THE EFFECT OF ALGAL SPECIES AND SUBSTRATE TYPE ON INFAUNAL ASSEMBLAGES IN *PENICILLUS CAPITATUS* AND *PENICILLUS DUMENTOSUS*

EMILY L. SHARP AND CAYELAN C. CAREY

Abstract: Macroalgae provide important refuges for infauna from visual predators. We compared the infaunal communities in two algal species (*Penicillus capitatus* and *Penicillus dumentosus*) on two different substrates (*Thalassia testudinum* and sand). We hypothesized that large infauna would be more abundant in *P. dumentosus* because it has larger inter-filament spaces that would provide better refuge than the smaller inter-filament spaces in *P. capitatus*. We also hypothesized that sandy substrates would have higher total infaunal abundance because there is a greater need for refuge in this habitat. We collected samples of each algal species from the back reef at Discovery Bay, Jamaica and measured infaunal abundance and size of each organism. As predicted, we found more large infauna in *P. dumentosus* and more small infauna in *P. capitatus*. Total and large infaunal abundance did not differ between substrates, though more small infauna were found in the sandy patches. This may be due to the ability of small infauna to utilize grass as a refuge, reducing the need for a macroalgal refuge in this habitat.

Key Words: macroalgae, marine infauna, refuge, Thalassia testudinum

INTRODUCTION

Macroalgae provide important refuges for infauna (Glastris et al. 2001, Guidi 2003, Richardson and Nelson 1989, Shandro and Sohn 1997, Stoner 1985, Stoner 1986). The physical structure of the algae may be important in determining the abundance and composition of the infaunal assemblage (Glastris et al. 2001). The surrounding habitat of the macroalgae may also influence the infaunal assemblage by providing other possible refuges, thus reducing the need for a macroalgal refuge.

Penicillus capitatus, a common marine macroalga found in shallow reef waters, is an important infaunal refuge (Shandro and Sohn 1997, Stoner 1985, Stoner 1986). More infauna is found in the *P. capitatus* capitulum than in the surrounding habitat (Stoner 1985). *Penicillus dumentosus*, a similarly-structured macroalga, coexists with *P. capitatus* across multiple substrates. The two algae differ in filament size and abundance; *P. dumentosus* has fewer and wider filaments (400-800 μm) that are more spaced than *P. capitatus* (100-200 μm) (Dawes 1976). We hypothesized that infaunal communities would be different between *P. capitatus* and *P. dumentosus* due to the difference in capitula structure and inter-filament spaces in their capitula. We predicted that larger-sized infauna would be more abundant in *P. dumentosus* than *P. capitatus* because of the greater inter-filament space between filaments in *P. dumentosus*.

In *Thalassia testudinum* patches, grasses may provide a refuge from predation for infauna, reducing the need for a macroalgal refuge. In addition, predation pressure may be higher in sandy areas due

to a lack of refuge (Walters 1991). Therefore, we hypothesized that infauna face greater predation pressures within sandy patches than grassy patches, and would thus have a greater need for a macroalgal refuge. We predicted that there would be greater total infaunal abundance within the sandy patches than grassy patches.

METHODS

On 23 February 2005, we collected 16 algal samples (eight *P. capitatus* and eight *P. dumentosus*) from the back reef at Discovery Bay Marine Laboratory, Jamaica. Four samples of each alga were collected from sandy substrate patches and four samples of each alga were collected from *Thalassia testudinum* patches. All samples were collected from 1 m depth, and were located in the center of a patch of at least 4 m^2 to minimize infaunal variation from being near other patches and substrate types. We placed plastic bags around each alga underwater before removal to prevent any infauna contamination from the sediment, and loss of infauna from the alga. We attempted to choose algae that had capitula of similar sizes.

For each algal sample, we measured displaced volume and mass. Each algal sample was rinsed twice in both salt and fresh water to completely defaunate the alga. The rinsed water was filtered through a 153 μm mesh to remove all infauna. We preserved our infaunal samples in 10% formalin. Using dissecting microscopes, we counted and identified to order all infauna. We grouped the six most abundant taxa into large (> 1 mm) and small (< 1 mm) size classes.

We log-transformed our infaunal abundances to meet assumptions required for parametric tests. We used two-way ANOVAs to determine the effects of substrate, algal species, and their interaction on the large and small size classes of the six most abundant infaunal taxa (JMP 5.0.1). We used t-tests to compare the differences in capitulum mass and volume displacement between *P. capitatus* and *P. dumentosus*.

