Description of an Unknown Gastropod From The Deep Sea

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Abstract

A previously undescribed gastropod (Gastropod X) was observed in May of 2008. This gastropod was found associated with the deep-sea urchins *Stylocidaris lineata* and *Cidaris blakei* from depths of 2100-1800 feet. Individuals were collected and observed live before preservation for later morphological observation and DNA analysis. A distinct protoconch, differing from adult shell in shape and color, makes this species morphologically distinct from known deep-sea gastropods. Protoconch form is indicative of a planktotrophic stage of development.

Introduction

An unknown gastropod snail was discovered while studying the epibiont community of the deep-sea urchins *Stylocidaris lineata* and *Cidaris blakei*. Urchins were collected from the Bahamas and undescribed gastropods were observed on the spines of the urchins. These gastropods are one member of a diverse group of species associated with these urchins.

Methods and Materials

Collection and Locations

S. lineata and *C. blakei* were collected from Paradise Island (25°07' N, 77°17' W), Southwest Reef (24°52' N, 77°32' W), Egg Island (25°30' N, 76°54' W), and Morgan's Bluff (25°01' N, 77°54' W) (Figure 1) in May of 2008. These collections sites are between 2100 and 1800 feet deep. Collections were made using the Johnson-Sea-Link submersible.

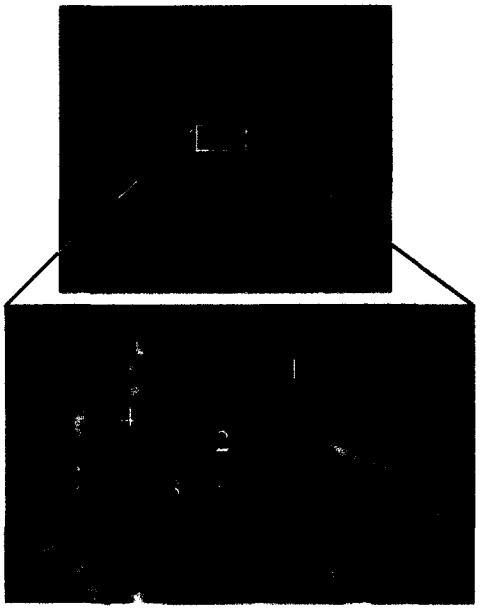

Figure 1: Sites at which *Cedaris blakei* and *Stylocedaris lineata* were collected in the Bahamas, May, 2008. 1: Egg Island 2: Paradise Island 3: Southwest Reef 4: Morgan's Bluff

Care and Study of Specimens

After collection, urchins and epibionts have high survival rates at 12°C in unfiltered seawater. On board the R/V Seward Johnson, urchin spines were searched for gastropod specimens. Once collected, gastropods were kept in unfiltered seawater, attached to spines removed from *Stylocidaris lineata*. Thirty-two specimens of the unknown gastropod (Gastropod X) with adult shells and one juvenile with only protoconch were collected.

We observed live specimens on board under dissecting microscopes. We took pictures of each specimen collected and analyzed images using ImageJ. After

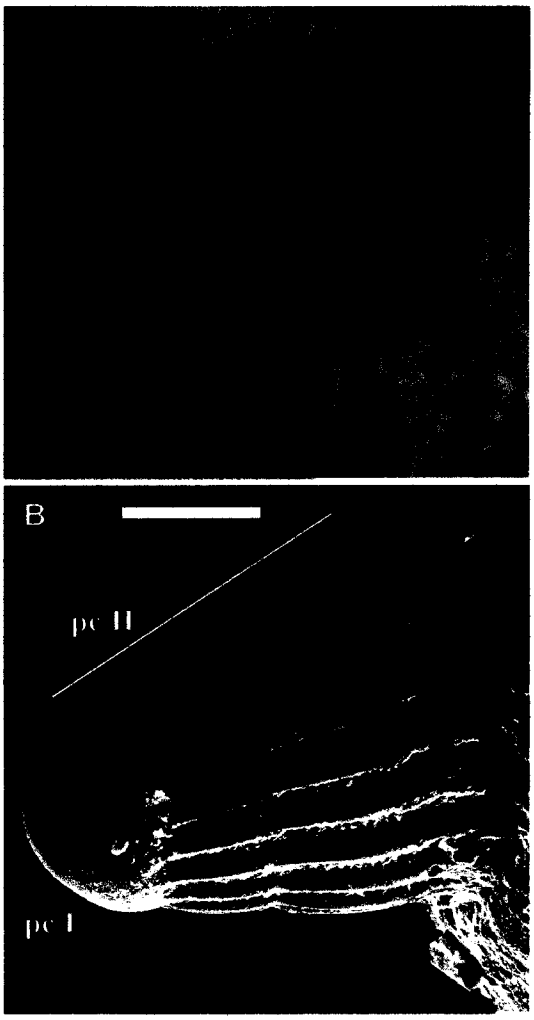

Figure 2: Protoconch of Gastropod X. A: Adult shell with visible protoconch. pc: protoconch. p: penis. ct: cephalic tentacles. Snail height 1-2 mm. B: SEM of protoconch with ornamentation. pc I: Protoconch I. pc II: Protoconch II. Scale bar = 100 μm.

observation, specimens were preserved for type specimens, DNA analysis, and SEM preparation.

