Effect of warming water temperatures on local gastropod growth, reproduction, and mortality

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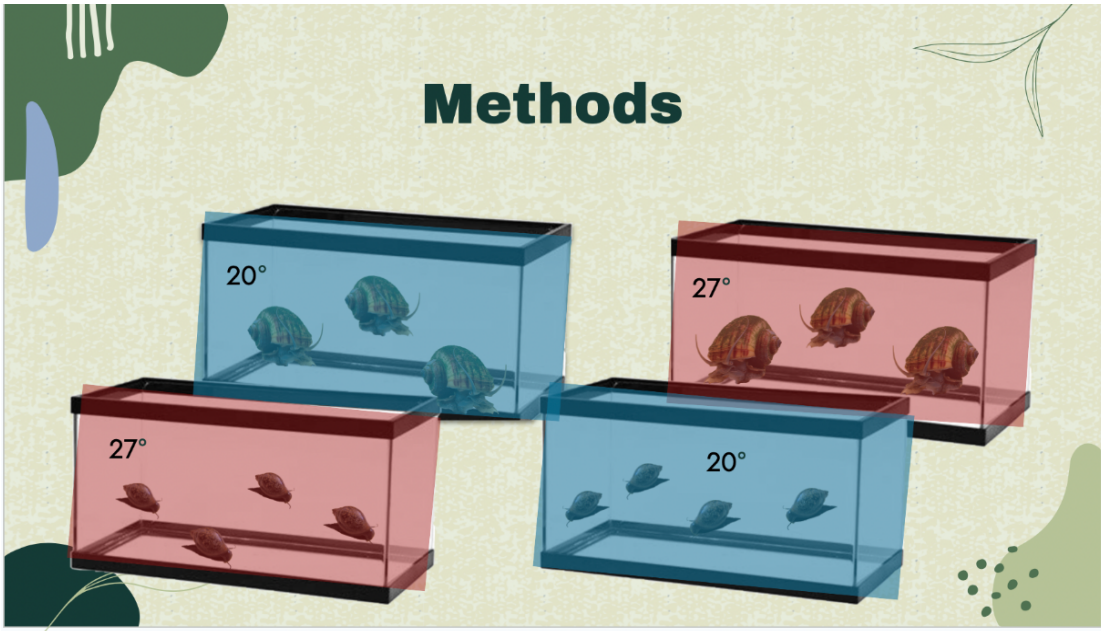
Introduction

Climate change is an emerging stressor for freshwater species that's begun changing the dynamics of the freshwater ecosystem these species inhabit (Wrona et al., 2006). In addition to affecting things like species growth, reproduction, and survival. For my summer 2023 FURSCA research, I wanted to study the effects of warming water temperatures on local snail growth, reproduction, and survival. The two snail species I chose to use for my research include the Chinese mystery snail (Bellamya spp.) and common pond snails (Physa spp.). The Chinese mystery snail is a mollusk species that is invasive to Northern America and has even been found in the Kalamazoo River (Burnnett et al., 2018). The common pond snail (Physa spp.) is a common snail species in the U.S. and is native to Michigan (Arendt 2015). I chose these species for my research because they both live within the Kalamazoo River. The purpose of my study is to gather more data on how climate change will affect interspecies relationships between local snail species. My hypothesis is that the warming water temperatures will affect the growth, reproduction, and survival of the two snail species.

Methods

For my experiment, I ordered 40 *Physa acuta* online and collected 16 *Bellamya chinensis* from the Kalamazoo River. Then I separated the two species evenly into four tanks. Two of the tanks were left at room temperature of 20° C while the other two tanks were heated to 27° C using aquarium heaters. I then measured the length, and weight of the adult snails each week and marked the snails using bee tags. In two separate tanks, I kept the egg masses and juveniles from *Physa acuta* in shot glasses. Both tanks were then heated to 27° C, and every week I took measurement photos of the juveniles. Then I used a computer program called Image J to measure their length. I also made a schedule for feeding the adult snails, cleaning their tanks, and taking

growth measurements. The goal of my experiment was to gather data on how two local species of snails would be affected by increased average water temperature caused by climate change.



