EFFECTS OF PREY AND PREDATORS ON THE DISTRIBUTION AND ABUNDANCE OF *HERMODICE CARUNCULATA*

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Abstract: Here we examine the effects of prey availability and predation on the distribution and abundance of the bearded fireworm (*Hermodice carunculata*). We hypothesized that fireworm distribution would be related to the abundance of sea anemone prey, and that they would employ chemotaxis to detect prey at a distance. We also hypothesized that fireworms would be subject to increased predation pressure at night, so they would be more abundant under shelter at night than during the day. We also expected the fireworms to be clumped under larger rocks in order to hide from predators. We found no relationship between fireworm and anemone abundance, and we did not observe the fireworms to have any chemotactic ability. Neither predation on tethered fireworms, nor abundance beneath rock rubble was different between day and night samples. The abundance of fireworms was distributed randomly across rock sizes. These results suggest that prey abundance is not an important factor in generating patterns of *H. carunculata* distribution and abundance, although predation may be.

Key Words: Bunodeopsis antilliensis, *chemotaxis, fireworms*

INTRODUCTION

The amphinomid polychaete *Hermodice carunculata* (bearded fireworm) is found throughout the Caribbean in mud flats, turtle grass beds, and coral reefs (Kaplan 1982). It is an important determinant of coral-reef community composition because of its voracious appetite and expansive diet. Fireworms are omnivores that are known to consume zoanthids, sea anemones, ten species of scleractinian corals, hydrocorals, sponges, and gorgonians, as well as moribund creatures (Witman 1988, Vreeland 1989). They have been shown to limit the growth and distribution of species of *Millepora*, *Acropora*, *Plexaura*, and *Zoanthus* (Witman 1988, Vreeland 1989); however, few studies have looked at the effects of prey availability on fireworm distribution and abundance. We hypothesized that the abundance of fireworms in turtle grass beds is related to the abundance of a common prey item, the anemone *Bunodeopsis antilliensis* (Abram 1994). We predicted that with increasing anemone abundance there would be increasing fireworm abundance.

Fireworms are selective in which type of prey they choose to eat if multiple prey items are available (Witman 1988, Vreeland 1989). Once touching a prey item, they can identify the prey with an olfactory organ, the caruncle (Witman 1988). This organ may also aid in searching for and tracking prey across the habitat. We hypothesized that fireworms are able to use chemoreception to detect prey from a distance. We predicted that fireworms would orient toward prey items.

The distribution and abundance of fireworms could also be affected by preda-

tion. Fireworms feed throughout the day with peak activity around 1600, and then they take shelter under rubble and sediment during the night (Abram 1994, Lewis 1996). Most soft-body worms hide under rubble during the day to avoid predation; however, fireworms are commonly seen in the open during the day. They have venomous setae and bright coloration that might serve to warn diurnal predators that use vision for prey detection (Kaplan 1982). Warning coloration, however, may not be an effective predation deterrent at night, thus increasing predation risk. We hypothesized that fireworms would be more abundant under rubble during the night to avoid increased night predation. Similarly, we predicted that predation rates on tethered fireworms would be higher at night than during the day. Also, to decrease predation by satiation we predicted that fireworms would be aggregated under the rubble.

METHODS

To determine the effect of prey abundance on fireworm abundance in turtle grass beds, we compared the abundances of *B. antilliensis* and fireworms at four sites in the back reef at Discovery Bay, Jamaica, West Indies on 5-6 March 2005. We counted fireworms along 10 min swimming transects through areas dominated by *Thalassia testudinum.* Along each transect, we counted anemone abundance on *T. testudinum* blades in three randomly chosen 0.5 m^2 quadrats. Transects were placed at four sites; two deep sites in the east back reef (4-6 m) and two shallow sites in the west back reef (1-2 m), because anemone abundance increases with depth (Guerrerio 1992). There were six replicate transects at each site.

To determine if fireworms can locate prey from a distance, we placed fireworms in a tank within 25 cm of a food item and observed their behavior. The fireworms had been starved for 24 hours prior to the observational period. We observed 10 fireworms with a halved *Tripneustes ventricosus* and then 10 fireworms with two *B. antilliensis.* To ensure that the prey were palatable, each anemone and urchin was fed to the fireworms after all the observations had been completed.

To determine if fireworm distribution and abundance may be affected by predation, we tethered fireworms in the water column away from refuges. We used monofilament line to suspend worms from buoys in the water column in the back reef, approximately 0.5 m from the surface in order to minimize wave action. We assessed predation during both the night and the day, leaving a set of nine fireworms on the line for 12 hours, from 1800 - 600, and nine new fireworms from 600 - 1800 the following day. As a control to measure the fireworms' ability to get loose from the line, we tethered a set of fireworms in the wet lab where there were no predators. We counted fireworm abundance on the lines after each time period.