RESULTS

There was no difference in capitula mass or displacement volume between *P. capitatus* and *P. dumentosus* (t-tests, $F < 1.52$, $df = 1, 14$, $P > 0.24$). We counted and identified 1660 infauna in 13 orders. The two-way model with effects of substrate type, algal species, and the substrate/species interaction on total infaunal abundance was not significant (2-way ANOVA, $F = 1.08$, $df = 3, 12$, $P = 0.40$).

Within the six most common taxa (Amphipoda, Copepoda, Decapoda, Isopoda, Ostracoda, and Polychaeta) and large and small size classes (see Table 1), there was no significant interaction of substrate type and algal species on the abundance of small infauna per capitula (2-way ANOVA, $F = 0.001$, $df = 1, 14$, $P = 0.98$; Fig. 1a). There were more small infauna in *P. capitatus* than *P. dumentosus* (2-way ANOVA, $F = 7.51$, $df = 1, 14$, $P = 0.01$) and more small infauna in capitula above sandy substrates than in capitula above

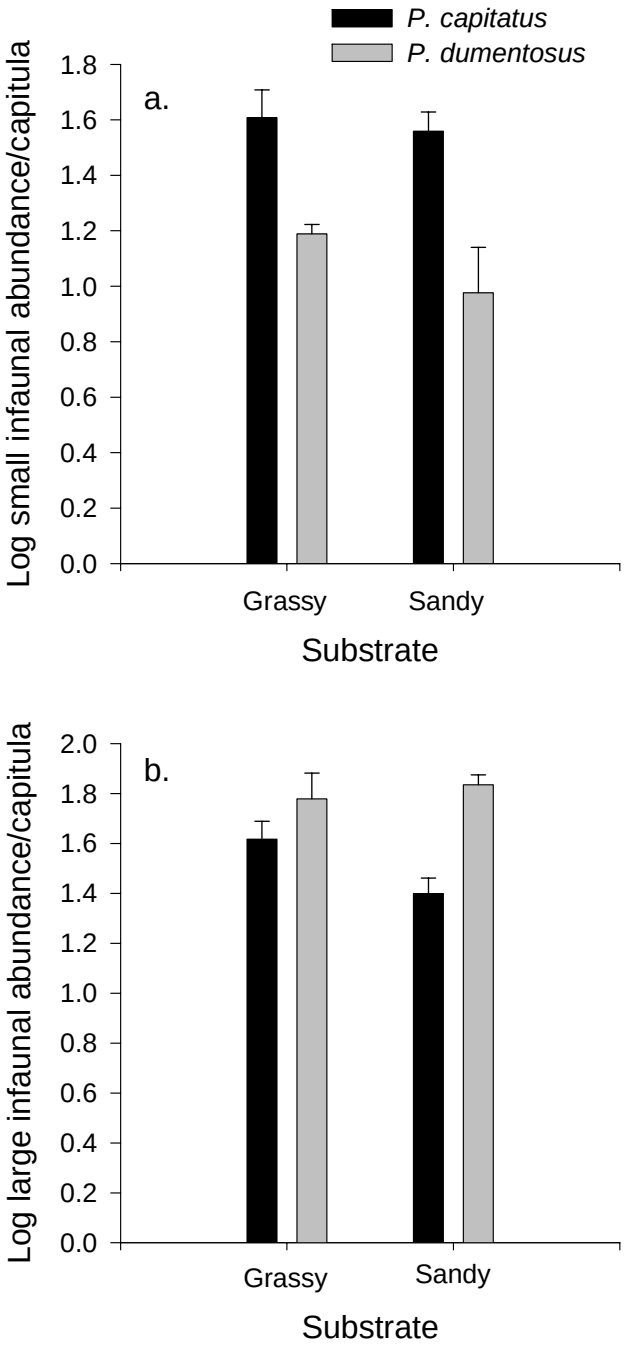

Figure 1. Effect of substrate type and algal species on infaunal abundance per capitula. A. Small infaunal abundance per capitula was higher in *P. capitatus* than *P. dumentosus* and in algae above sandy substrate than algae above grassy substrate. B. Large infaunal abundance per capitula was higher in *P. dumentosus* than *P. capitatus*, with no effect of substrate type.

grassy substrates (2-way ANOVA, F = 4.10, df = 1, 14, P = 0.06).

