Differential recolonization of dislodged macroalgal tufts by marine invertebrates

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Abstract: A wide variety of marine invertebrates inhabit cryptic, sheltered habitats to avoid predation. Among the habitats used are algal tufts, which can provide a refuge for both large and small invertebrates. I analyzed the composition of natural algal tufts, and also experimental tufts that had been defaunated and recolonized. I predicted that small copepods would colonize these new habitats faster, while larger organisms would move in more slowly. The recolonized tufts showed a higher proportion of copepods, and a lower proportion of amphipods and isopods, in support of my prediction. This might be due to greater refuge loyalty in these larger invertebrates, or could be a result of more frequent migrations into the water column by copepods.

Key Words: amphipods, Bryothamnion triquetrum, *copepods, isopods*

INTRODUCTION

Marine invertebrates inhabit a variety of benthic microhabitats. These organisms have the ability to swim and choose their microhabitat, though they do not necessarily swim strongly enough to cover great distances. The habitats are a refuge from visual predators, and include corals, sponges, algae, and the sediment. Algae that form dense bunches or "tufts" with three dimensional complexity should provide a particularly good habitat for these organisms to hide in. Though water currents cause movement in algal tufts, the algae reduces water movement inside the tuft, providing a fairly good place for weak swimmers to reside.

Due to the daily activity of many invertebrates, colonization of algal tufts could be very rapid, and the community inhabiting a recently defaunated tuft might regain its former community composition in just a few days. I hypothesized that as the invertebrate community rebuilt in defaunated algal tufts, different taxa of invertebrates would colonize at different rates. Specifically, I predicted that smaller, and perhaps more planktonic, organisms would colonize defaunated tufts most rapidly, while larger, stronger swimming organisms, some of which have been shown to have some loyalty to specific refugia (Twining et al. 2000), would colonize at a slower rate. Additionally, I hypothesized that algal tufts that were fixed in place would be colonized at different rates by the various taxa than those with freedom of movement. I predicted that algal tufts fixed in place would be colonized by smaller taxa, which might be affected more by water currents in the moving tufts. Larger invertebrates that did colonize the experimental tufts would be better able to stay with a moving substrate, and thus be proportionally more common in tethered tufts.

METHODS

I collected 18 tufts of the red algae *Bryothamnion triquetrum* from the back reef of Discovery Bay, Jamaica on 6 March 2003. This alga was chosen because its dense tufts held together well for my manipulations. I collected and sealed six samples in plastic bags to capture their inhabitants to quantify the natural community. After draining the water from the samples, I rinsed them in fresh water two times. The seawater and subsequent fresh water rinses of six of the samples was filtered through a 0.25 mm mesh, and I preserved all invertebrates from these samples in 10% formalin. I measured the size of these tufts by the volume they displaced when wet. Twelve additional tufts were collected for experimental treatments. I defaunated them with fresh water, but the removed organisms were not preserved. I attached each of six of these latter tufts to a weight by a 1 m length of string ("tethered") to simulate an algal tuft detached by wave action. The other six tufts were each tied directly to a weight ("fixed") to simulate an algal tuft that remained in place after a storm, but was defaunated by the process. I then placed the samples in a back reef algal bed at a depth of 2.5 m.

To quantify the recolonizing community of these experimental treatments, I collected three tethered and three fixed tufts each on day two and day four by sealing them in a plastic bag. After draining the water from the samples, I rinsed them in fresh water two times. The seawater and subsequent fresh water rinses of six of the samples was filtered with 0.25 mm mesh, and I preserved all invertebrates from these samples in 10% formalin. The algae were then dried and weighed. I identified organisms in the samples to class or order and counted them. Taxa quantified included amphipods, isopods, copepods, decapods, and polychaetes; other organisms, which were rare in all samples, were not counted.