We compared fireworm abundances during the day and night under rubble refuges in the barren zone behind the reef crest in the west back reef on 7 March 2005. We searched under rocks and broken corals at 1500 and 2000, and recorded both the

surface area of the rubble and fireworm abundance. To determine the dispersion pattern of the fireworms under the rubble, we found the variance of the fireworm abundances among the rubble and divided this by the mean number of fireworms per rock (only rocks with fireworms were used). A variance to mean ratio = 1 indicates random dispersion, < 1 is over-dispersed, and > 1 is clumped.

All data were analyzed with one-way ANOVAs and linear regressions using JMP 5.0.1. The surface area of rocks was log-transformed; all other data met the assumptions for parametric tests.

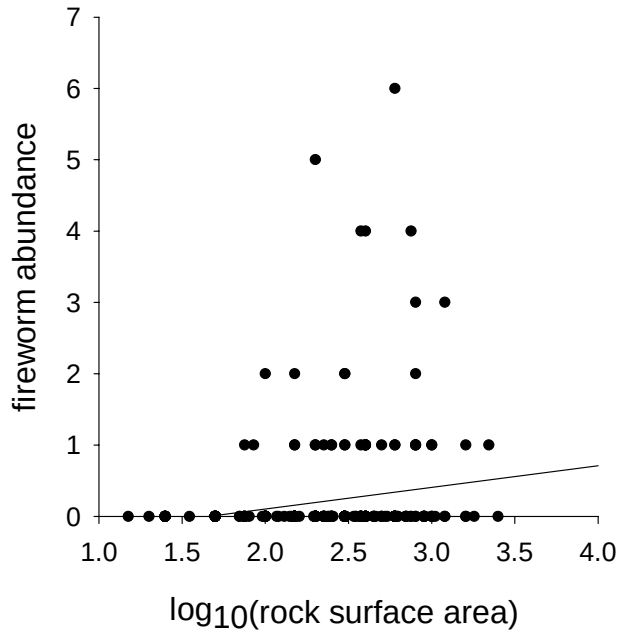

Figure 1. Rocks with more surface area have higher worm abundance.

RESULTS

In all 24 transects, we found a total of 14 fireworms (mean = 0.58 fireworms /10 minute transect) and 43 *B. antilliensis* (mean = 0.60 anemones /quadrat). There was no relationship between fireworm and anemone abundance ($r^2 = 0.08$, df = 1, 22, P = 0.19).

Our observational study of chemotaxis showed that the fireworms were unable to detect their prey before touching it. Fireworms that turned towards the food did not appear to actually sense the prey until they physically ran into it, often passing within millimeters of the prey without stopping or reacting. After the observational period, the fireworms that were offered the prey quickly ate it.

Predation on tethered fireworms was equal in the day and night; five of nine fireworms were absent in each time period ($X^2 = 0.22$, df = 1, P = 0.64). None of the fireworms in the lab were able to escape.

There was no difference in fireworm abundance under rubble during the day or night (t = 1.143, df = 311, P = 0.25). Because of this, both day and night samples were pooled for the remaining analyses. There were more fireworms under larger rubble ($r^2 = 0.03$, df = 311, P = 0.0012; Fig. 1). Worm abundance = -0.50 + 0.30 $\log_{10}$(rock surface area). Rubble without fireworms was smaller (mean area = 313.72 cm^2 ± 18.77 SE) than rubble with fireworms (mean area = 527.24 cm^2 ± 71.54 SE; F = 15.012, df = 1, 311, P = 0.0001). The index of dispersion was 0.98 showing that fireworms were randomly distributed across rocks. When we removed the rubble without fireworms present, we found no relationship between rubble size and fireworm abundance ($r^2 = 0.0057$, df = 36, P = 0.65).

DISCUSSION

Since there is no relationship be-

tween the abundances of *B. antilliensis* and *H. carunculata* in turtle grass beds, it seems that the distribution of anemones does not affect that of the fireworms. *H. carunculata* is not capable of chemotaxis and seems to find prey by stumbling upon it. It would be interesting to determine whether fireworms are even capable of foraging optimally due to their lack of ability to detect prey at any distance. The fireworm's inability to detect prey from a distance could be driving its expansive diet, because they can eat only what they stumble upon. Since fireworms have such a varied diet and have no chemotactic ability to detect prey, it seems unlikely that any one prey type should affect distribution of *H. carunculata*. Perhaps the total abundance of all prey types may influence the distribution or abundance of *H. carunculata*, and depth and substrate may as well.

Although we found slightly more fireworms under rubble in the day than during the night, the difference was not significant. We were not able to detect a difference in predation on fireworms between night and day. It appears that predation is constant through time, as is fireworm hiding behavior. Weather conditions were much rougher in the field than in the lab, so our fireworms might have escaped, and were not eaten.

Increased abundance of fireworms under larger rubble suggests that fireworms avoid smaller rubble. This may be because smaller rubble is less stable and may not provide the benefits of larger, more stable refuges. Contrary to our hypothesis, the number of fireworms was random with respect to rock size, for rubble with fireworms present. This indicates that they may not be clumping to avoid higher predation. Future studies could elucidate why the fireworms are present under the rubble, investigating whether they are foraging under the rocks, avoiding UV radiation, or seeking shelter from waves and predators.

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