An Analysis of Crayfish Populations in the Rouge River Compared with Select Water Quality Parameters

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Abstract

The Rouge River watershed of Southeastern Michigan is encompassed within a region that has become highly urbanized during the last century. This development has led to a significant number of fragmented ecosystems and has decreased species biodiversity. The wetlands, floodplains, and tributaries of the Rouge River make up a variety of smaller sub-ecosystems, each with its set of unique characteristics. There must be attention and research into the species that inhabit these smaller regions if we hope to restore, preserve and protect the species that remain. The crayfish is one crustacean that inhabits these inland wetlands and branches of the Rouge River. Crayfish are considered a keystone species in many aquatic ecosystems. They control plant and fish populations and are a needed food source for many aquatic lifeforms. The crayfish's prominent role explains why it is necessary to study these lobster-like creatures. This research was conducted over two months using minnow traps that were designed, engineered, and deployed to monitor crayfish populations in two branches of the Rouge River - the Lower and Middle Branch. Data was also simultaneously collected on air and water temperature, dissolved oxygen, and turbidity using Vernier LabQuest 2 sensors. During this research, crayfish populations were monitored throughout the autumn of 2021. Crayfish were trapped, measured, identified, and returned to the river. As autumn progressed and temperatures dropped, the quantity of crayfish collected increased. Only one crayfish species was trapped in both areas of the Rouge River during sampling - the Virile Crayfish (*Orconectes virilis*). For future research, we would like to expand our collecting period to include other seasons and to see what specific river environments and water quality parameters are most suited for crayfish reproduction and growth.

Introduction/ Hypothesizes

Crayfish are aquatic crustaceans found in inland bodies of water around much of the world. They have a varied diet of small organisms including insects, tadpoles, fish, snails, plants, and even decaying material (Helfrich). This wide-ranging diet allows them to fill in a niche where energy is transferred within aquatic food webs. However, this varied diet makes some crayfish species notoriously opportunistic and invasive. Once introduced into an environment, they can survive and compete against native crayfish species. In Michigan, this has caused the introduction of two invasive species into ecosystems known as the Rusty Crayfish (*Orconectes rusticus*) and the Red Swamp Crayfish (*Procambarus clarkii*). Crayfish are also important bioindicators where their population numbers correlate heavily to specific environmental conditions. As a result, their populations can be used as a sign of a change in a certain condition of an aquatic ecosystem. According to Dr. Lucas, some of these indications include water quality of pollutants, pH, BOD, and dissolved oxygen. These important bioindicator properties and the significance of crayfish as a keystone species, makes understanding their local populations even more essential to properly assessing and managing the Rouge River watershed.

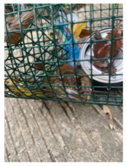
1. There is no difference in crayfish species and their numbers found in two (2) branches of the Rouge River.
2. There is no correlation between crayfish numbers and dissolved oxygen levels.
3. There is no correlation in crayfish numbers and turbidity.
4. There is no correlation between temperature values and crayfish numbers.

Methodology

Crayfish were trapped at two separate sites, the Lower Rouge Branch and Middle Rouge River Branch.

The river's dissolved oxygen, turbidity, air temperature, and water temperature would be measured.

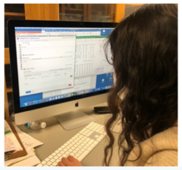
Traps were set



Traps were retrieved and crayfish were captured

Measuring crayfish collected

Crayfish were examined for species and sex



Submitting our research data onto the GLOBE database

Results

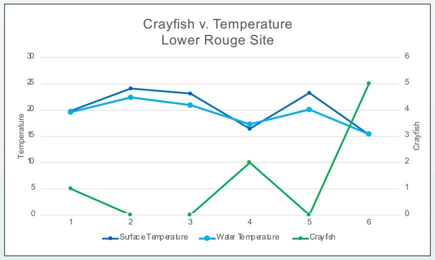


Figure 1- The graph shows a strong negative correlation between air temperature (dark blue line) and crayfish populations (green line). The graph shows a strong negative correlation between water temperature (light blue line) and crayfish populations (green line)

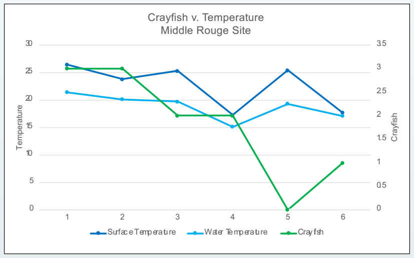


Figure 2- The graph shows a negative correlation between air temperature (dark blue line) and crayfish populations (green line). There is also a less clear negative correlation between water temperature (light blue line) and crayfish populations (green line). These correlations are most clear in data points 4-6

