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Does Species Interference Play a Role in Habitat Preference of the Freshwater Snails *Elimia livescens* and *Planorbella campanulata*?

Abstract

Habitat selection is an important mechanism for the determination of the realized niche, which may be influenced by factors such as nutrient availability or interference. This project explores the habitat selection and interactions of two freshwater snail species *E. livescens* and *P. campanulata*, found in Douglas Lake, Michigan. Substrate preference of each species was examined, both alone and in the presence of the other species. Our findings suggest that interference is occurring between the two snail species since the substrate preference of *E. livescens* changed in the presence of *P. campanulata*.

Introduction

Organisms are able to occupy a variety of habitats in nature, determined by abiotic factors and expressed in their fundamental niche in the environment. However, biotic factors may influence habitat selection, which may restrict the environments in which an organism can live, or its realized niche. There are a variety of factors that influence habitat selection, such as nutrient availability and interference. It is important to have a comprehensive understanding of an organism's habitat, since habitat destruction is the primary challenge facing endangered species (Tilman et al. 1994).

Douglas Lake, located in northern Michigan, is a glacial remnant with both a rocky and sandy bottom and dense vegetation surrounding most of the shoreline. The aquatic freshwater snails of Douglas Lake at UMBS (Michigan) display differential habitat selection and appear in patchy densities throughout the lake. One significant factor determining snail habitat selection is substrate (Vaidya 1978). For the purposes of our study, we focused on two periphyton feeding snail species that both occupy rocky substrates (Lichty 1977),

P. campanulata have a whorled shell with a "flared aperture" and are found on rocky substrates in many different lakes and ponds where vegetation is present. Shells of *E. livescens*

are dark brown and conical in shape, and the species is found on rocky substrate in a wide range of freshwater environments (Burch & Jung 1992). The physical characteristics of Douglas Lake suggest that it comprises the fundamental niche for both of these species. Biotic factors such as predation and competition may be influencing the realized niche of these two species, possibly decreasing the habitable space of the organism. Sometimes competition results in the hyperdispersion of an organism, which was observed in *P. campanulata* and suggests the presence of intraspecific competition for space on substrate (Karowe 2011).

There is a lack of knowledge regarding the substrate preference and diet of freshwater snails and little is known about the interactions between the two species (West 2002). Further exploration of snail substrate preferences could explain the observed differential abundances throughout the lake and may reveal the presence of interference. This study will examine the interspecific and intraspecific competition for substrate, and specifically whether or not addition of a species changes snail substrate preference.

Our observations and preliminary experiments have led us to the following questions. (1) In the absence of the other species, do *P. campanulata* or *E. livescens* have a substrate preference? (2) In the presence of the other species, do *P. campanulata* and *E. livescens* influence the habitat selection of the other? Hopefully, the answers to these questions will add to the current knowledge of the two species.