Results

At the end of my research period I found that there was a huge difference in survival rate between both species. The survival rate for *Bellamya chinensis* was the same between both temperature treatments but there was a vast difference for the species *Physa acuta*. The 20° C treatment for *Physa acuta* stabilizes but the 27° C treatment has a vast decline (Figure 1). Eventually all of the *Physa acuta* in the 27° C tank died by week 4 (Figure 1). Similarly, for *Physa acuta* I found that there were more egg masses being produced in the 20° C treatment while there is a huge decrease in the number of egg masses produced in the 27° C treatment. Using R for the growth measurements, I found that for the 20° C treatment, *Physa acuta* had no significant difference in growth between weeks for mass but there was a significant difference in length. The other results showed that there was no significant change in mass and length growth for the species *Bellayma chinensis.* I found that for the adult *Physa acuta* in the 20° C treatment, they had a significantly higher number of egg masses produced opposed to the 27° C (Figure 2). The final graph of results shows the number of eggs in egg masses between the two treatments and that their results are not significantly different (Figure 3).

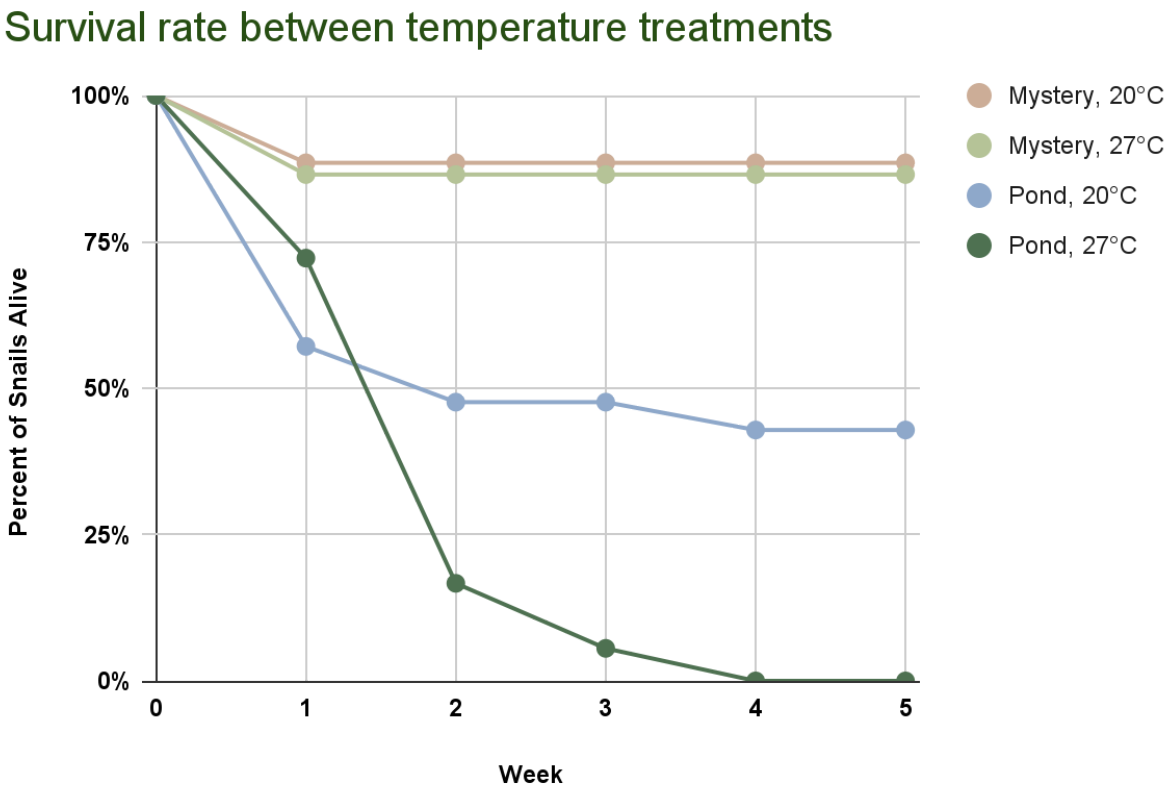


Figure 1. Depicts the survival rate for adult *Physa acuta* and *Bellamya chinensis* over a five week period.

