student's t-test:  $t = 1.34, .4 > p > .2$ )

Taxa richness did not differ significantly between depths. (Table 1; Student's t-test:  $t = 1.34$ ,  $.4 > p > .2$ ) No significant differences were found when richness was corrected for sponge <sup>volume</sup> ~~volume~~ (Student's t-test:  $t = .602$ ,  $.9 > p > .5$ ) or water content (Student's t-test:  $t = .260$ ,  $.9 > p > .5$ ).

Taxa diversity tended to be higher in the deeper sponges, but no statistical tests could be performed on this index. (Table 1)

No significant differences were found between the 35 foot and 60 foot brittle brusher in either Infuna abundance (Student's t-test:  $t = .131$ ,  $p > .9$ ) or in taxa richness (Student's t-test:  $t = .946$ ,  $.4 > p > .2$ ). (Table 2)

Taxa overlap as measured by Czernowsky's coefficient ( $C_2$ ) was highest (66.6%) between the bristle brushes at 35 and 60 feet. The  $C_2$  for the lumped sponge sampler from each depth was 51.1%. The  $C_2$  between the sponges and brushes at the same depth was 31.3% at 35 feet and 20.0% at 60 feet.

The two *I. fasciculata* collected from 40 feet contained infaunal numbers and richnesses consistent with those in the shallow *I. strobilata*, but the small sample size and single depth precluded further analysis.

(Table 1)

(For complete infauna data from all sponges and brushes, see Appendix A.)

### Discussion

As we predicted, there was a significant difference in number of individuals of infauna per ml between I. Strobilinae at 35' and 60'. A great deal of this difference in infauna abundance was undoubtedly due to the large number of "polychete A" individuals in the 35' sponges! The reason for the superabundance of this species is unknown. Colin (1978) describes a family of polychaete, parasitic on sponges which "occurs by the tens of thousands", and which "may be so abundant in some specimens, that the worms comprise 5% of the weight of the sponge." We believe, due to the superabundance of this polychaete, that it may belong to this parasitic family.

Perhaps the 35' zone is within this worms range, and it is comparably abundant wherever it occurs. Alternatively, I. Strobilina rarely occurs at depths less than approximately 35'.

The 35' sponges were thus at the edge of their depth range, perhaps making them more susceptible to parasitism by this species.

A  
The sponge may actually be excluded from shallower depths by the presence of polychaete parasites. Additionally, we noted

but did not quantify a difference in the roughness of sponges from the two depths.

Sponges from 60' were very tough and difficult to cut, whereas those from 30' were considerably softer and more easily cut.

Perhaps the low abundance of Polychaete A in the sponges from 60' was related to the toughness of these sponges.

A final possibility is that there are greater sponge food resources at the shallow depth for the polychaetes

and other infauna to feed on. It has been shown that there is more particulate matter at shallower depths (Reiswig, 1973) and primary productivity ~~is inversely~~ <sup>may be directly</sup> correlated with light intensity which, in turn, decreases with depth.

Our finding of lower number of individuals per ml of sponges at deeper depths is consistent with the findings of Westinga and Hoetjes (1981) on the infauna of *Spongiosponge vespa*, but contradicts other workers who found no correlation or an inverse correlation of infauna abundance or richness with depth. (Pearse 1932; Uebelkeber 1977; Hoetjes 1976) No difference was found in number of taxa per ml sponge or per gram of H<sub>2</sub>O between the two depths. Overall number of species per ml or gram H<sub>2</sub>O is a measure

"species richness". Diversity index, a more accurate measure of diversity, appeared to show no differences between the two depths either. Diversity has been shown to be correlated with sponge size, (Reichert and Bachman 1978) and thus size may be more important than depth in determining infaunal diversity.

Our analysis of taxon overlap was somewhat confounded by difficulties in infauna identification. Overlap of taxa between the two depths in bivalves and sponges, respectively, was on the order of 50% to 65%. Our sample size was too small to conclude that this overlap is the actual overlap. However, it is possible that this result indicates different assemblages of infauna at the two depths. The overlap between

brushes and sponges within the same depth was only 20% to 30%. This relative lack of overlap indicates that, although the brushes could be used to show rates of colonization between depths, they are not very useful models of sponges.

✓ Much work remains to be done on sponge infauna assemblages. Future studies could extend our depth gradient below 60 feet. Another interesting possibility is an analysis of sponges which differ in toxicity.

Finally we would like to warn future workers that the common name of I. strobilina - the "stinky pillow sponge" - is extremely accurate. Fish behavior might prove more appealing...



