

Is There A Difference in Urban River Water Quality Between Michigan and Ohio Rivers?



#1221

Category: EA
Division: Junior
Science Type Project

Abstract:

- The purpose of this research was to discover if there is a difference in water quality of urban rivers between Ohio and Michigan and if that difference shows improved benthic aquatic life. The hypothesis used stated that the water quality in the urban Michigan rivers will have a more improved environment for benthic life because the waters are clearer, less odor is present, and many restoration projects have been active over the years to help clean these rivers up again. If the river is healthier, then the water quality index will fall within the ideal parameters for healthy river water and more benthics will be present.
- Four urban rivers were sampled, two in Michigan and two in Ohio. Ten trials will be run. Each river was impacted by urban industrialization. In Michigan, the Detroit and Rouge were sampled. In Ohio, it was Silver Creek and the Ottawa River. All were sampled and data collected using basic protocols that determine the health of rivers for benthic macroinvertebrate survival. LaMotte kits were used, along with LabQuest probe ware to validate data results. Tests performed were: Dissolved Oxygen ((DO), pH, nitrates, phosphates, turbidity, and water/air temperature. Data was recorded for later analysis. Lead testing was not performed due to the high cost of test kits. The control variable was the protocol standards set forth from the DEQ. Atmospheric data was also collected. The analyzed results were studied and the data gathered appeared to support the stated hypothesis.



Introduction

Do urban rivers have different water quality which can affect benthic macroinvertebrates?

- Water quality is a hot topic in the area where I live. Many urban communities must deal with aging infrastructures which cause unsafe drinking water issues. Since our drinking water also comes from these urban rivers, the question rises up that asks which urban rivers provide the healthiest water quality parameters: Ohio or Michigan?
- Using benthic macroinvertebrates as an indicator species helps to determine the health of the water for all aquatic life that must survive in the water. If these variety of living things can survive successfully, then there is hope for the rest of us.
- The purpose of this research is to discover if there is a difference in water quality of urban rivers between Ohio and Michigan and if that difference shows improved benthic life.



Introduction

- The **hypothesis** tested stated that the water quality in the urban Michigan rivers will have a more improved environment for benthic life because the waters are clearer, less odor is present, and restoration projects have been active over the years to help clean these rivers up again.
- **If the river is healthier, the water quality index will fall within the ideal parameters for healthy river water so more benthics will be present.**
- Much of the literature seems determined to name these places Areas of Concern, but do not give indication as to whether they have truly improved over time. It is the researcher's hope that this project will help to answer the question for the healthiest rivers.



Methods:

What is the experimental design?

- Four urban rivers were sampled, two in Ohio and two in Michigan. In Ohio, the Ottawa River and Silver Creek were used. In Michigan, the Rouge River and the Detroit River were used. Attempts were made to gain ten trials for each river, but the seasonal freezing made it difficult to obtain samples in Silver Creek on a second sampling excursion.
- Basic professional water quality tests were performed, following strict protocols for manufacturers directions and for GLOBE (NASA) where data will be uploaded once completed. These tests were: Dissolved oxygen, water/air temperatures, nitrates, phosphates, turbidity, and pH. These parameters are necessary to determine water health for benthic macroinvertebrates. (Big things with no bones, or BMI). Vernier probe ware will also be used for measurements.

Atmospheric protocols were also measured, using the GLOBE Observer app, which measures cloud cover, air temperatures and basic weather protocols.



Methods:

What is the experimental design?

- Data will be logged for later analysis. Samples taken from different sites on each river would allow for a variety of sampling sources and a more accurate picture of the river's health.
- Using these test results will give an indication as to each river's overall health. The results will be measured against the standard set by the Environmental Protection Agency (EPA) for healthy river water.
- The comparison of data for each river was analyzed and compared to determine each river's overall health in respect to benthics (BMI)



Materials:

- LaMotte test kits for:
 - Dissolved oxygen
 - pH
 - Phosphates
 - Nitrates
 - Turbidity

Fluke 63 non contact infrared thermometer (IRT)

Vernier Go Direct pH probe

SIS hand held unit for air temperature and gps locations



Results: Ohio

What did the data show?

	1/9/2021	1/26/21	1/30/21	1/30/21
Name of Test	Trial 1	Trial 2	Trial 3	Trial 4
Dissolved oxygen	3	-----	-----	-----
Nitrates	3	-----	-----	-----
Phosphates	3	-----	-----	-----
pH	7	-----	-----	-----
Turbidity	0 JTU	-----	-----	-----
Air temperature C	5 C	2	2	2
Water temperature C	-8.8 C	-----	-----	-----

GPS Coordinates:
41.7287
-83.5090



This is Silver Creek, Ohio, adjacent to a huge landfill. We were only to sample once because the next three times, it was frozen solid and stream banks were too steep to climb down and chisel ice to melt.