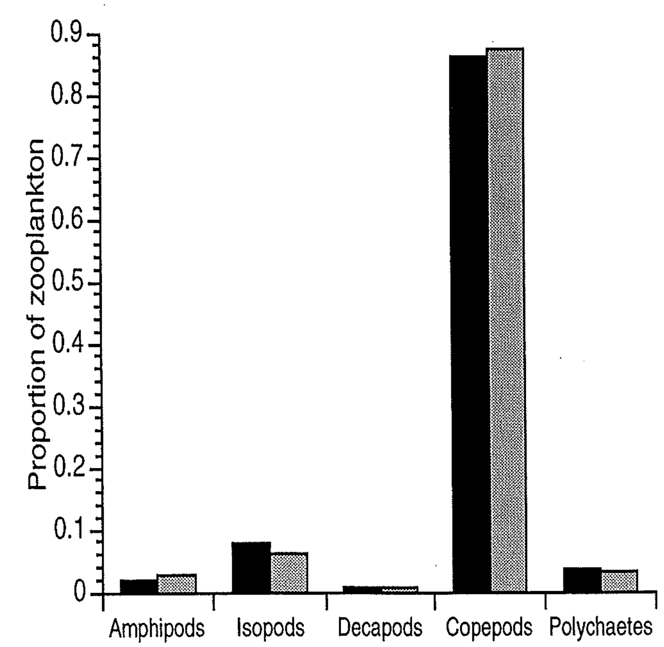

Figure 1. Relative frequency of invertebrates collected from algal tufts on a 1 m tether (dark bars) and those fixed to their weight (light bars) after four days of recolonization in Discovery Bay, Jamaica

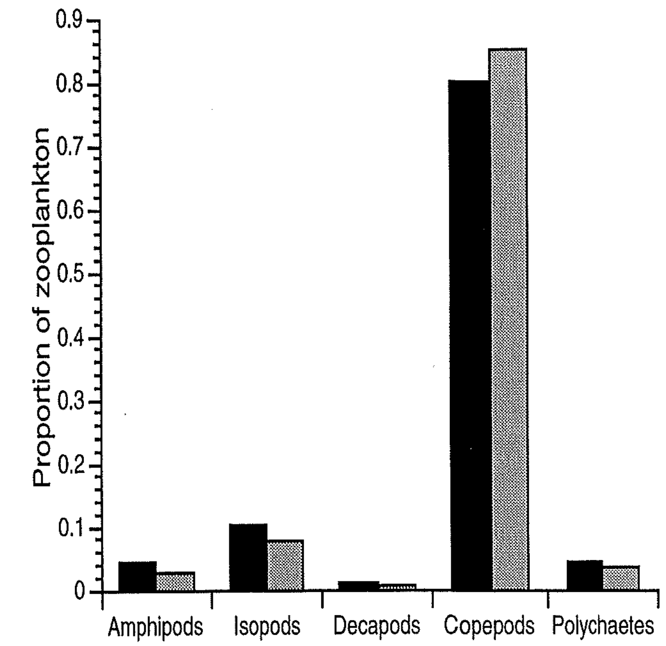

Figure 2. Relative frequency of invertebrates colonizing algal tufts after two days (dark bars) and four days (light bars) of recolonization in Discovery Bay, Jamaica. Data were pooled from tethered and fixed treatments

Data from all replicates were pooled for contingency tests, and are presented here as proportions of the treatment totals.

RESULTS

In total, 4,906 invertebrates were counted from the natural samples, and 8,296 from experimental treatments. The majority of all samples were copepods, but amphipods, isopods, and polychaete worms were also numerous. The faunal composition was not different between the tethered and fixed treatments from the fourth day (Fig. 1; $G = 5.23$, $df = 4$, $P < 0.01$), and only isopod frequency was appreciably affected by the treatments. The taxa counted (pooled from both treatments) on the second and fourth day were unevenly distributed, but there was no effect of time on these distributions (Fig. 2; $G = 20.51$, $df = 4$, $P < 0.01$). The difference between the natural and day four recolonized samples was highly significant (Fig. 3; $G = 451.6$, $df = 4$, $P < 0.01$), both because there was unequal distribution of taxa within natural and recolonized samples, and because the distributions were not the same between these two treatments.

