COMPARISON OF INFAUNAL COMMUNITIES IN CRYPTIC AND EXPOSED SPONGES AT DIFFERENT DEPTHS

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Abstract: Sponges are sources of refuge and food for microfauna in coral reefs. Characteristics of infaunal communities in exposed sponges are well studied, but infaunal communities in cryptic sponges have not been examined. We compared infaunal communities in cryptic and exposed natural sponges at three depths. In addition, we ran a controlled experiment to evaluate the effects sponge orientation (oriented towards water column = exposed and oriented into substrate = cryptic) on infaunal communities. Abundance of infaunal organisms did not vary with depth or between cryptic and exposed natural sponges. Richness was greater in cryptic sponges, perhaps due to fewer chemical defenses. We found no effect of orientation of synthetic sponges on infaunal community composition. Both abundance and richness were highest at shallow depths, but did not differ between cryptic and exposed sponges. This same pattern may have been obscured in natural sponges by variation among species and growth forms. Cryptic sponges harbor diverse infaunal communities that are similar to communities in exposed sponges.

Key words: abundance, community composition, Discovery Bay, richness, synthetic sponges

INTRODUCTION

Sponges function as important sources of refuge and food for microfauna in coral reef ecosystems (Westinga and Hoetjes 1981). Sponges have two growth orientations: on the bottom of buried coral rubble (cryptic sponges) and emerging into the water column (exposed sponges). Past studies have examined the infaunal communities of single species of exposed sponges (Ferrie et al. 2003, Campbell and Lovette 1990), but no study has examined infaunal communities in cryptic sponges.

Exposed sponges may be more accessible to organisms both in the water column and on the substrate than cryptic sponges that grow under rubble in the substrate. Cryptic sponges may also pump less water or be exposed to less water flow than exposed sponges. Because some infaunal organisms feed on matter pumped through sponges, these sponges may be a poorer quality habitat. Finally, there may be less need for microfauna in cryptic environments to take refuge in sponges because they are already somewhat hidden from predation. Therefore, there may be increased infaunal abundance and richness in exposed sponges than in cryptic sponges. We also predict that the composition of infaunal communities in these two sponge types may differ because of the different quality of habitat and food source they may offer.

The effect of depth on infaunal communities in exposed sponges is disputed. Ferrie et al. (2003) found no differences in infaunal abundance in *Aplysina fistularis* with depth, but Campbell and Lovette (1990) found decreased abundance of organisms in *Ircina strobilina* in deeper (20 m) water. We collected both exposed and cryptic sponges at three depths to compare their infaunal communities and determine whether there were effects of depth, and if these effects were similar in cryptic and exposed sponges.

Using synthetic sponges to control for variation among natural sponges in growth form, osculum size, atrial volume, and chemical defenses, we tested for effects of sponge orientation (exposed or cryptic) and depth. Experimental sponges differed only in their orienta-

tion (face up in the water column to simulate exposed sponges vs. face down in the sand to simulate cryptic sponges) and in depth. If orientation is the factor driving community differences, then we would expect to see similar patterns in synthetic and natural sponge communities. We also expected to see similar patterns of depth effects in synthetic and natural sponges.

METHODS

We examined the infaunal invertebrate communities in natural sponges collected from Discovery Bay, Jamaica. We collected cryptic and exposed sponges at depths of 1 m in the west back-reef, and 11 m in the fore-reef at M1 and Dairy Bull. We measured the volume of each sponge by water displacement in a graduated cylinder. To extract the infaunal organisms, we cut up the sponges and rinsed them twice in seawater and once in freshwater, filtering the rinse water each time through a 153 μm mesh. We preserved the samples in 10 parts seawater, 1 part formalin. We examined the infauna with dissecting microscopes, recording size and taxonomic category of each organism.

For the experimental portion of our study, we cut synthetic sponges to 50 ml volumes. We tied the sponges to the top and bottom of a ceramic tile using fishing line, and weighted the bottom side of the tile with two bolts (Fig. 1). Top sponges will hereafter be referred to as exposed, and bottom sponges as cryptic. We placed four tiles in the sand at the sand-reef interface at depths of 1 m in the west back-reef and 11 m and 20 m in the fore-reef at M1. We collected the tiles after three days, and examined the infaunal organisms of the synthetic sponges using the same methods as for the natural sponges.