Species Description

Protoconch

Gastropod X has a distinct form due to the protoconch (larval shell), which differs in color, shape, and angle from the teleoconch (adult shell) (Figure 2A). In color, the protoconch is between brown and brick red. Length varies between .204 and .357 mm. The smooth, dome-shaped portion of the protoconch (Figure 2B) consists of one incomplete whorl and fits descriptions of the embryonic shell (Protoconch I) (Jablonski and Lutz 1980). The remainder of the protoconch (Protoconch II) consists of three whorls heavily ornamented with vertical ridges, crossed with smaller horizontal ridges. This structure is indicative of a feeding, planktotrophic larval period (Shunto 1974). Ornamentation in the form of ridges may reinforce larval shells that are thin to minimize weight (Bouchet and Warén 1979). Similar indications of a feeding larval stage in deep-sea gastropods from the northern Atlantic (Bouchet and Warén 1979) and hydrothermal vents (Gustafson et al 1991) have been observed.

One individual Gastropod X was found with no teleoconch, indicating a newly settled juvenile. The same size and ornamentation are observed on the juvenile's protoconch as the protoconch on adult snails. This indicates that erosion does not significantly chang the appearance of the protoconch during adult growth.

The protoconch extends from the teleoconch at an angle approximately between 30° to 45°. This may be an indication of heterostrophy, a change in shell growth coiling patterns after metamorphosis (Hadfield and Strathmann 1990). However, while noticeable, the angle of protoconch to teleoconch is not 90° as described in other heterostrophic gastropods.

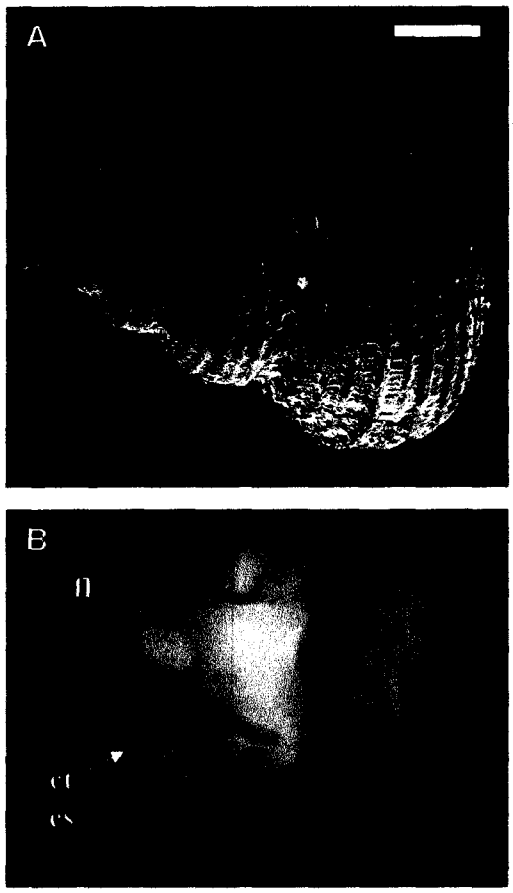

Figure 3: Adult Gastropod X. A: SEM of adult shell with protoconch visible at apex. Scale bar = 500 µm. B: Body of live specimen under dissection microscope. ct: cephalic tentacle. es: eyespots. fl: foot lobes. Shell height 1-2 mm.

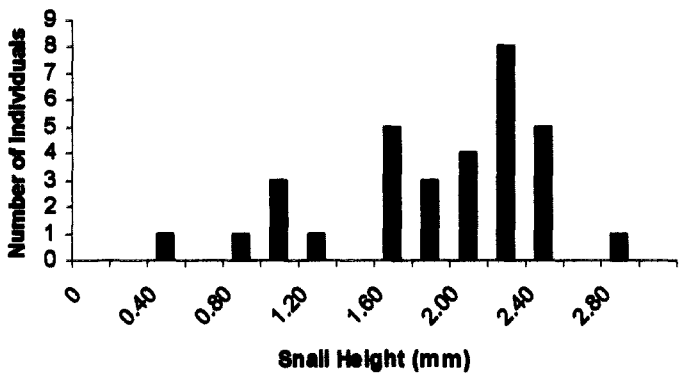

Figure 4: Size-Frequency distribution of Gastropod X. Individuals ranged from .549 to 3.06 mm in height.

