Effects of Predator Chemical Cues On Snail Behavior

BIOS 35502: Practicum in Field Biology

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Abstract.-Predator and prey relationships are complicated by the fact that predators affect prey behavior and their ability to obtain necessary resources for survival. Snails detect chemical cues from predators and respond by altering their behavior. The presence of predators causes snails to reduce their foraging behavior and instead engage in avoidance behaviors. Crayfish and pumpkinseed sunfish are two common predators on freshwater snails. We hypothesized that snails can detect predators and respond with avoidance behaviors. Our study examines the avoidance behavior of two freshwater snails (*Heliosoma trivolvis* and *Bellayma chinensis*) in the presence of crayfish and pumpkinseed sunfish. Eight snails were exposed to predators and their behavior (climbing, burrowing, or foraging) was recorded after 1 hour. During trials predators were held in containers with mesh sides to allow diffusion of chemical cues in the water. We found that the *Heliosoma trivolvis* had been affected significantly both in behaviors climbing and burrowing with predators present. The *Bellayma chinensis* had only been influenced to climb in our findings and burrowing was not a significantly impacted by the presence of predators. *Bellayma chinensis* are invasive to Michigan and they pose a huge ecological change in fresh water systems.

Introduction

It is important to gain an understanding of our world. One important belief is that of evolution. Evolution is continuous and linear. All organisms have experienced evolution. The theory of evolution requires organisms to avoid a potential predator or it will end up being unable to further its genetic gene pool (Dalesman et al. 2006).

Survival of the fittest is the phrase most people associate with evolution. It is important to note that phrase survival of the fittest because fit is a term used to describe having all of the things needed for survival. For survival and self-preservation you need to be in tune with your senses. All senses that are developed in organisms morph the behavior of the prey mostly out of necessity than that of cosmetics (Lakowitz et al., 2008).

I am deeply interested in two types of snails the *Heliosoma trivolvis* and the *Bellayma chinensis*. These organisms have developed greatly over the course of evolution. These organisms are very sensitive to their aquatic environment. The *Heliosoma trivolvis* and *Bellayma chinensis* are so sensitive that the slightest change in water temperature and pH could send them into shock (Gerald et al., 2004).

Snails are primary feeders in the aquatic food web and they support a huge food web by being foragers and prey alike. Some predators that pose a threat to the safety of the snails are the pumpkinseed sunfish and the crayfish. Snails are so advanced in evolution that they have the ability to detect predators by chemical cues emitted in the aquatic environment. The activity of the snail is hindered with the presence of the predator (Gerald, et al., 2005). The snails after detecting the predators responded with avoidance behaviors. The avoidance behaviors include snails climbing up reeds, and burrow themselves out of reach of the crayfish and pumpkinseed sunfish (Turner et al., 1999).

Methods

My snail organisms that I have used are the *Heliosoma trivolvis* and the *Bellayma chinensis*. My predators are the pumpkinseed sunfish (*Lepomis gibbous*) and the crayfish (*Orconectes propinquus*). The pumpkinseed sunfish and the crayfish are one factor in my study the other is one or two snail species in my trial. Avoidance behaviors are my variables which include foraging, burrowing, and climbing. I did a percentage for recording the avoidance behavior. I have placed sets of 8 snails from each species of snail into 10 gallon aquarium tanks (Fig. 1.) with mesh openings for the containers holding predators (Fig. 1. A&B).

I had placed algae tiles out in North Tenderfoot Creek. I then used those tiles that had built up algae in my trials. I have placed algae tiles to allow foraging for the snails (Fig. 1. D). I placed my snails in the center of the aquarium tank and left the snails for an hour. After the hour I returned and I recorded the snail's behavior. Included inside the aquarium tanks are wooden dowels to mimic reeds found in the snail's natural habitat (Fig. 1. C). Before any trials had been done I set buckets of water out and recorded water temperature and pH. It is important to pay attention to water temperature and water pH. If water temperature and pH change a lot it could offset your experiments with snails.

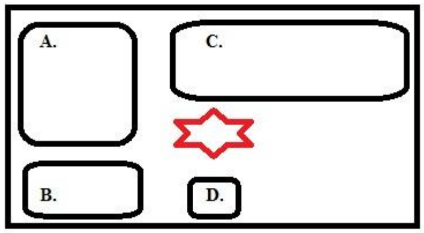

FIG. 1.— Test Aquarium complete with containers for predators (A.) Pumpkinseed sunfish ;(B.) Crayfish; (C.) Wooden Dowels; (D.) Algae Tiles; Red star is where we placed the snails.

Results

I had transformed the burrowing results for the *Bellayma chinensis* because it did not keep normality (Shapiro-Wilk test, $P < 0.007$). The burrowing results for the *Heliosoma trivolvis* was transformed because it did not maintain normality (Shapiro-Wilk test, $P < 0.04$). The climbing for results for the *Bellayma chinensis* did keep normality (Shapiro-Wilk test, $P < 0.28$). The climbing results for the *Heliosoma trivolvis* kept normality (Shapiro-Wilk test, $P < 0.45$). The *Heliosoma trivolvis* throughout the study had been affected by the predators and the chemical cues they put out (Fig. 2&4.). The *Bellayma chinensis* was not cued by the predators when tested on the burrowing (Fig. 5.) but had showed that the *Bellayma chinensis* did sense predator chemical cues during the climbing analysis (Fig. 3.).