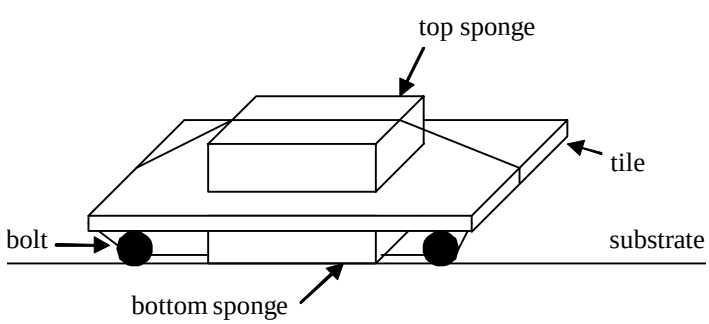

Figure 1. Experimental tiles simulating exposed (top) and cryptic (bottom) sponges with synthetic cellulose sponges. Tiles were placed on sandy substrate.

Two tiles at 1 m and one tile at 20 m were overturned when we collected them. Because the sponges originally on the bottom of these tiles all showed extensive fading while the top sponges did not, we were confident that they had been flipped over for the majority of the three days. We therefore used the final orientation of the sponges for our analyses.

For each sample, we calculated the abundance and taxon richness of infaunal organisms. We analyzed the abundance of organisms in each of five main taxonomic groups (Copepoda, Amphipoda, Isopoda, Polychaeta, and Decapoda) for natural and synthetic sponges at 11 m. We chose 11 m as a representative depth because it was intermediate and no tiles at this depth had been overturned.

RESULTS

There were rich and abundant infaunal communities in natural cryptic sponges. Abundance of infaunal organisms ranged from 0.8 to 7.5 organisms per ml sponge and taxon richness ranged from 0.4 to 2.5 taxa per ml sponge.

Abundance of infaunal organisms in natural sponges did not vary with sponge type (cryptic or exposed) or across depth (Table 1, Figure 2). Taxon richness tended to be higher in cryptic sponges than in exposed sponges, although there were no differences across depth (Table 1, Figure 3).

Abundance of infaunal organisms in synthetic sponges was higher in sponges at 1 m than in sponges at either 11 m or 20 m, but was

not different between cryptic and exposed sponges (Table 2, Figure 4). Taxon richness was higher in synthetic sponges at 1 m than in synthetic sponges at either 11 m or 20 m (Figure 5), but did not differ between cryptic and exposed sponges (Table 2).

The abundance of organisms in each of the five dominant taxonomic groups did not differ between cryptic and exposed natural sponges, or between top and bottom synthetic sponges (Table 3).

DISCUSSION

Living cryptic sponges harbor infaunal communities that are similar to those in living exposed sponges, despite the seemingly less accessible locations of the former. Although abundance of infauna did not differ between cryptic and exposed sponges, there was a trend towards greater taxon richness in the cryptic sponges. Cryptic sponges tend to be more palatable than exposed sponges (Wulff 1997), pos-

Table 1. 2-way ANOVA results comparing abundance of infauna and taxon richness per ml of cryptic and exposed natural sponges at three depths.

	Abundance			Taxon richness		
Treatment	F	df	P	F	df	P
Depth	2.24	1	0.16	0.91	1	0.36
Sponge type	0.37	1	0.55	3.74	1	0.07
Depth x sponge type	1.02	1	0.33	0.04	1	0.84

Table 2. 2-way ANOVA results comparing abundance of infauna and taxon richness per 50 ml of cryptic and exposed synthetic sponges at three depths.

	Abundance			Taxon richness		
Treatment	F	df	P	F	df	P
Depth	18.74	1	**0.0003**	10.75	1	**0.004**
Sponge type	0.19	1	0.66	1.37	1	0.26
Depth x sponge type	0.07	1	0.80	0.75	1	0.40

Table 3. T-test results comparing abundance of infauna by taxa in exposed and cryptic sponges at 20 m. There were no decapods in any natural sponges.

