Effect of Variable and Constant Food Availability on the Growth of *Heterandria formosa*

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ABSTRACT

In this study, the small livebearing fish *Heterandria formosa* was selected in order to test the effect of varying food availability and constant food availability on growth. The *Heterandria formosa* utilized in this experiment were hybrids from two distinct wild Florida panhandle populations. One typically experiences low food periods while the other does not. The experimental design consisted of 18 pairs of tanks, each of which began with 40 fish of the same length distribution(N=18). Half of the pairs were treated with constant food intake while the other half received varying food availability. The populations receiving constant food intake, were given the same amount (300mg) of food consistently throughout. The other group the populations receiving varying food availability, received the daily amounts (30mg, 500mg, and 520mg) for the same total average amount as the constant food intake after every two weeks. I hypothesize that the fish receiving food at a constant rate will both be longer in length and have a higher population number compared to the populations experiencing variable food availability. The results showed that there was no significant difference between the abundance of *Heterandria formosa* that were fed with constant food compared to those with variable food treatment. However, this experiment is still ongoing, therefore, differences may be observed in the future.

Introduction

- Investigating the impact of fluctuating food availability on aquatic vertebrates like *Heterandria formosa* is crucial due to the fact that human activity has been and continues to impact countless of communities and overall ecosystems. It is now especially important to research how organisms may adapt or survive to changing resources.
- The *Heterandria formosa* utilized in this experiment were collected from two distinct sites. The first site was Wacissa River where individuals experience lower and more variable food levels. The second site was Trout Pound which was less dense with high predation. Additionally, individuals from Wacissa River have a larger size at maturity and survive food deprivation much better compared to the fish at Trout Pond.
- For the experiment, in the laboratory, half of the tanks receive constant food while the other half are fed based on a fluctuating food availability schedule. The lengths of the fish were measured previous to initiating the experiment and were measured multiple times during the experiment as well.
- Previous research showed that fluctuating food levels can affect small fish similar to how low food conditions impact energy levels (Molina-Moctezuma et al., 2020). From this article I hypothesize that the populations experiencing variable food availability will be negatively impacted. Specifically, variable food availability may negatively impact reproduction or lower the chance of survival causing a lower abundance.
- This study aims to research the impact that food availability has on the growth and overall length of the fish and to see if organisms are able to adapt to changing resources.

Figure 1: *Heterandria formosa*

Figure 1: shows a mature female *Heterandria formosa*.

Figure 3: *Heterandria formosa* on Petri Dishes

METHODS

- Prior to setting up our experimental design, fish were taken at random from two differing field sites, Wacissa River and Trout Pond, and were then bred at the greenhouse. It is the offspring, hybrids born in the greenhouse, which were then utilized in the experiment.
- Our experimental design is based on a total of 18 pairs of tanks each initially consisting of 40 fish (F1s) plus their offspring (F2s). Half of the pairs were treated with constant food intake while the other half were fed based off of a variating food availability schedule.
- Prior to initiating the experiment, all fish were measured utilizing the application PictureMeasure. After all measurements were taken 40 fish were placed in each tank. There was a fixed number of fish from each length assigned to each tank.
- Once the experiment began, 9 pairs of tanks received a consistent 300mg of food. The other 9 pairs of tanks received 30mg, 500 mg, and 520 mg depending on the day. After the span of two weeks the fish receiving variable food would have eaten the same total amount as the ones receiving consistent food; the only difference being that one group received food at a constant rate while the other received it at a varying rate.
- The experiment began November 29th, 2021 and after 6-9 weeks in these conditions each individual fish was measured using the same application as before, PictureMeasure.
- Next, all data was transcribed onto an Excel sheet and onto a program, RStudio, for further analysis.

Figure 2: Wacissa River

Figure 2: The figure shows the Wacissa River, one of the field sites where the original fish were collected. The population of *Heterandria formosa* in this location were both larger in size and had greater survival under food deprivation.

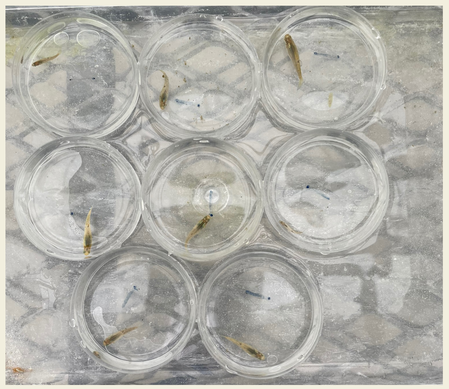

Figure 3: The figure displays *Heterandria fromosa* in petri dishes prepared to be measured using the application, PictureMeasure.

