Potential impacts of crayfish on native amphibians

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Abstract

The reason to study native versus invasive crayfish and amphibian interactions is for a better understanding of how invasive crayfish impact an environment, if at all. In this experiment twelve thirty-eight liter tanks were utilized as a home for the *Rana catesbeiana* tadpoles, *Cambarus sp. C* crayfish, and *Procambarus clarkii* crayfish. Three different tank set ups were made, with control tanks being tadpoles only, and two different treatment tanks (invasive plus tadpole and native plus tadpole). After data was collected for ten consecutively and again at the twenty-four hour mark, average survival rate was taken from each tank group. It was found that after both ten and twenty-four hours, there was a significant difference in survival rates of tadpoles when living with invasive crayfish versus native crayfish.

Introduction

An invasive species is any species that is non-native to an area and causes harm to the environment and the native species in the region. A native species is any species that is endemic to an area. It is important to study the different responses of native and invasive crayfish to native amphibians and other native species to better understand how invasive crayfish impact the environment.

Many experimental studies have shown, that invasive crayfish species have increased the mortality of amphibians (Kats & Ferrer 2003). In another study, invasive species of crayfish were introduced into the Paul do Boquilobo Natural Reserve, and in doing so, the native amphibian population declined. It was concluded that the crayfish were the main cause of the amphibian population decrease (J. Cruz et al. 2008). Previous studies have shown, that the invasive species, the *Procambarus clarkii*, appeared to feed on tadpoles at a faster rate than the native species, even though both species seemed to have the same motivation and or ability to eat the tadpoles, dead or alive (J. Cruz et al. 2006).

The purpose of this study was to determine the potential impacts of crayfish on amphibians, and to determine if the native or invasive had more of an impact on the amphibians. The question at the beginning of this experiment was what will be the difference in survival rates of tadpoles when present with native and invasive crayfish? It was then hypothesized that there would be no difference in the survival rates of the tadpoles when living with the invasive versus the native crayfish species.

Material and Methods

Study Species:

Our first study species in this experiment was the *Rana catesbeiana* (American bullfrog) tadpoles. American bullfrog tadpoles are usually found in the majority of the eastern coast, midwest, and in certain areas of the west coast. The next study species was the native crayfish the *Cambarus sp. C* (Piedmont crayfish). The Piedmont crayfish live in the piedmont and coastal plains area (the Patapsco Basin in Maryland down to the Saluda drainage system in South Carolina). The final study species in our experiment was the invasive crayfish, *Procambarus clarkii* (Red-Swamp crayfish). The Red-Swamp crayfish is native to the regions of mid-southern and midwestern United States, but was introduced (invasive) into the west coast and the southern east coast.

Experimental Design:

Twelve thirty-eight liter tanks were used as the housing unit for the study species throughout the experiment. Each tank was filled with nine centimeters of treated tap water and then labeled with the numbers one through twelve. After the water sat for one week, an air filtration system was created by using aquarium rigid plastic tubing, connectors, and air diffusers. After adding the air filtration, the water sat for an extra three weeks before any study species were added into them. Before the crayfish were added into their tanks, they were starved for three days so that they would be more predatory to the tadpoles in their tank.

Our control in the experiment were the first four tanks. These tanks contained only three tadpoles per tank. The second group of four tanks were used as one of the treatment groups. These four tanks held one Piedmont crayfish per tank and three tadpoles per tank. In the second treatment group, the last set of four tanks, held one Red-Swamp crayfish per tank and three tadpoles per tank. The three sets of four tanks were used to test the response variable, of how long the tadpoles survived in different circumstances. The control tanks tested how long the tadpoles could survive when there are no predatory sources threatening their survival; whereas the treatment tanks tested the predictor variable, of whether invasive crayfish or native crayfish consumed tadpoles at a faster rate (Table 1).

Table 1. The total amounts of species associated with the control and treatment groups in the tank setup.

Treatment	Native per tank (4 tanks)	Invasive per tank (4 tanks)	Tadpole per tank (4 tanks)
Native + tadpole	1	0	3
Invasive + tadpole	0	1	3
Tadpole only	0	0	3
Total Amount	4	4	36

Data Collection:

In addition to being starved before being placed into the tanks, both species of crayfish had their weight (g), carapace length (mm), and claw length (mm) measured (Table 2). Once the crayfish and tadpoles were in the tanks together, data collection started and continued in hourly increments. For ten hours the data

was collected hourly and then at nine the next morning it was collected for the final time so that a full twenty-four hours had been observed. Each time data was collected the amount of tadpoles still surviving in the tanks was recorded.

