

Habitat Preference of a Deep Sea Gastropod

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Introduction

At first glance, the bottom of the ocean seems barren, devoid of life. Upon closer examination, one encounters a world filled with exotic organisms, ranging from sea urchins to fish. The deep sea was once thought to contain no life past 550 m, but the Azoic hypothesis has since changed and great species diversity has since been discovered and explored (Grassle 1989, Gage & Tyler 1991, Grassle & Maciolek 1992).

The topography of much of the deep sea is soft sediment, i.e., there less refuges for shelter than the rocky intertidal. One way to combat this is to seek protection on another organism as an epibiont. While many associations have been found between organisms and bacterial symbionts, there are also many associations where megafauna such as sponges, sea urchins and corals (Ilan et al. 1994, Beaulieu 2001, Levin et al. 2001, Krieger & Wing 2002) serve as microhabitats for macro epibionts.

Our study examined the relationship between gastropods found on two species of deep sea urchins, *Stylocidaris lineata* and *Cidaris blakei*. The gastropods appeared to have a preference for spines with zooanthids. The gastropod was not previously identified and its morphology is described in a separate paper by Ezzy Cooper. The goal of our study was to determine whether the gastropod had a habitat preference based on the type of spine on which it was located.

Materials and Methods

Unknown gastropod sp. were collected from spines of *Stylocidaris lineata* and *Cidaris blakei* (Figure 1.A). The sea urchins were collected using the Johnson Sealink II deep sea submersible on dives sites centered around the Bahamas. Urchins were collected the following sites: Paradise Island (25° 08' N, 77° 18' W), SW Reef (24° 53' N, 77° 32'), Egg Island (25° 30' N, 76° 55' W) and Morgan's Bluff (75° 01' N, 77° 54' W).

Habitat

The gastropods were associated with spines covered in nonstalked zooanthids. Only one gastropod was found per urchin, with the exception of 2 urchins that had 2 gastropods each. A total of 33 gastropods were found, one being a juvenile. The percent cover of nonstalked zooanthids on spines associated with the gastropods was 90-100%, with the exception of one spine that only had 5% cover. The remainder of spines on the low percent urchin was 90-100%.

Experiments

Four experiments were conducted to determine habitat preference. Gastropods were placed in petri dishes with grids to track their movements (Figure 1.B). Each experiment was checked every .5 hours for 2 hours. A total of 20 gastropods was used for each experiment. An initial pilot study was conducted to establish the proper distance to place the gastropod by the spines. *Stylocidaris lineata* spines were primarily used based on quantity of urchins.

Experiment 1-one gastropod was placed in the middle of the dish with 2 spines on either side, equidistant from the gastropod (6.35 mm). One spine was covered in zooanthids and the other had none.

Experiment 2-one gastropod was placed in the middle of the dish with 2 spines on either side, equidistant from the gastropod (6.35 mm). Neither of the spines had zooanthids on them.

Experiment 3-one gastropod was placed in the middle of the dish, with 1 spine also placed in the middle. The spine was 2 cm long and half was covered with zooanthids and the other half was bare. Gastropod was placed with .5 cm from the center of spine, either on the zooanthid or non-zooanthid end of the spine. Gastropods were attached or placed with foot to spine.

Measurements were made from center of spine. The zooanthid region was counted as positive and the non-zooanthid side was measured as negative from the center.

Experiment 4-one gastropod was placed in the middle of the dish with no spines.

Results

Initially the gastropods were placed in the middle of the dish with spines 12 mm away from the gastropods. After two trials, we discovered the gastropods were not moving near the spines and the spines were placed 6.35 mm away from the individuals. The size of the petri dish did not affect the results. The gastropods' positions were checked every .5 hours for two hours

and their locations were marked according to the grid on the petri dishes. In addition to their location on the grids, it was noted whether they were located on a nonzooanthid spine, a zooanthid spine or on the glass itself.

Experiment 1

2 spines (zooanthid-covered and non), one gastropod

Gastropods preferred the zooanthid spines (Goodness of fit test, $P=0.000232$). The gastropods showed no preference between the glass and the nonzooanthid spine. At the end of the trial, no gastropods were found on the nonzooanthid spines; they were either on the glass or a zooanthid spine.

Experiment 2

2 spines (both spines nonzooanthids), 1 gastropod

No preference was shown between the nonzooanthid spines and the glass (Goodness of fit test, $P=0.344$). The majority of gastropods that crawled onto spines remained on the spines for the trial period.

Experiment 3

1 spine, 1 gastropod (1 spine, 2 cm long, with 1 cm zooanthid and 1 cm naturally uncovered or with zooanthid cover scraped off)

The gastropods preferred the zooanthid portion of the spine (Goodness of fit test, $P=0.003645$). Gastropods initially placed on the zooanthid side of the spine remained on the zooanthid side while gastropods placed on the nonzooanthid side moved towards the zooanthid side.

Experiment 4

No spine, 1 gastropod (Gastropod placed in clean dish with no spines)

Gastropods were placed in a container without any spines to investigate movement. Roughly half of the gastropods moved (more than 2 grid spaces) while the other half either did not move or moved less than 2 grid spaces. The gastropods' movement appears to be haphazard and random.