Discussion

The defaunated algal tufts were rapidly recolonized over the four-day experiment by a different infaunal community than was present in natural samples. The magnitude of recolonization over the experimental period could not be assessed because tuft size measurements were not standardized, but the colonization process was probably not complete. Small copepods composed a higher proportion of the recolonized samples than the natural tufts, suggesting that they are among the first taxa to colonize algal tufts on the benthos. This may be due to the planktonic nature of many copepods, which often disperse into the water column, and settle later in a new location. Amphipods and isopods are generally larger organisms which do not always range so far, and some species may prefer to return to the same refuge. Alternatively, the predation risk on amphipods and isopods hiding in isolated clumps might be higher due to the greater exposed surface area. Smaller copepods could probably better take advantage of the three-dimensionality of even small tufts, and might be less affected by predation in these cases.

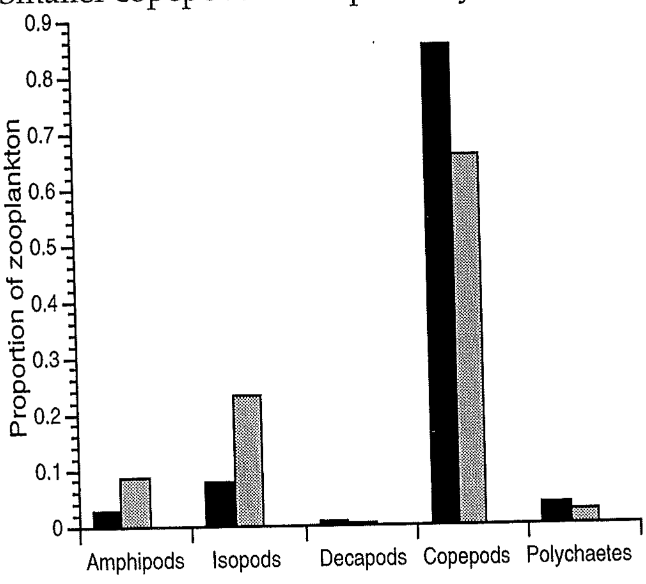

Figure 3. Relative frequency of invertebrates from day four recolonized (dark bars) and natural (light bars) algal tufts in Discovery Bay, Jamaica

The effect of the tethered and fixed treatments on species composition was minimal, as only isopods were very different between the two. Although the tethered tufts were initially quite mobile, currents and movement tangled the cords that held many of them to their weights, possible reducing the difference in the microhabitat created by the treatments.

The total defaunation of the samples with fresh water was analogous to certain kinds of natural events. For example, a big storm might bring an influx of fresh water to the back reef, dislodge some tufts of algae from the turf, and disturb them enough to cause some defaunation. Depending on the magnitude of the storm, many algal tufts could wind up defaunated and mobile, or just defaunated like the experimental treatments. In the case of a large storm event, the algal habitats available for invertebrates would shift from primarily natural, stable algal turf to loose, defaunated clumps. If such habitats are in fact less suitable or preferred habitats for amphipod and isopod invertebrates, the invertebrate community at large might shift temporarily to one of greater dominance by small, mobile invertebrates best able to use the new habitat types. In this case, that might lead to a reduction in the abundance of amphipod and isopod crustaceans. There might even be an effect on the community of fish which rely on invertebrates as a food source, as their prey community would no longer be comprised of as many large individuals.

Literature Cited

Twining, B. S., J. J. Gilbert, and N. S. Fisher. 2000. Evidence of homing behavior in the coral reef mysid *Mysidium gracile.* Limnology & Oceanography 45(8). Pp. 1845-1849.