Materials and Methods

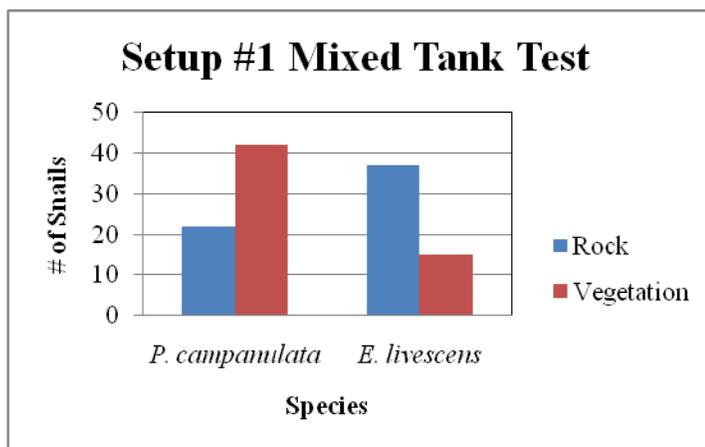
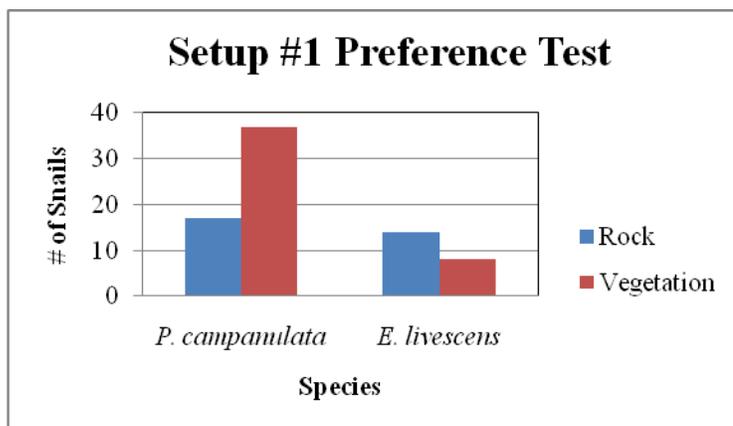
P. campanulata and *E. livescens* were observed in their natural habitats in Douglas Lake, Northern Michigan. *E. livescens* was found almost exclusively on rocky substrate while *P. campanulata* was found on both rocks and vegetation. Both species were found in different areas of the lake. In order to determine species preference for rock or vegetation, two trials were run, each with 30 *E. livescens* specimens obtained from the rocky area by the UMBS boat dock and 30 *P. campanulata* collected from Grapevine Point using glass bottom buckets. Rocks from each collection area were obtained near the shoreline. Six 10 gallon tanks were filled with approximately 1 ½ inches of sandy substrate, and lake water was added until the tanks were ¾ full and left outside overnight to settle. A small net was used to remove the layer of algae that had accumulated in order to create a neutral sandy medium.

For the first setup, shoots of vegetation with roughly equal amounts of algae were placed on one end of each tank, and two rocks (one from each of the collection sites of *E. livescens* and *P. campanulata*) of similar size and algae cover were placed on the opposite side, separated by approximately 5 inches of bare sand. A second setup was designed after realizing that the snails might not have been presented with a clear choice between rock or vegetation. Six rocks (three from each of the collection sites) of roughly equal size and algae cover were placed alternately around the perimeter of each tank, and separated by shoots of vegetation. The two rock types were used in case each species had a preference for the rock type found at their collection site.

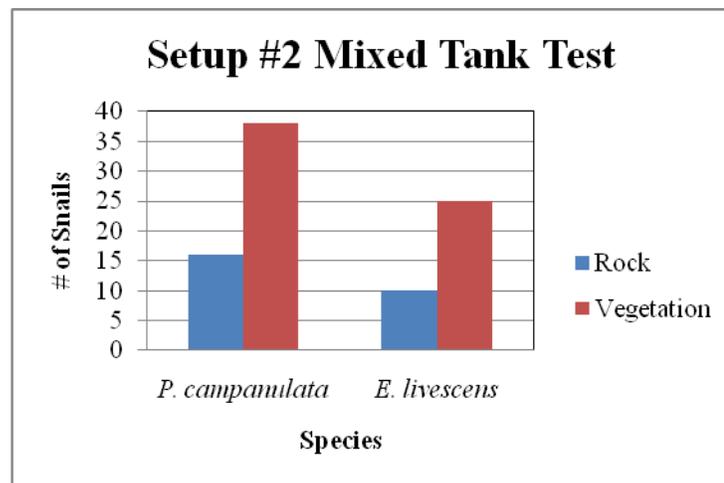
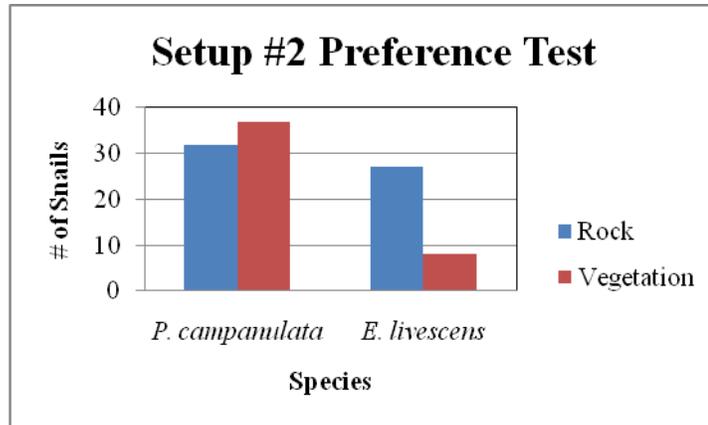
In order to determine if *P. campanulata* or *E. livescens* had a substrate preference in the absence of the other, ten snails of each species were placed in the middle of each tank within an hour after collection and left overnight to acclimate to the experimental settings. Snails were numbered with sharpie markers. Location was recorded four times during the day in approximately three hour intervals. Snail location was designated as sand, vegetation, wall, P. rock or E. rock to differentiate between rocks collected from the *P. campanulata* site from those taken from the *E. livescens* site. Floating snails were placed back in the middle of the tanks. Only rocks and vegetation were used in our data analysis since sand was assumed to be a neutral medium used for travel and a tank wall would not be encountered in nature.