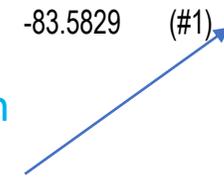


	1/9/2021	1/26/21	1/30/21	1/30/21
Name of Test	Trial 1	Trial 2	Trial 3	Trial 4
Dissolved oxygen	2	2	2	2
Nitrates	30	3	5	5
Phosphates	4	2	2	1
pH	5	7	8	7
Turbidity	0	0	0	0
Air temperature C	2 C	-1	-2	-2
Water temperature C	-6.8 C	-10.2	-12	-11.9

GPS Coordinates:
41.6130
-83.5829 (#1)



This is the Ottawa River which moves through the center of Toledo. The smell at site 1 was terrible to endure while sampling. We could only sample once there; the other sites were further down from the center of the city.



Except for pH, all numbers are parts per million, or ppm



Results: Michigan

What did the data show?

	1/9/2021	1/26/21	1/30/21	1/30/21
Name of Test	Trial 1	Trial 2	Trial 3	Trial 4
Dissolved oxygen	1	6	6	6
Nitrates	30	30	30	40
Phosphates	4	>4	10	10
pH	8	6	6	8
Turbidity	0	0	0	0
Air temperature C	3	1	0	0
Water temperature C	0.2	-2	-5	-5

GPS Coordinates:
42.3093
-83.2445



Except for pH, all numbers are parts per million, or ppm

The Detroit River @ Belle Isle was tested in 4 Locations around the island. It was surprisingly Clean for being an urban river between two cities.

The Rouge River has a long notorious history of being the most polluted river in the country. During the winter months, it has a history of being extraordinarily high in nitrates which no one seems willing to explain.

	1/9/2021	1/26/21	1/30/21	1/30/21
Name of Test	Trial 1	Trial 2	Trial 3	Trial 4
Dissolved oxygen	0	3	3	6
Nitrates	1	1	1	2
Phosphates	2	3	4	1
pH	7	6	7	7
Turbidity	0	0	0	0
Air temperature C	1	-2	0	0
Water temperature C	-6.8	5.6	-1.5	-0.1

GPS Coordinates:
42.3371
-82.9997



Discussion:

How were the results interpreted?

- The data was more fun gathering it. The testing took a long time. So did collecting all those samples!
- The data shows improvement in the Michigan samples but the Ohio samples also showed healthy portions. Some of the chemical tests were within the acceptable parameters for benthics to thrive, but others were not. The very high nitrates that continue to exist in the Rouge River is a huge area of concern and one reason perhaps that it still is listed as an Area of Concern (AOC) with the state of Michigan. The low levels of dissolved oxygen were expected due to winter conditions, but not that low.
- It seems other testing should include the presence of heavy metals but the cost for these test kits were too expensive for use with the research. You could smell the metals in the Ottawa River where the first sample was pulled and the stench made it almost impossible to perform the necessary tests.



Discussion:

How were the results interpreted?

- According to the EPA, the vital parameters for benthic survival should be:

Test	Score
Dissolved oxygen	8-14
Phosphates	0-5
Nitrates	0-5
pH	6.5-7.5
Turbidity	5 JTU/NTU

- data courtesy of river water quality from EPA

Based on the data obtained, none of the rivers showed enough improvement to consistently sustain benthic life in all areas necessary for survival. It was impossible to predict what Silver Creek would have shown with only one trial to sample. We were not able to get to the other river, the Maumee, to sample at any time.



Conclusion:

- In conclusion, several things should be noted: first these samples were too small to adequately support or disprove any hypothesis.
- The data was inconclusive, based on environmental factors such as the weather.
- A longer timeframe, with many more sampling sites and trials per site would be necessary to support or disprove the hypothesis.
- The areas of concern still remain areas of concern. More questions were raised while completing this research:
 - Why are the nitrates so high, especially during the winter season? (Rouge and Ottawa)
 - Why are the oxygen levels so low? If the water is moving, there should be oxygen.



Conclusion:

- More questions:
 - What is all the metallic smells in the Ottawa River and why is nothing being done about it?
 - How does this affect that city's drinking water?
 - Why are all the waters clear, instead of some turbidity? Benthics need a place to hide from predators.
 - Will these parameters be different in different seasons?

Who would be interested in this project? The real world applications for this research would be of interest to environmental organizations, water management systems, housing and industrial facilities. They could plan their future developments around this data.



Further research is critical for this project. It is my intention to follow through with research in different seasons and compare this data with the new data gathered to analyze results.

References

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