Figure 1 : Number of infauna individuals per ml of *Ircinia strobilina* at two depths. (Student's T-test:  $t = 3.18^{\circ}$ , d.f. = 3;  $0.05 > p > .02$ ) Error bars show standard deviation.

Sponge Species	# of individu- als in Pan- ama	# of infauna sponges (#/m)	# of infauna Hab was- tage (#/g)	infauna taxa richness (# / m <sup>2</sup> )	infauna taxa sponge volume (# / m <sup>3</sup> )	infauna taxa habi- tats diversity (# / s)	taxa diversity
I. strobilina	60	111	0.555	0.581	17	0.085	0.089
"	2	60	146	0.730	0.568	25	0.125
"	3	60	317	0.793	0.890	7	0.018
"	4	35	946	4.300	3.540	10	0.045
"	5	35	316	3.160	3.720	8	0.080
"	6	35	1701	7.730	22.380	10	0.045
I. fasciculata	7	35	206	1.030	1.140	13	0.065
"	8	35	80	0.800	1.050	8	0.080

Table 1: General Sponge Infauna Data

	# of infauna individuals	taxa richness
Brush 1	109	14
Brush 2	59	9
Brush 3	72	10
Brush 4	52	11
Brush 5	79	13
Brush 6	101	14

Table 2: Abundance and richness of infauna from larvalle brushes. Brushes 1-3 are from 60 feet and 4-6 from 35 feet.

Sources Cited

Colin, Patrick L. Marine Invertebrates and Plants of the Living Reef. TFH Publications, Inc., 1978.

Hoetjes, 1976 - a mistake in citing. See Hoetjes et al., 1976

Hoetjes, P.; Westinga, E.; and de Kruif, 1976.  
 "The intrasponge fauna of the loggerhead or manjack sponge (Porifera: Spongiospongiae vesparia). Mimeographed manuscript, Caribbean Marine Biological Institute, Curacao, N.A.

Merrens, E.J., 1987. The Effect of Sponge Morphology on Infaunal Community Structure in *Niphates digitatus*. Dartmouth FSP Final Project, 1987.

Pearse, A.S., 1932. Inhabitants of Certain Sponges at Dry Tortugas. Papers from the Tortugas Lab, Duke University.

Reicher D, and D. Bachman. Natural and Artificial  
Sponge Infouva Communities: An Island  
Biogeographical Analysis. Dartmouth FSP  
Final Project, 1979.

Reiswig, H.M., 1973. Population Dynamics of Three  
Jamaican Demospongiae. Bulletin of Marine  
Science, 23: 192-226.

Tyler, J.C. and J.E. Böhlke, 1972. Records of  
Sponge-dwelling Fishes, Primarily of the  
Caribbean. Bull. Mar. Sci. 22: 601-641.

Velzeacker, J.W., 1977. Cryptofaunal Species/Area  
Relationship in the Coral Reef Sponge,  
Geliooides digitalis. III International Coral  
Reef Symposium, Miami: 69-73.

1981

Westinga, E. and P.C. Hoetjes.<sup>1</sup> The Intrasponge  
fauna of *Sphaerospongia vesparia* (Porifera:  
Demospongiae) at Curacao and Bonaire.  
Marine Biology 62: 139-151

# Appendix A

## Appendix A, cont.

28

	brush 1	brush 2	brush 3	brush 4	brush 5	brush 6
Geographic	-	-	-	-	-	-
A	2	3	2	2	2	2
B	1	1	1	1	1	1
C	7	3	1	1	1	1
Bivalve	1	1	1	1	1	1
Brittlestar	1	1	1	1	1	1
Sea Urchin	1	1	1	1	1	1
Fish Larva	1	1	1	1	1	1
L.A.V.*	1	1	1	1	1	1
R.P.D.*	1	1	1	1	1	1
R.E.*	1	1	1	1	1	1
Sponge 1	1	1	1	1	1	1
Sponge 2	1	1	1	1	1	1
Sponge 3	1	1	1	1	1	1
Sponge 4	1	1	1	1	1	1
Sponge 5	1	1	1	1	1	1
Sponge 6	1	1	1	1	1	1
Sponge 7	1	1	1	1	1	1
Sponge 8	1	1	1	1	1	1
Sponge 9	1	1	1	1	1	1
Shells	1	1	1	1	1	1
Brush 1	-	0	-	-	-	-
Brush 2	-	0	-	-	-	-
Brush 3	-	0	-	-	-	-
Brush 4	-	0	-	-	-	-
Brush 5	-	0	-	-	-	-
Brush 6	-	0	-	-	-	-

L.A.V. = "Little Armed Vehicle"

R.P.D. = "Red Polka Dot"

R.E. = "Red Eye"