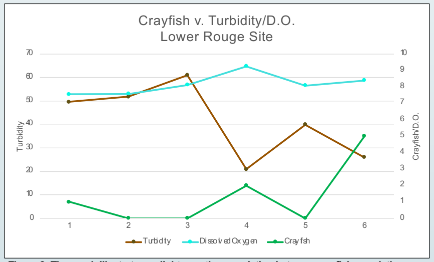


Figure 3 -The graph illustrates a slight negative correlation between crayfish populations (green line) and turbidity (brown line). The graph shows a slight positive correlation between crayfish populations (green line) and dissolved oxygen (blue line)

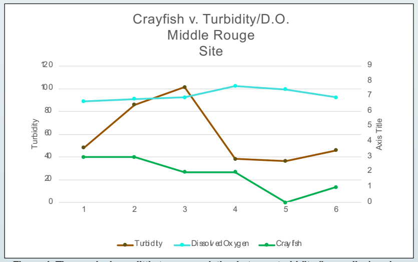


Figure 4- The graph shows little to no correlation between turbidity (brown line) and crayfish populations (green line). The graph also shows little to no correlation between dissolved oxygen (blue line) and crayfish populations (green line). However, this is inconclusive and more data and research would be needed to determine the correlation

Discussion

The Middle Rouge Branch seemed to not correlate with temperature as closely as the Lower Branch had. The Middle Branch's crayfish population seemed to strictly decrease as fall progressed, rather than correlating to measured temperature Crayfish of the Lower Branch seemed to highly correlate to changes in air and water temperature. The Middle Branch testing site had less correlation with crayfish populations concerning turbidity and dissolved oxygen than the Lower Rouge testing site. While on the other hand, crawfish populations of the Lower Rouge seemed to correlate more to turbidity and DO. Another difference between the two sites is the number of crayfish caught and the distribution in which they were caught. The Middle Branch site caught 3 more crayfish than the Lower Rouge and the capture rate was distributed much more evenly along the seven-week testing period, where each week saw a capture between 0-3 crayfish. The Lower Rouge, on the other hand, had caught three less crayfish and the capture rate was much more varied. From week 1-6 the site captured only 3 crayfish. In the final week the site caught 5 crayfish. This very random distribution compared to the even distribution of the Middle Branch is both surprising and remarkable in how two sites containing the same species only separated by approximately 4 kilometers would behave so differently. It was also expected during preliminary research that crayfish populations would decrease as temperatures dropped, as crayfish would lower activity and go dormant. However, looking towards the results from the Lower Rouge Site that was not the case. Populations and activity had increased as temperatures decreased. This drop-in activity may still occur as crayfish activity begins to drop at lower temperatures. Looking back at our Null Hypotheses we can conclude that the same species was found in both rivers while their number varied therefore, we can accept the first part of this hypothesis and reject the second part. The D.O. and Turbidity correlated with crayfish populations in the Lower Branch meaning we must reject these two-null hypothesis for this site. However, D.O. and turbidity had no correlation to crayfish populations of the Middle Branch meaning we must also accept these two null hypotheses for this site. If further research was conducted, we could definitively accept or reject these two null hypothesizes. Crayfish populations correlated with air and water temperature meaning we can reject our fourth null hypothesis. During the seven-week period our team noticed changes in the river corresponding with rainfall. Water depth, speed, and turbidity all shifted with the rain. Furthermore, this may be of interest in future research.

Conclusion

As our society continues to develop, we need to do our part in monitoring and keeping track of how it affects our local ecosystems. Crayfish are a great indicator species for water quality assessment. This experiment was designed for the purpose of determining the health of our local river rouge system through the capture of these species compared to their habitat. Results have found trends that varied from the lower and middle branch tested. The aspects that were shared by the two sites was that populations of crayfish increased as surface temperature went down, the two sites contained the same species, the Virile Crayfish, and they both had a majority of females caught. The trend for global temperatures in the world is expected to increase because of the immense amount of greenhouse gasses entering our atmosphere annually. Since our data shows that crayfish populations fair better in cooler temperatures, this global warming trend is not good at all. Crayfish most likely aren't the only species in danger of a growing industrialized society. If crayfish are disturbed by higher temperatures, whole food chains can collapse.

Acknowledgements/Bibliography

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