Adult Shell and Body

The teleoconch of Gastropod X has a white to cream color with striations running parallel to the whorls of the shell (Figure 2A, Figure 3A). No more than three or four whorls were observed in any individual adult Gastropod X, with the body whorl constituting more than half the length of the entire teleoconch. The smallest whorl is difficult to discern on the largest individuals with light microscopy. The number of body whorls increases with increasing shell height. Specimens with one whorl are between .5 and 1 mm in height (2 individuals); observed specimens with two body whorls are between 1.01 and 1.65 mm in height (6 individuals); specimens with three or four body whorls are between 1.67 and 3.06 mm in height (23 individuals).

Adult shell height without the protoconch varied between .549 and 3.06 mm, with most individuals falling between 2.20 and 2.40 mm (Figure 4). Adult shell size did not correlate with protoconch size ($P = .116$) (Figure 5).

The aperture of Gastropod X is round and often close to circular. The edges of shell ridges are visible at the aperture margin, but no aperture teeth are present. No umbilicus is present. At the posterior end of the foot, an operculum is present which will completely cover the aperture of the shell.

At the head of Gastropod X were two cephalic tentacles with an eyespot located at the base of each tentacle (Figure 3B). The anterior end of the foot was divided into an upper and lower lobe (Figure 3B) which were often observed to move semi-independently of each other. No function was observed for this structure.

The foot of Gastropod X produces a mucus capable of holding the individual to the

substrate. When the snail is removed from the substrate, a mucus cord will stretch. When tension is released, the mucus cord will retract the snail back to the substrate. The longest distance the mucus was observed to stretch is eight mm, more than four times the length of the snail.

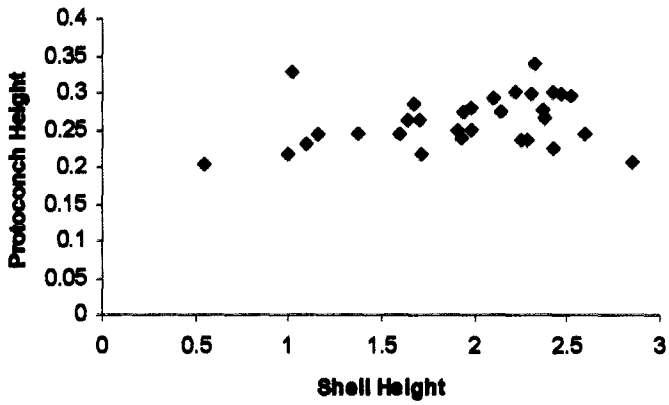

Figure 5: Protoconch height vs. adult shell height for Gastropod X. Protoconch size is independent of teleoconch size.

In many individuals, a penis was observed extended from the right side of the male (Figure 2). In some individuals, no penis was observed even during dissection, so we presume that Gastropod X is dioecious.

During dissection of three Gastropod X individuals, no radular structures were found. Because these microgastropods are very small, it is possible the radula may be present but reduced and difficult to observe.

Habitat

Gastropod X is found as an epibiont on two species of urchin, *Stylocidaris lineata* and *Cidaris blackei*. Both of these urchins are found on soft sediment in the deep sea. Both species have epibiont communities dominated by zooanthid species, both stalked and unstalked, living on the spines of the urchins. Three Gastropod X were found on three different specimens of *C. blackei*. Approximately 40 specimens of *S. lineata* were searched and 30 Gastropod X individuals were found. Of these, two urchins were discovered with two individuals present on different spines. Every other Gastropod X was found without conspecifics on the same urchin.

Thirty-two of thirty-three specimens of Gastropod X were found on urchins spines with 90-100% cover of unstalked zooanthids. One specimen was found on an urchin spine with 5% zooanthid cover, with the majority of spines on the same urchin showing much higher rates of zooanthid cover.

Conclusion

This paper represents only the initial study of this previously undescribed gastropod. Further study of the type specimens and closer examination with SEM will provide more details of the biology and taxonomy. Samples preserved for DNA analysis will also help to place Gastropod X into a phylogenetic framework.

A particularly intriguing aspect of Gastropod X is the protoconch structure, which indicates a feeding, pelagic larval stage. The larval shell has a specific brown- red color and a clear spire shape. These distinctive characters should make the larval form instantly recognizable in plankton samples.

Gastropod X is a small but easily identifiable species due to the color and angle difference of the protoconch. More intensive searches for specimens through the entire species range of deep sea urchins *C. blackei* and *S. lineata* will determine if Gastropod X is commonly associated with these urchin species or if it is endemic to the Bahamas region.

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