MOVEMENT OF TECTARIUS MURICATUS AND NERITA VERSICOLOR IN A TIDE POOL AT SPITTAL POND NATURE RESERVE, BERMUDA Morgan M. Atkinson Department of Biology, Clark University, Worcester, MA 01610 USA (matkinson@clarku.edu)

Abstract

Habitat exposure plays a key role in the movement and densities of the littorine gastropods *Tectarius muricatus* and *Nerita versicolor*. This study demonstrates that either snail can travel varying distances and that distance traveled is correlated with size. By marking snails and measuring their distance from the original point of release, distance traveled can be measured and compared between individuals and species. Both species inhabited crevices, tide pools and the leaves of plants surrounding tide pools in the Nature Reserve at Spittal Pond, Smiths Parish, Bermuda where data were collected. Size may also have been a factor in their movements; either allowing more access to certain places, such as crevices, to different sized snails or enabling snails to overcome exposure to wind and water currents.

Key Words: Tectarius muricatus, Nerita versicolor, Bermuda, marine gastropods

Introduction

Snails, including Littorina sp., are some of the first animals to colonize the upper intertidal zones (Dayton 1971). Some have lived in the waters of tide pools and survived long periods of desiccation above the water level, returning to an active life in the water after periods of weeks or months of being dry and away from moisture, even residing on maritime vegetation around the water in tide pools (Emson 2002; Stephenson 1950). Their movement and distribution, similar to other species in the intertidal, is based on several different factors including wind, terrain, and exposure (Thomas 1985).

Tectarius muricatus and *Nerita versicolor* are nocturnal littorinid gastropods that thrive in times of high humidity and rainfall (Bovbjerg 1984; Emson 2002). They have been observed to move long distances away from the water. For example, *T. muricatus* was found to move up to 28 m away from the water (Piovia-Scott, 2009), and least three different *Nerita* species have been documented above the high tide line (Hughes, 1971). Size also has been associated with movement. Smaller *T. muricatus* have been found in higher regions of the intertidal than their large conspecifics (Piova-Scott 2009). *Nerita versicolor* were known to aggregate in crevices, more of which can be inhabitated by smaller individuals (Bovbjerg 1984).

This study investigates whether size is correlated with distance traveled by snails. Because both species are nocturnal and move more in periods of high humidity, a period of at least one full day, with rain, was ideal. A negative correlation between distance traveled and snail size would demonstrate that smaller snails are more likely to be found higher above the water level and away from exposed areas closer to the tides.

Materials and Methods

Study organisms: Tectarius muricatus, the beaded periwinkle, and Nerita versicolor, the four-tooth nerite, were obtained from a tide pool at Spittal Pond Nature Reserve (see description below). Both were found below and above the water level. All individuals found within a single large tide pool selected for the study were collected. The *T. muricatus* were smaller than *N. veriscolor* and more *T. muricatus* were present and spread out in the tide pool. Both species were more likely to move around at night and at times with higher humidity (Bovbjerg 1984; Emson 2002).

Study site: Spittal Pond Nature Reserve is located in Smiths Parish, Bermuda, on the southern portion of the island (32°19'N, 64°44'W). It is home to the largest freshwater pond in Bermuda. The coast on the southern side of Bermuda is more susceptible to high winds and therefore higher wave action than the northern shore (Thomas 1985).Parts of the reserve contain wetland areas with brackish water and there are trails that run through the woods and along the shore, where there are numerous tide pools. These tide pools house numerous snails including the two study organisms and *Batillaria minima*. Some of these pools also support small *Synodus intermedius*, sand divers, and *Abudefduf saxatilis*, sergeant majors.

Methods: Nerita versicolor and Tectarius muricatus were taken from the water of the tide pool and their shells were allowed to dry in the sun. Nail polish was applied to their shells and allowed to dry. The species were marked with different colors; neon pink for T. muricatus and neon orange for N. versicolor. Individuals were not distinguishable until the next day when distance traveled and size were measured. A metal washer was also marked with each nail polish color and dried. When the washer was dry it was placed on the bottom of the tide pool. The snails (18 Nerita versicolor and 3 Tectarius muricatus) tagged with the corresponding color were placed around each washer. Washers were placed in distinct areas of the tide pool and pictures were taken in case the washers were moved either by snails, people, or currents. Snails were observed for about 15 min after they were placed in the tidepool to make sure they remained undisturbed in the presence of investigator activity in the water. Figure 1) Snails were measured across the inner lip of the shell using calipers.



Twenty-four h later, the locations of the washers were verified using pictures to make sure they were in the same place as the day before. Distances between washers and the snails of corresponding colors were measured with a flexible measuring tape. Snails were then removed from the water and size was measured across the inner lip of the shell using calipers.

Results and Discussion

Tectarius muricatus: There was a negative, though non-significant, correlation between T. muricatus size and distance traveled (Fig. 2). Snails were found below and above the water level. Their sizes, measured across the inner lip ranged from 6.0-8.0mm with a mean of 6.4mm. They traveled distances ranging from 12.8-119.0 cm, with an average of 43mm. Figure 2) Size vs. Distance traveled in *T. muricatus* (diamond) and *N. versicolor* (square) at Spittal Pond over a period of 24 hours. Both show a nonsignificant negative correlation (*T. muricatus*: R = -0.03, Degrees of Freedom = 17; *N. versicolor*. R = -0.09, Degrees of Freedom = 2).

Nerita versicolor: There was also a negative, though non-significant correlation between *N. versicolor* size and distance traveled (Fig. 2). One was found above the water level wedged in a crack in the tide pool. The other two were found below the water level. Their sizes measured across the inner lip ranged between 9.0-15.0 mm, with an average of 12mm. The distances they traveled ranged from 10.0-61.4cm with an average of 42.8cm.

Distances traveled by these species did not differ significantly (t_{20} = 0.69, p=0.49).



Though non-signficant, the two intertidal snails *Tectarius. muricatus* and *Nerita versicolor* both provided data that indicated a negative correlation between size and distance traveled in the period of about twenty-four hours. Both species moved away from the deeper portions of the tide pool and many individuals moved above the water level. Because the study was done on a day with high humidity and during rainy conditions, it is not surprising that there was a significant amount of movement in both species, because both species are known to move more when there is less risk of desiccation (Emson 2002; Bovjberg 1984). Although no significant difference was found between species, these data give some preliminary indication that *T. muricatus* travels longer distances, and farther from the water, which could be because they survive desiccation for long periods of time, as observed by Emson et al (2002).

Smaller individuals were found at higher levels in the intertidal, and farther away from their start points, which would allow for them to travel to higher points above the water level. Emson et al.(2002) also observed that smaller individuals tended to be found in higher areas. This trend could be due to individuals avoiding exposure to water movement, wind, or direct sunlight (Piova-Scott 2009). Smaller individuals also were more able to hide in crevices to avoid exposure, as *N. versicolor* has been known to do (Bovbjerg 1984).

Factors other than size could also influence distance traveled by *N. versicolor* and *T. muricatus*, such as population density, weather, and temperature; these factors could be examined in . future studies Other species may also have had an impact on the results of this study. Fish trapped in the tide pools could affect the movements of the snails, or birds in the area could trigger behavioral responses. Future studies could focus on these interactions.

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