Discussion

The role of epibionts varies from possibly parasitic to beneficial for the host organism. Epibionts can range from bacteria to macroscopic worms and gastropods (Buck et al. 2000, Mercier and Hamel 2008). With large epibionts in the deep sea, the hosts may provide a

microhabitat in a landscape where food resources are scarce. Our unknown gastropod sp. had a preference for urchin spines with zooanthids on them, but it could not be determined if the gastropods were actually eating the zooanthids (Figure 1.C). We were unable to detect a radula after dissecting three gastropods, so if they are consuming zooanthids, they most likely use a suction mechanism to extract them. We also examined the feces of the gastropod, but the results were inconclusive, as the samples appeared to be composed of sand.

If the gastropods have a zooanthid spine preference, how do they detect their preferred spine? While the gastropods placed in a dish without any zooanthid spines appeared to move haphazardly, when zooanthid spines were present, the gastropods that were found on the spines at the end of the experiment actually had moved to the spines within the first half hour of the time trial. This suggests a possible chemosensory mechanism for zooanthid detection.

Epibionts benefit from their hosts, but do the hosts benefit from their interlopers? *Stylocidaris lineata* and *Cidaris blakei* were not just covered in gastropods, but had a menagerie of organisms on their spines (Dunn and Keammerer, pers. comm. 2008). The organisms may serve as a biological coat of armor or possibly keep their hosts free from parasites. The organisms may serve as cleaners of their hosts. Regardless of their epibiotic function, the unknown gastropods demonstrate a distinct habitat preference, and possible food preference, and further studies are needed to determine the gastropod's species and behaviors.

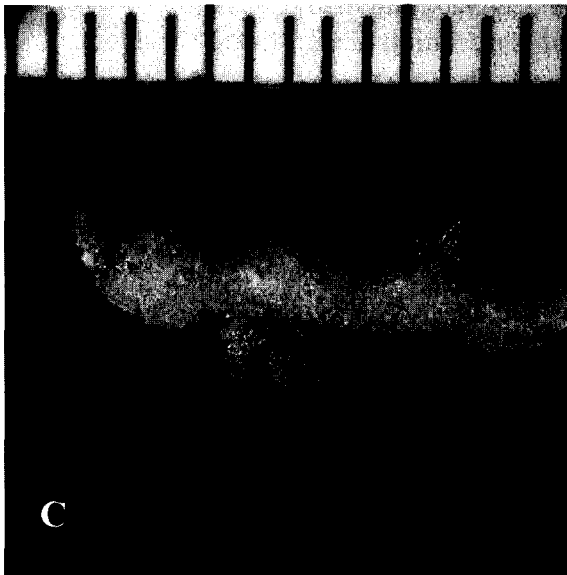
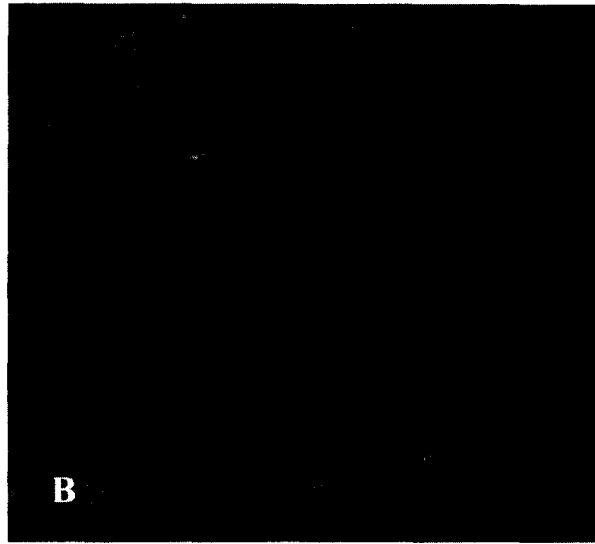
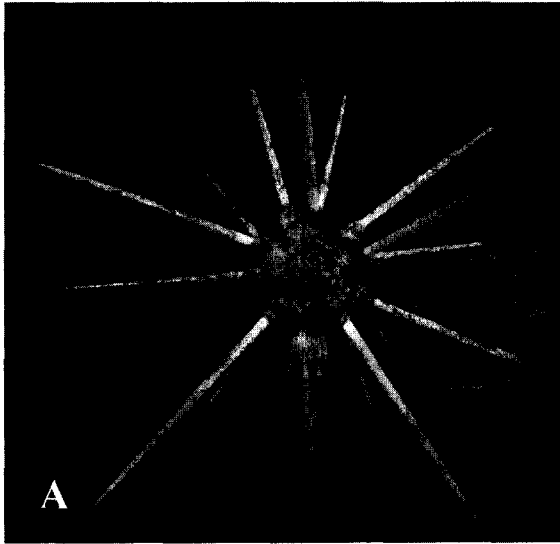


Figure 1. A. *Stylocidaris lineata* aboral view. B. Grid system for tracking gastropod movement. C. 2 unknown gastropods on a zooanthid spine from *S. lineata*. Each demarcation = 1 mm.

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