Table 2. The average measurements for the native (Piedmont crayfish) and invasive (Red-Swamp crayfish).

Measurements	Invasive	Native
Mass (g)	38.6 (±5.412)	14.25 (±0.805)
Carapace Length (mm)	52.35 (±2.770)	36.375 (±0.728)
Claw Length (mm)	43.125 (±1.171)	24.025 (±0.256)

Data Analysis:

Once all the data for the response variable had been recorded, the data was analyzed using the statistical program R. A one-way Anova and TukeyHSD were ran for post hoc comparisons. The averages were also taken from the data to generate comparison graphs.

Results

Average Survival Rate

The average survival rate of tadpoles in the control tanks after ten hours is 3 (100%). Average survival rate of tadpoles in the treatment tanks with the native crayfish is 2.5 (83.5%). The average survival rate of tadpoles with the invasive crayfish is 1.75 (58.5%) (Figure 1). The survival of tadpoles in the three different treatment groups at ten hours is significantly different from each other (F-value= 8.143, P-value= less than 0.05%) (Figure 3).

The average survival rate of tadpoles in the control tanks after twenty-four hours is 3 (100%). Average survival rate of tadpoles in the treatment tanks with native crayfish is 2 (66.75%). The average survival rate of tadpoles in the treatment tanks with invasive crayfish is 0.25 (8.25%) (Figure 2). The survival of the tadpoles in the three different treatment groups after twenty-four hours is significantly different from each other (F-value=25.36, P-value= less than 0.05%) (Figure 4).

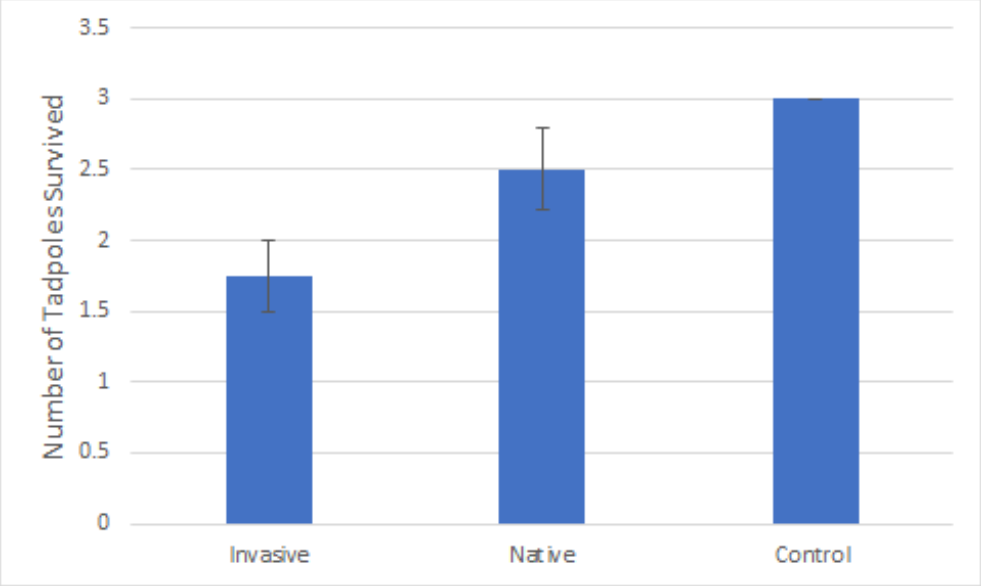

Figure 1. The average number of tadpoles that survived while living with Red Swamp and Piedmont crayfish after 10 hours.