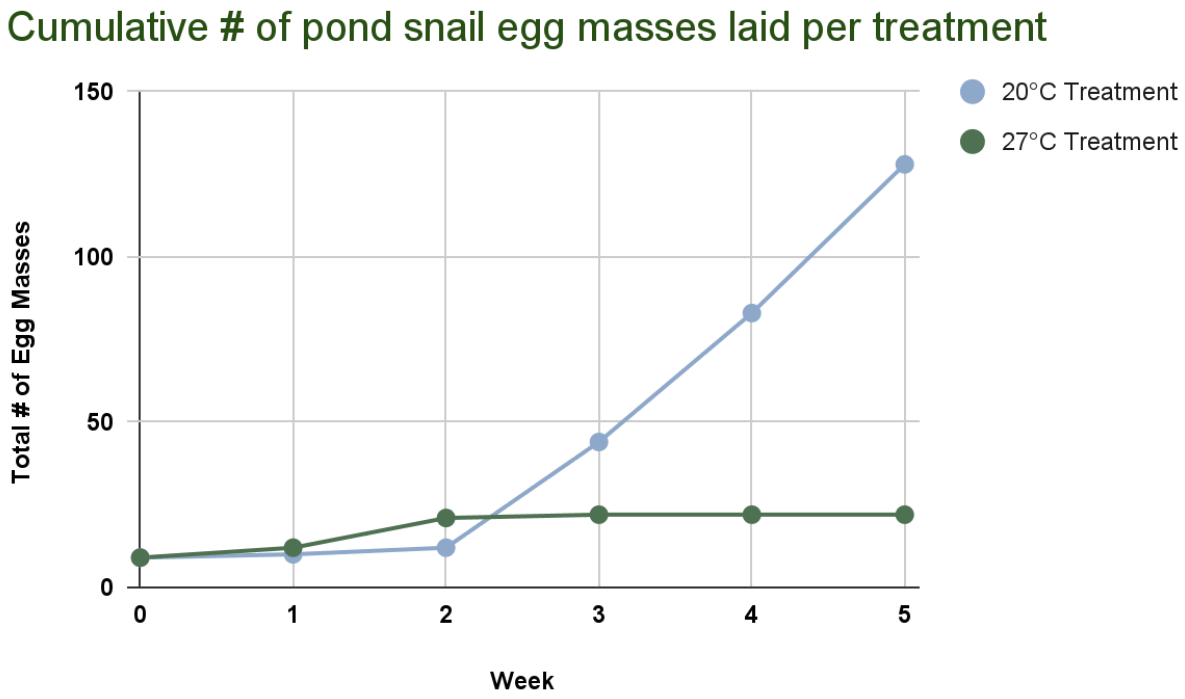


Figure 2. Depicts the number of egg masses produced by adult *Physa acuta* within the two temperature treatments.