Tanks and snails were kept consistent in a second experiment to investigate whether substrate preference changed when the two species were mixed. Five *E. livescens* and five *P. campanulata* were placed in the middle of each tank and snail location was recorded as in the previous trials. The same method was repeated for setup #2 with a new set of snails. Chi square analysis was performed for each data set. There was not a statistically significant preference found in rock choice, so we did not differentiate between “P. rock” and “E. rock” in our data analysis.

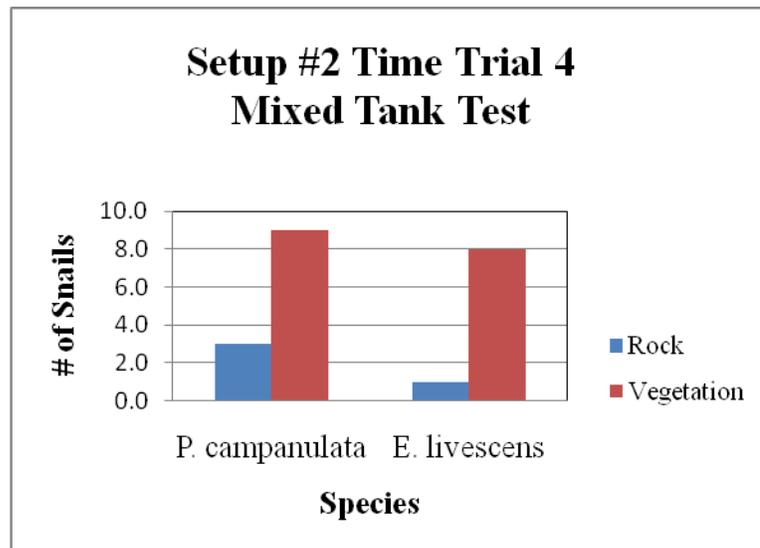
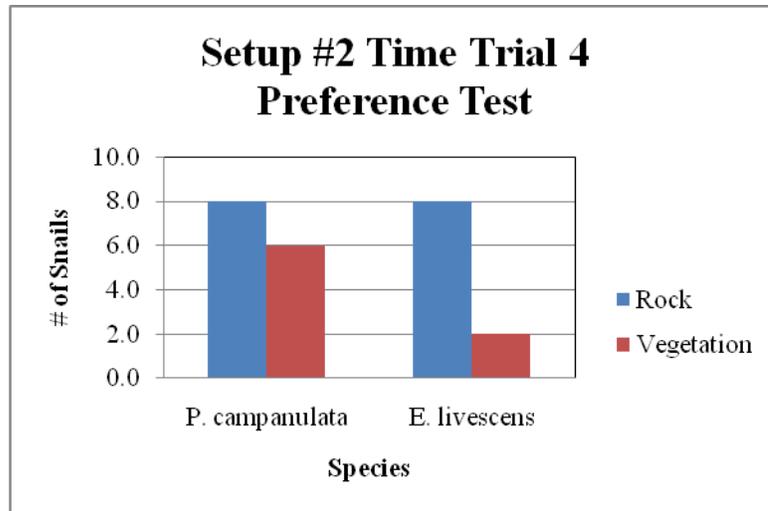
Results



In the setup #1 preference test, *P. campanulata* significantly preferred vegetation over rock ($X^2=7.41$, d.f.=1, $p=0.006$). In contrast, *E. livescens* showed no substrate preference ($X^2=1.64$, d.f.=1, $p=0.201$). In the setup #1 mixed tank test, *P. campanulata* again showed a significant preference for vegetation over rock ($X^2=6.25$, d.f.=1, $p=0.012$). *E. livescens* showed a significant preference for rock over vegetation ($X^2=9.31$, d.f.=1, $p=0.002$).