	Natural sponges			Synthetic sponges		
Taxon	t	df	P	t	df	P
Copepoda	0.04	5	0.97	1.07	6	0.32
Amphipoda	-0.36	5	0.73	-1.35	6	0.23
Isopoda	1.15	5	0.30	-0.40	6	0.70
Polychaeta	-0.32	5	0.77	-1.10	6	0.32
Decapoda	NA	NA	NA	-0.66	6	0.54

sibly due to lower chemical defenses. If chemical defenses also have a detrimental effect on infaunal organisms, cryptic sponges may then be a more suitable habitat for infaunal organisms. Our study showed that there was no difference between cryptic and exposed sponges in the abundance of fauna in each of the five classes. This suggests that the increased rich-

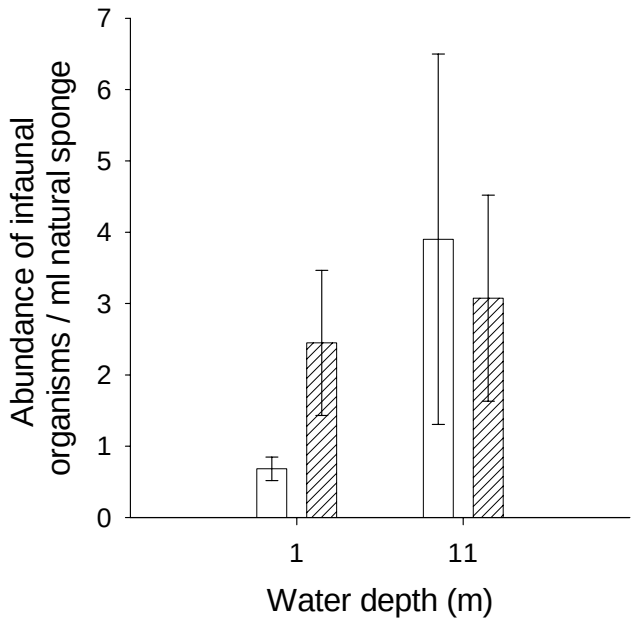

Figure 2. Mean abundance of infauna per ml of natural sponge tissue from two depths at Discovery Bay, Jamaica. Open bars = exposed sponges, hatched bars = cryptic sponges. Sample size above each bar. Error bars show 1 SE.

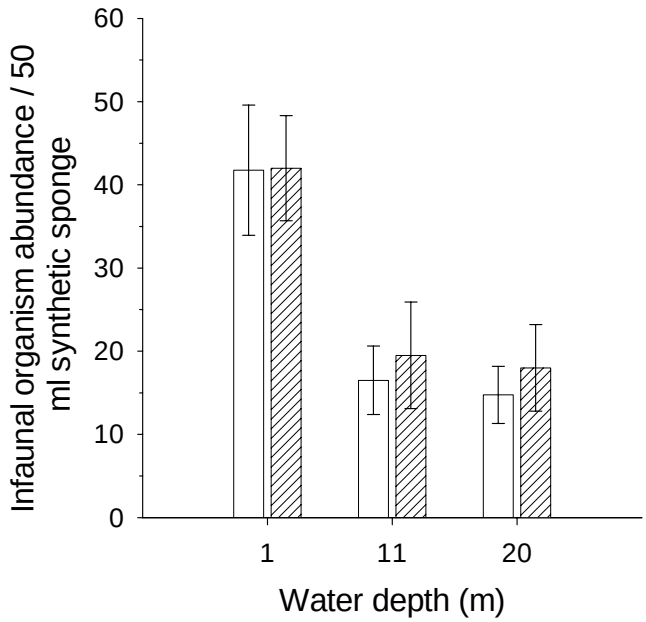

Figure 4. Mean abundance of infauna per 50 ml of synthetic sponge from two depths at Discovery Bay, Jamaica. Open bars = top sponges, hatched bars = bottom sponges. N = 4 for each bar. Error bars show 1 SE.