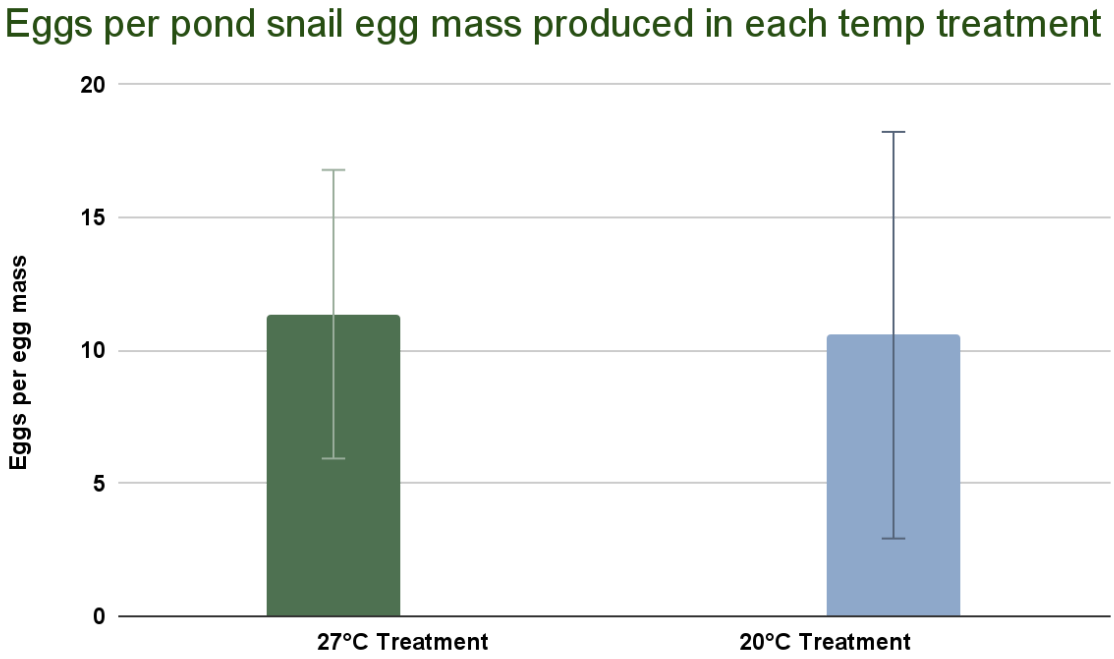


Figure 3. Depicts the average number of eggs per egg mass produced by adult *Physa acuta*. Between the two temperature treatments my p-value after performing a t-test was 0.650. Meaning that there was no significant difference between temperature treatments.

Discussion

In my results, I got a p-value of 0.650, meaning that there wasn't a significant difference between temperature treatments regarding how many eggs were produced per egg mass (Figure 3). Further analysis is needed for my growth data, for the adult snails, there is some significance in growth between weeks but not as a result of being in different temperature treatments. Instead, this difference is either because of shell growth, because of how much food they were receiving, or other environmental factors. As for my other results, I found there to be a significant difference in survival rate and egg mass production between temperature treatments (Figure 1, Figure 2). Overall, my results supported my hypothesis for the species *Physa acuta* but not for *Bellamya chinensis*. This means that the warmer water temperatures had a significant impact on growth, reproduction, and survival for the native species but not the invasive. Potentially, this could give the invasive species *Bellamya chinensis* the ability to outcompete the species *Physa acuta*. With this in mind, The rise in average water temperatures could help *Bellamya chinensis* expand its habitat and spread to new regions faster. Further study would need to be made to fully understand all the factors that could go into the survival, growth, and survival of these species in a changing environment.

Experience and Acknowledgements

Conducting this research through FURSCA has been an amazing experience for me. It gave me the opportunity to practice doing research with live animals and learn how to code using the program R. During my research I did hit a couple of curves like having the adult *Physa acuta* reproduce hundreds of egg masses in a really short time span. Also, the pH in the tanks started to get unusually high and I had to order a pH reducer, but that's part of the uncertainty that comes with working with live animals. Going forward, I'm going to finish analyzing my data and present my findings at Elkin Isaac next spring. I'm also planning to present my results off-campus at the Society for Integrative & Comparable Biology conference. I would like to

thank the Robson Family Endowment for supporting my research through FURSCA this summer! Their support has allowed me to further my understanding of how climate change will affect local ecosystems like the Kalamazoo River and two snail species that live in these habitats.

Citations

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