Figure 4: Initial Length Distribution

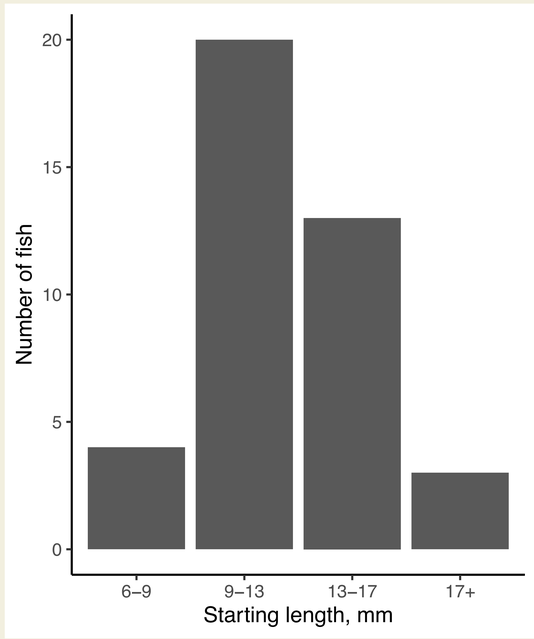

Figure 4: This figure displays a chart showing the initial number of fish in each individual length group on November 29th, 2021. The length groups are 6-9 mm, 9-13mm, 13-17mm, and 17+ mm in each population.

Figure 5: Final Length Distribution.

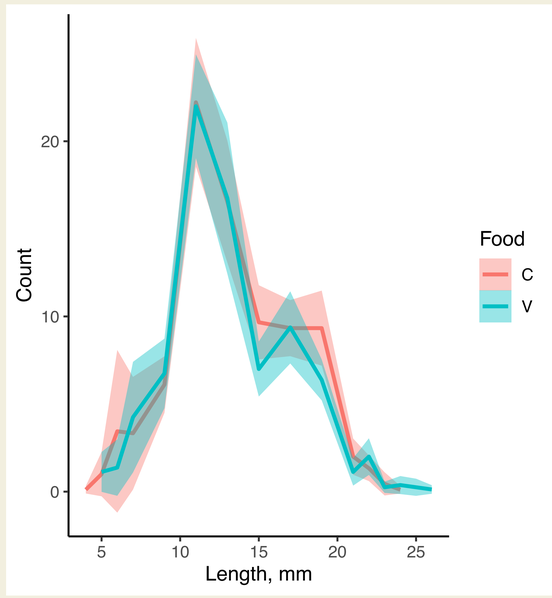

Figure 5: This figure above shows the mean length distribution(average number of individuals per length per population) of the *Heterandria formosa* populations after 6-9 weeks in constant and variable food conditions. Error bars represent +/- standard error of the mean times 1.96.

RESULTS

In this experiment, it was shown that there was no significant difference in the abundance of *Heterandria formosa* in the length groups that experienced constant food compared to those treated with variable food treatment. On average there were more individual fish in the constant treatment compared to the group treated with variable food (Figure 5); however, the difference was not enough to be caused by more than random chance. Most of the subject fish were approximately the same length as when they were put in; therefore, more differences may appear as growth and time progress. The results also seem to suggest that the fish we are using in our experiment carry some genetics for being able to tolerate food variability. Trials for this experiment plan on being continued as this was just the first trial.

Discussion

There is not a strong negative Jensen's effect for this species. As previously stated, this could be due to the population descending half from a wild population that naturally experiences food variability. There may have also been multiple variations other than food treatment such as temperature and light between the tanks that impacted the results. Additionally, detecting the difference in growth due to the food treatment may be more detectable if the length growth of individually marked fish was measured instead. Another possibility could be that negative effects of food availability may have been effects on survival and reproduction, rather that effecting the growth of the fish. Overall, the other variations between tanks will be reduced as the experiment continues and the effects of food treatment may vary depending on the season and in general as the experiment progresses.

Conclusion

At this point in the experiment food availability appears to not significantly impact growth in length. This knowledge can be useful to understanding how changes to environments may impact organisms. All in all, if this experiment continues to show that food availability is not significantly impacting the growth of body length future studies can begin to focus and test other factors food availability could be impacting, such as reproduction.

Acknowledgements

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References:

- Molina-Moctezuma, A., Hernández-Rosas, A. L., & Zúñiga-Vega, J. J. (2020). Resource availability and its effects on mother to embryo nutrient transfer in two viviparous fish species. *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology*, *333*(3), 181–193. https://doi.org/10.1002/jez.2342