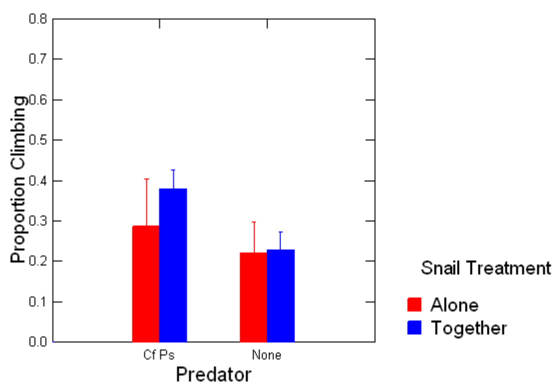

FIG. 2.— This graph shows snail treatments for the *Heliosoma trivolvis* climbing. The *Heliosoma trivolvis* climbed significantly when predator was present ($F_{1,43}$= 8.12, P= 0.006, Mean= 0.52, SE= 0.03). The *Heliosoma trivolvis* did not climb in the snail treatment alone ($F_{1,43}$= 1.11, P= 0.29). In the treatment with predators with both snails together; the snails did not climb ($F_{1,43}$= 2.10, P=0.15).

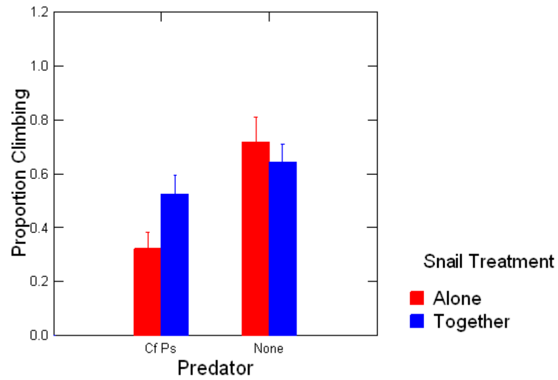

FIG. 3.— This graph shows snail treatments for the *Bellayma chinensis* climbing. With predator present the *Bellayma chinensis* did not climb ($F_{1,42}$= 3.78, P= 0.05, Mean= 0.29, SE= 0.02). The *Bellayma chinensis* did not climb when alone in the snail treatment ($F_{1,42}$= 1.09, P= 0.30). The predators did not affect both snails when they were in the same treatment ($F_{1,42}$= 0.20, P= 0.65).

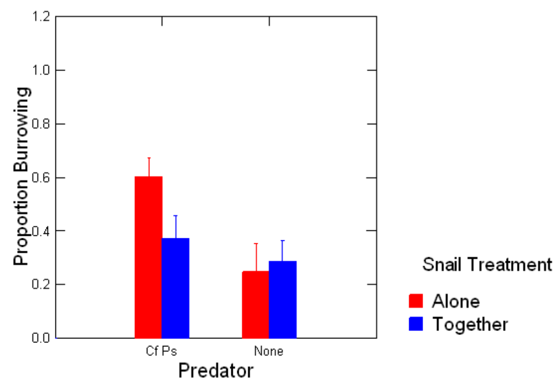

FIG. 4.— This graph shows snail treatments for the *Heliosoma trivolvis* burrowing. With the predator present *Heliosoma trivolvis* did burrow ($F_{1,43}$= 4.57, P= 0.03, Mean= 0.39, SE= 0.04). With the *Heliosoma trivolvis* alone the snails were not affected in the treatment ($F_{1,43}$= 1.21, P= 0.27). With the predators present both snails did not burrow ($F_{1,43}$= 1.92, P= 0.17).

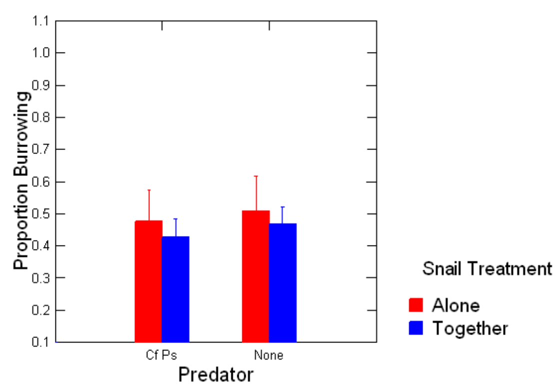

FIG. 5.— This graph shows snail treatments for the *Bellayma chinensis* burrowing. With the predators present the *Bellayma chinensis* did not burrow ($F_{1,42}$= 0.22, P= 0.63, Mean= 0.46, SE= 0.03). With the *Bellayma chinensis* alone they were not inclined to burrow ($F_{1,42}$= 0.30, P= 0.58). With both predators and both snails together in the same treatment the snails did not burrow ($F_{1,42}$= 0.03, P= 0.84).

Discussion

After careful observation and recording of data I have reason to believe that these messages are creating a physiological response and a cued defensive action or behavior (Phonert et al., 2007). The physiological response is key in observation. I have also noticed discriminative behavior on part of prey to predator (Relyea et al., 2003). Some discriminative behavior that the *Heliosoma trivolvis* have demonstrated, include escaping the area by climbing up wooden dowels. The *Bellayma chinensis* however was not affected by predators as much as the *Heliosoma trivolvis* which causes me come up with further thoughts for more projects.

I have seen that the prey can detect predators; which means that chemical cues are not beneficial to predators when it comes to hunting prey like the *Heliosoma trivolvis* and *Bellayma chinensis* (Dobson et al., 2009). We have found in our study like in other studies that chemical cues in fact had caused both snails species to climb to escape the predators (Dobson et al., 2009). A shell is developed to help secure wellbeing found in the theory and reasoning of evolution which is about phenotype found in nature (Hoveman et al., 2009). The only strange thing noticed what that the *Bellayma chinensis* was not cued to burrow. I can only presume that they know they are too big to be prey to the pumpkinseed sunfish and the crayfish. I can see now that is part of being fit. My fear is the impact that these competing species have to one another; Especially the *Bellayma chinensis* because it is invasive to the Michigan region (Kipp et al., 2012). The *Bellayma chinensis* come from Asia (Sura & Mahon, 2011).

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