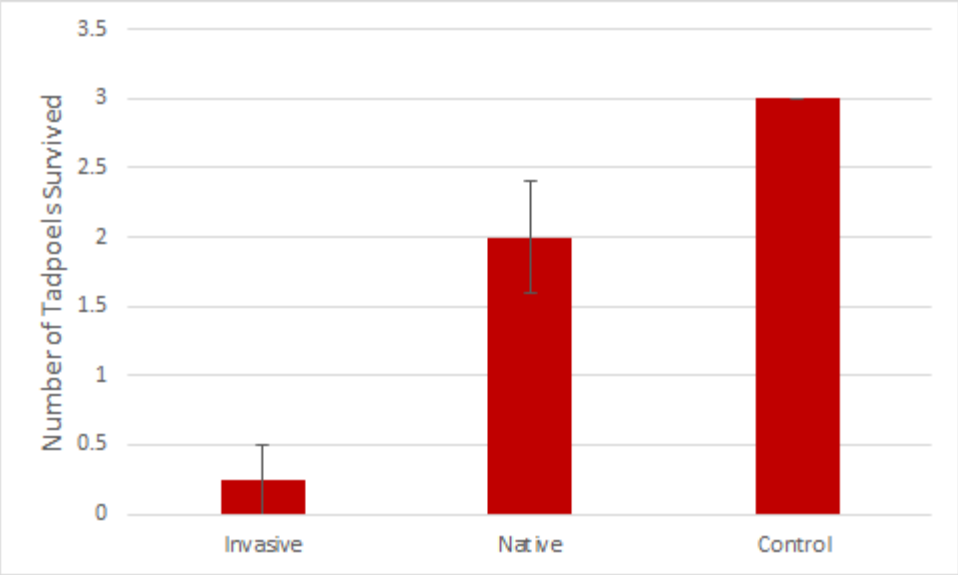

Figure 2. The average number of tadpoles that survived while living with Red Swamp and Piedmont crayfish after 24 hours. The average for Red Swamp was 0.25, for the Piedmont 2, and for the control group was 3 tadpoles.

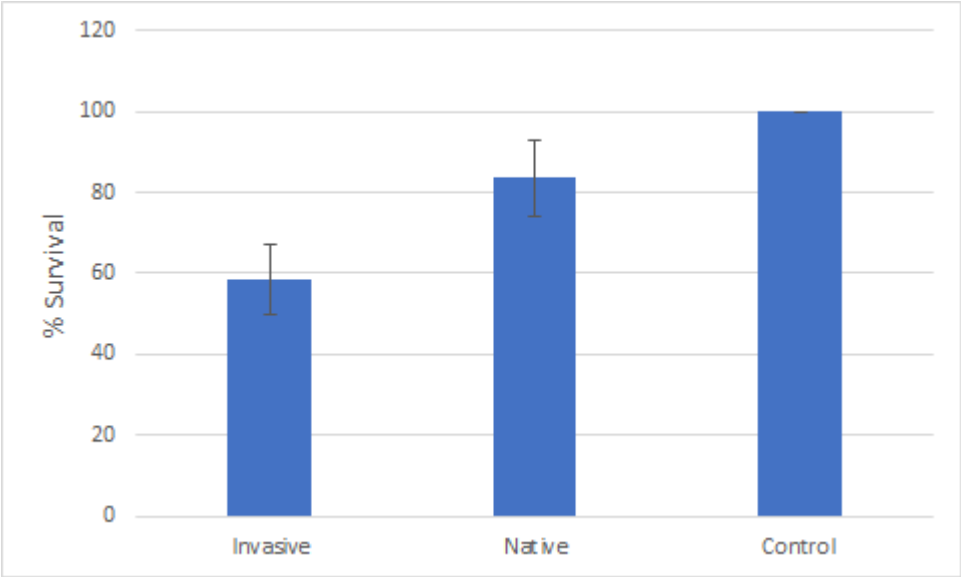

Figure 3. The average survival rates of tadpoles while living with the Red Swamp and Piedmont crayfish species of crayfish after 10 hours. The average survival rate of tadpoles for the Red Swamp was 58.5%, for Piedmont was 83.5%, and for the control group was 100%.