There was a significant interaction of substrate type and algal species on the abundance of large infauna per capitula (2-way ANOVA, F = 5.52, df = 1, 14, P = 0.04; Fig. 1b). There were more large infauna per capitula in *P. dumentosus* than *P. capitatus* (2-way ANOVA, F = 5.75, df = 1, 14, P = 0.03), but there was no significant effect of substrate type on large infaunal abundance per capitula.

DISCUSSION

We found the same abundance of total infauna in the four possible algal/substrate groups (grassy *P. capitatus*, sandy *P. capitatus*, grassy *P. dumentosus*, and sandy *P. dumentosus*), indicating that *P. capitatus* and *P. dumentosus* are utilized equally as refuges in both sandy and grassy substrates. There was no difference between *P. capitatus* and *P. dumentosus* in mass and displacement volume of the capitulum, so differences in faunal abundance are likely not a function of differences in capitulum size between the two species.

As predicted, *P. dumentosus* had more large infauna than *P. capitatus*, which may be due to its larger inter-filament spaces. The large organisms might only be able to fit inbetween the filaments of *P. dumentosus*, possibly competitively excluding small organisms from utilizing that alga as a refuge. The low abundance of large infauna in *P. capitatus* would then allow small organisms to dominate the infaunal

Table 1. Infauna taxa abundance per size class in *P. capitatus* and *P. dumentosus*. Small organisms are less than 1 mm in length, and large organisms are greater than 1 mm in length

Taxa	Size Class	Abundance in *P. capitatus*	Abundance in *P. dumentosus*
Amphipod			
	Small	147	28
	Large	110	356
Copepoda			
	Small	64	31
	Large	3	49
Decapoda			
	Small	0	0
	Large	146	98
Isopoda			
	Small	27	28
	Large	15	37
Ostracoda			
	Small	137	27
	Large	5	16
Polychaeta			
	Small	14	4
	Large	24	45
Total infauna			
	Small	389	118
	Large	303	609

assemblage in *P. capitatus*.

Contrary to our predictions, total infaunal abundance did not differ between those macroalgae in grassy substrates and those in sandy substrates. There were more small organisms in the macroalgae in sandy patches than in the grassy patches, but no change in abundance of large organisms between the two substrate types. If the small organisms could successfully use grasses as a refuge, then they would have less need to use macroalgae as a refuge in grassy habitat. This would explain their decreased abundance in the macroalgae surrounded by grass. Conversely, if large organisms faced similar predation pressures in both grassy and sandy areas but could not successfully utilize grass to evade predators, then we would expect them to utilize macroalgae equally in both substrates.

LITERATURE CITED

Dawes, C. J. 1976. Marine algae to the west coast of Florida. University of Miami Press: Coral Gables, FL.

Glastris, C. L., M. L. Grace, and P. S. Leslie. 2001.

Invertebrate colonization composition differences between three macroalgae species on a Jamaica reef. Dartmouth Studies in Tropical Ecology, p. 121-123.

Guidi, B. W. 2003. Differential recolonization of dislodged microalgal tufts by marine invertebrates. Dartmouth Studies in Tropical Ecology, p. 166-168.

Heath, S. R., P. S. Leslie, J. E. Musnicki, and A. J. Sepulveda. 2001. Invertebrate colonization of artificial substrate in a coral reef ecosystem. Dartmouth Studies in Tropical Ecology, p. 142-147.

Iwamoto, K. A., and N. L. Salant. 2003. The effect of depth on invertebrate colonization patterns on a Caribbean reef. Dartmouth Studies in Tropical Ecology, p. 163-165.

Littler, D. S., M. M. Littler, K. E. Bucher, and J. N. Norris. 1989. Marine plants of the Caribbean: a field guide from Florida to Brazil. Smithsonian Institution Press: Washington, D. C.

Richardson, T., and D. Nelson. 1989. *Penicillus capitatus*: an island in the sands. Unpublished manuscript.

Shandro, J. R., and E. B. Sohn. 1997. The enchanted broccoli forest under the sea: macrofauna community composition and recruitment on *Penicillus capitatus*. Dartmouth Studies in Tropical Ecology, p. 149-153.

Stoner, A. W. 1985. *Penicillus capitatus*: an algal island for macrocrustaceans. Marine Ecology Progress Series, 26: 279 - 287.

Stoner, A. W. 1986. Cohabitation on algal habitat islands by two hermaphroditic Tanaidacea (Crustacea : Peracarida). Journal of Crustacean Biology, 6: 719-728.

Walters, K. 1991. Influences of abundance, behavior, species composition, and ontogenetic stage on active emergence of meiobenthic copepods in subtropical habitats. Marine Biology, 108: 207-215.