In the setup #2 preference test, *P. campanulata* did not show a significant preference for either substrate ($X^2=.36$, d.f.=1, $p=0.547$). *E. livescens*, though, did show a significant preference for rock over vegetation ($X^2=10.31$, d.f.=1, $p=0.001$). In the setup #2 mixed tank test, *P. campanulata* showed a significant preference for vegetation over rock ($X^2=8.96$, d.f.=1, $p=0.003$). *E. livescens* also showed a preference for vegetation over rock ($X^2=6.43$, d.f.=1, $p=0.011$).



In the setup #2 time trial 4 preference test, *P. campanulata* did not show a significant preference for either rock or vegetation ($X^2=0.29$, d.f.=1, $p=0.593$). *E. livescens* did not show a preference either ($X^2=3.60$, d.f.=1, $p=0.058$). In the setup #2 time trial 4 mixed tank test, *P. campanulata* did not show a significant preference for either rock or vegetation ($X^2=3.00$, d.f.=1, $p=0.083$). *E. livescens* did show a significant preference for vegetation ($X^2=5.44$, d.f.=1, $p=0.02$).

Discussion

Our results from setup #1 suggest that *P. campanulata*, both when alone and in the presence of *E. livescens*, preferred vegetation over rock. These results are different than what we would have expected, as literature suggests that *P. campanulata* is found on rocks in areas where vegetation is present (Burch & Jung 1992). In contrast, *E. livescens* displayed no substrate preference when alone, but preferred rock over vegetation in the presence of *P. campanulata*. This preference for rocky substrate is expected in *E. livescens* (Sharland). This difference in substrate preference suggests the presence of resource partitioning, often a result of past competition. *E. livescens*' preference for rock could have arisen as a mechanism to avoid competition. This could in turn be reflected in morphological differences, which are apparent in shell shape.

Results from setup #2 showed that *P. campanulata* had no substrate preference when alone, but preferred vegetation in the presence of *E. livescens*. Additionally, *E. livescens* showed a preference for rock when alone, and vegetation when in the presence of *P. campanulata*. Unlike setup #1, setup #2 does not seem to suggest resource partitioning, because each species shares the same preference when mixed. The tanks were exposed to unseasonably cold and rainy weather which could have caused a change in snail behavior. The snails appeared stressed and several were observed burrowing in the sand. Perhaps clinging to vegetation and burrowing in the sand is a way for the snails to avoid shell damage.

Our analysis assumes independence of each of the four time trials, allowing for an increased sample size. Results were compared to those from a single representative time trial from setup #2, in the interest of precision. These results suggest that when alone, neither *P. campanulata* nor *E. livescens* displayed a substrate preference. In the presence of *E. livescens*, *P. campanulata* did not display a substrate preference. *E. livescens* showed a preference for vegetation in the presence of *P. campanulata*. In general, these results support the setup #2 data.

Although there was a discrepancy between our results from setup #1 and setup #2, they both showed that *E. livescens* made a different substrate choice in the presence of *P. campanulata*. This could be due to chemical communication that exists between snails (Phillipe 2006). *E. livescens*' substrate preference may have been affected by the chemicals emitted by *P. campanulata*. This is an area that should be explored further in future research. Developing a more efficient numbering system for both rocks and snails could help analyze the effect of

chemical signaling. This would enable the tracking of chemicals left by one species, which could possibly prevent the other species from going to the same spot.

The following experimental design changes could be made to improve upon our project. Tank water should be replaced daily to ensure a more natural environment. Tanks should also be protected from weather to ensure consistency of both sunlight and precipitation. Larger tanks could possibly prevent the observed crowding effects. A larger sample size could increase the confidence of our results. Snails should be numbered in a more effective way to allow for improved tracking. We recommend investigating the use of nail polish.

Acknowledgements

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