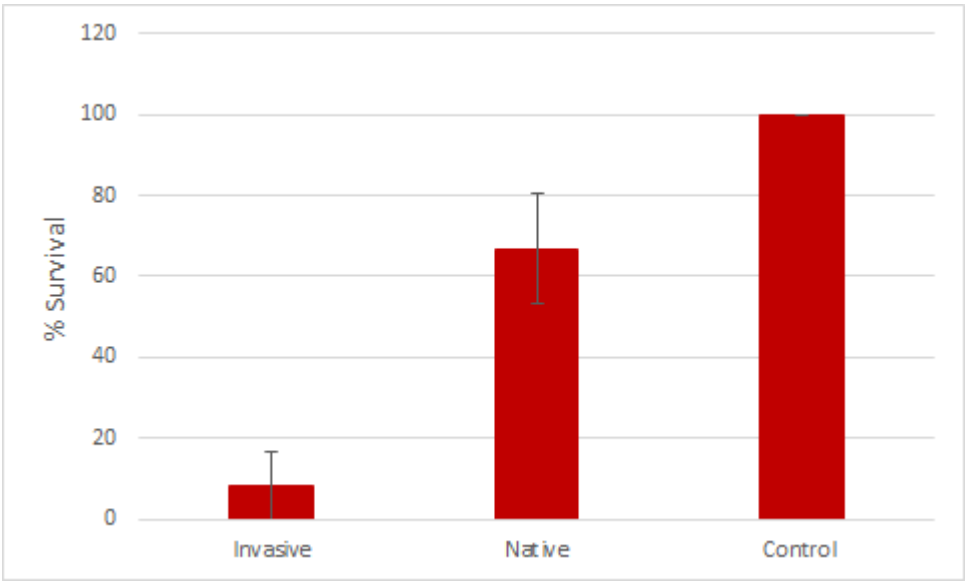

Figure 4. The average survival rates of tadpoles while living with the Red Swamp and Piedmont species of crayfish after 24 hours. The average survival rate of tadpoles for the Red Swamp was 8.25%, for Piedmont was 66.75%, and for the control group was 100%.

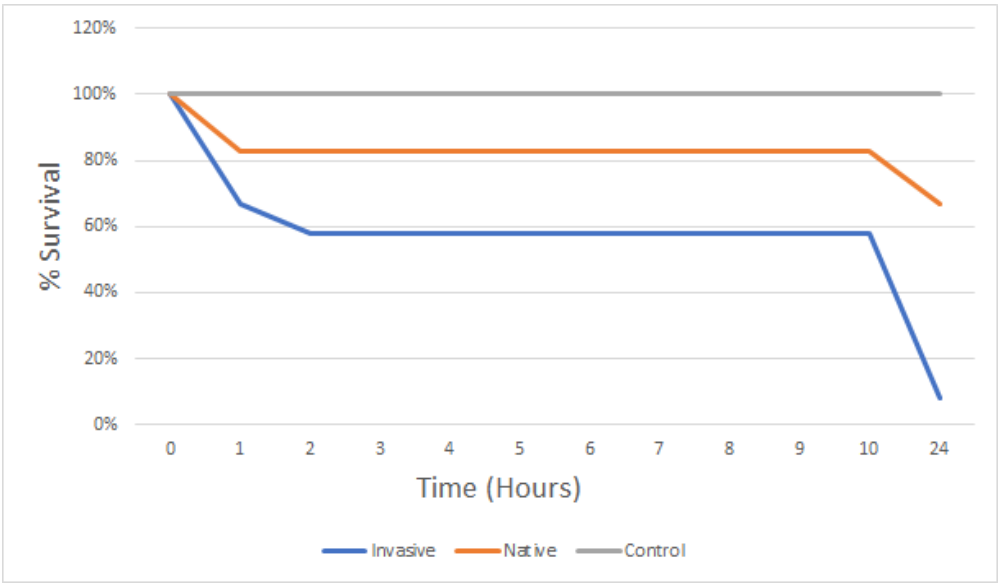

Figure 5. The percent survival of tadpoles while living with the Red Swamp and Piedmont crayfish over the span of 10 and 24 hours.

Discussion

Our hypothesis that there would be no difference in survival rates of tadpoles when placed with native and invasive species of crayfish was not supported by the data that was gathered. The results garnered from the data showed that there was a significant difference in tadpole survival rates when living with the native species of crayfish versus the invasive species of crayfish. [Sentence on how our findings are relative to the associated theory and the broader picture of science].

One of the limitations in our experiment was the small sample size used. Using a larger sample size provides more data, thereby reducing uncertainty as to whether or not the results provided are accurate. Another limitation was the length of the experiment. By conducting the experiment in more than one day, it would have given more data points to base the results off of. Ways to improve this research would be to enlarge the sampling size and by that the length of time of the experiment would also be increased.

In future experiments it would be interesting to have treatment tanks where there is native crayfish, invasive crayfish, and tadpoles all placed together. These treatment tanks would be interesting to have in the experiment to observe if the invasive crayfish still eat more tadpoles at a faster rate, and what the competition between crayfish for the tadpoles look like. It would also be interesting to have these tanks to see if the crayfish are more attracted to attacking each other or if they are more attracted to the tadpoles also in the tank.

This experiment and experiments like this are important for discovering how invasive crayfish can possibly impact their new environments. By looking at the invasive crayfishes aggressiveness and predatory response toward the tadpole (and possibly native crayfish) we can discover how they are to impact environments. [better closing statement].

Acknowledgements

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