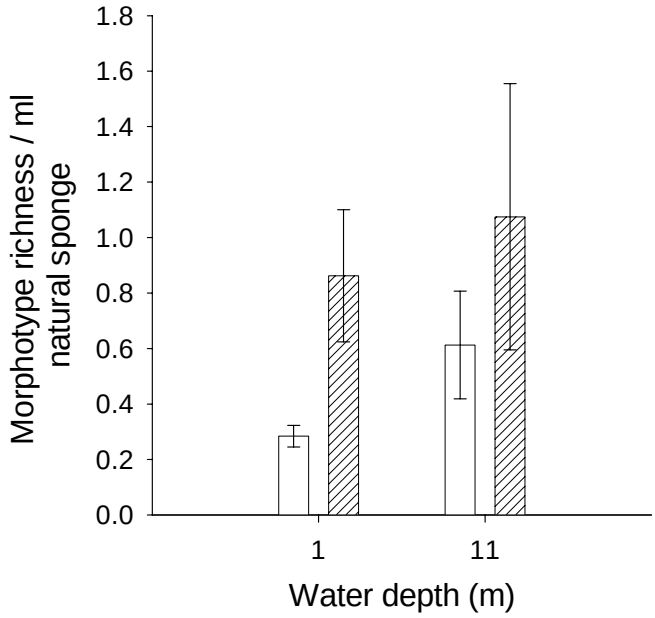

Figure 3. Mean taxa richness per ml of natural sponge from two depths at Discovery Bay, Jamaica. Open bars = exposed sponges, hatched bars = cryptic sponges. Sample size above each bar. Error bars show 1 SE.

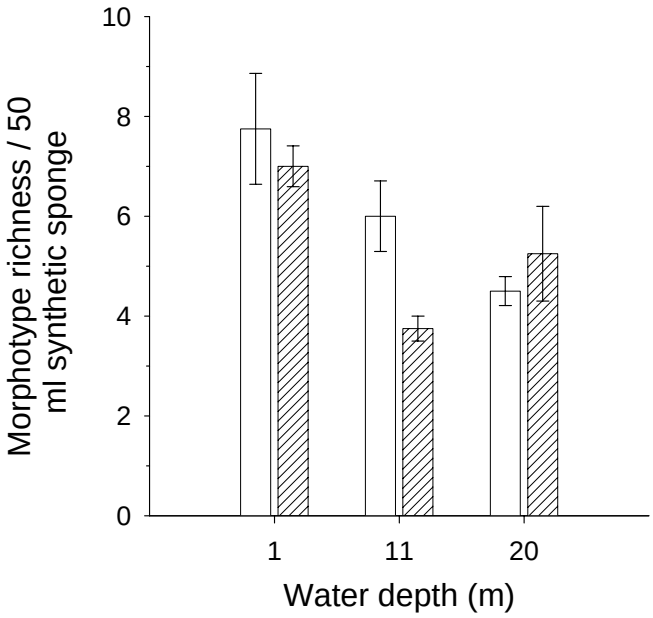

Figure 5. Mean taxon richness per 50 ml of synthetic sponge from three depths at Discovery Bay, Jamaica. Open bars = top sponges, hatched bars = bottom sponges. N = 4 for each bar. Error bars show 1 SE.

ness in cryptic sponges is a result of differences at a finer taxonomic scale of classification.

Unlike natural sponges, synthetic sponges showed no difference in taxon richness based on sponge orientation. It is possible that orientation does not influence community richness, or that our experimental design did not effectively simulate differences between cryptic and exposed sponges. Additionally, the difference in richness patterns between natural and synthetic sponges may have been caused by functional differences. Natural sponges provide both habitat and feeding opportunities to their associated infaunal communities, whereas synthetic cellulose sponges provide only habitat. Some organisms that feed in natural sponges may have been absent from the synthetic sponges, thereby reducing differences between communities occupying top and bottom synthetic sponges.

We found significantly higher abundance and taxon richness in synthetic sponges at the 1 m depth, but this pattern was not observed in natural sponges. Variations among natural sponges may have obscured the depth related patterns we observed in our synthetic sponges. Campbell and Lovette (1990) found that abundance and richness of the infaunal communities in the tube sponge, *Ircina strobilina*, were highest at shallower depths; however, Ferrie et al. (2003) found that the infaunal communities of the tube sponge *Aplysina fistularis* showed no patterns with depth. Thus, species-specific trends with depth in infaunal sponge communities may have obscured overall trends present in natural cryptic and exposed sponges.

Our study shows that cryptic sponges harbor infaunal communities that are similar to those in exposed sponges. However, many characteristics potentially affecting infaunal communities in both cryptic and exposed sponges vary both within and among sponge species. Further studies could examine the effects of toxicity, growth form, osculum size, flow rate, and other factors on infaunal communities.

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