A Comparison of the Oxygen Levels in Mill Creek and Harrison Lake

to
The Ohio Academy of Science
by

Brooke Moreland

February 8, 2020

Research Supervisor: Mrs. Smith

Millcreek-West Unity School
1401 West Jackson Street
West Unity, OH 43570

Table of Contents

Abstract

This project was about the dissolved oxygen levels in Mill Creek and in Harrison Lake. Dissolved oxygen levels can be affected by the temperature of the water, algae blooms, the amount of sun that the water is exposed to, and other variables. Samples from Mill Creek and Harrison Lake were taken. Those samples were observed and recorded about Mill Creeks and Harrison Lakes temperatures and their dissolved oxygen levels. The water that is being tested goes into Lake Erie, so this data can eventually tie into the Lake Erie algae blooms. The recorded data had some differences every week, one week the water might have 11 ppm and then the next week it might be 5 ppm, this just depends on how much it rains and other things. The oxygen level in the creek was greater than the oxygen level in Harrison Lake, usually by 2 ppm, except for one day when they were the same. This is probably due to the fact that the creek is moving much faster than the water in the lake.

Purpose

The purpose of this experiment is to observe and see the differences in the water and the health of the water (because that water does lead to the same place), and eventually it will tie into the Lake Erie Algae Bloom.

If the water's oxygen level is very low, then there may not be much living things in that water. If the oxygen level is high, then living things are going to have a better chance to live, so there will be more living things in that water. Example; certain fish, like catfish, can live on lower amounts of oxygen, but other fish like trout need more oxygen to live.

Hypothesis

It was thought the water from Mill Creek would have more oxygen than the water from Harrison Lake when tested on the same day and time.

Introduction

Dissolved oxygen is a measure of how much oxygen is dissolved in the water, also known as the amount of oxygen available to living aquatic organisms. The amount of dissolved oxygen in a river or any body of water can tell a lot about its water quality. Around the gulfs there are areas called “Dead Zones”, in these areas there is little dissolved oxygen, so fish and other organisms have a hard time living there (USGS, “Dissolved Oxygen and Water”).

It’s easy to think about oxygen in the air we breathe around us, but what about the water and other liquids around us? Humans are not the only living organisms that need oxygen to survive. Oxygen has a major role in water management and environmental monitoring. Oxygen is not just in the atmosphere, but in liquids too. This makes dissolved oxygen a key measurement for many different things (Hanna Instruments, “Why test for dissolved oxygen?” Allison Hubbard).

The amount of dissolved oxygen can depend on the temperature of the water. The solubility of oxygen decreases as temperature increases. This means that colder lakes and other bodies of water can hold more DO than warmer waters. If the water is too warm it makes it so aquatic life can’t survive in that area (Fondriest, “Dissolved Oxygen”).

Which type of water holds more, freshwater or saltwater? Freshwater can and will hold more dissolved oxygen than saltwater. Saltwater has less space for oxygen molecules because of the sodium and chloride ions it contains. So the warmer and saltier the water, the less dissolved oxygen it will contain (Limno Loan, “Range of tolerance for dissolved oxygen in fish”).

Only certain types of organisms can live in low dissolved oxygen concentrated water. One of these organisms is Bacteria, it can survive, there are also only a few amount of fish that can live in very low levels, like northern pike and fathead minnows. Fish like Trout and Bluegill need higher levels of concentrated oxygen (Utah State University Extension "Water Quality"-Nancy Mesner).

When the dissolved oxygen level is low, there isn't a lot to do except to expose the water to the air. Decomposing plants, hot temperatures, and a lot of sunlight decrease the dissolved oxygen levels. One way to get oxygen back into the water is to create a paddle of wheel that mixes the water into the atmosphere. Another way is to let the water free fall through the air. You could also add force pressurized air or pure oxygen into the water with diffusers, this will result with an increase in the DO levels in the water (Campbell Scientific, "How is the oxygen level in water controlled")

Dissolved oxygen in irrigation water can be and is completely neglected. It's very important but yet completely ignored and it can have a significant impact on plant health, root development, fertiliser, and water uptake. Even some of the most advanced high tech farms who pay attention to everything that influences plant growth completely ignore water dissolved oxygen requirements (HortiDaily "The importance of dissolved oxygen in irrigation water"-Mike De Jong).

Algae needs light, nutrients, oxygen, and warmer temperatures to grow and multiply. The weather, location, and shape or size of the body of water also affect its growth. If any of these are

low then the algae will decrease. If conditions are good, algae growth is very high and creates an algal bloom. This can and will cause an imbalance in the ecosystem and could become a harmful algal bloom. This can be hard for the organisms that need water for survival including plants, fish, birds and even other algae (Center for Earth and Environmental Science "Algal Bloom" Purdue University).

Phosphorus and Nitrogen are nutrients that can become water pollutants when they enter into rivers, lakes, and oceans. These nutrients get into the bodies of waters through runoff, like rain washing leftover fertilizer from a field into a lake, or when a sewage treatment plant pumps sewage into a river. When these leftover nutrients build up in a body of water, algae and other plants grow at high rates, causing plants to have an overgrowth and harmful algal blooms. When the plants die, their decaying process lowers the dissolved oxygen level in the water, a level too low for fish to survive (Sciencing "The Effects of Sewage on Aquatic Ecosystems" Karen G Blaettler).

Water has a very tiny amount of dissolved oxygen. Most fish do well when the dissolved oxygen is five parts per million (ppm) or higher. When the dissolved oxygen is less than five ppm they become very uncomfortable and can start to suffocate. This can cause an imbalance in their ecosystem, which can result in aquatic life to die off and start to decompose, which eats up the level of dissolved oxygen making the level lower even more (U.S. Fish and Wildlife Service "Dissolved Oxygen" -Gary Peeples).

Just like fish need oxygen to survive, aquatic plants need carbon dioxide for life and growth. Carbon dioxide dissolves into water 200 times more easily than oxygen. Sometimes the carbon dioxide levels in the water become too high. Pollution can result into producing too much

carbon dioxide. When this happens, fish can have a hard time getting the oxygen they need to survive from the water. This can cause them to suffocate and die, which can cause fish kills. This is why keeping a good balance between dissolved carbon dioxide levels and dissolved oxygen levels are very important (Sea Grant Michigan “DISSOLVED OXYGEN AND LAKE STRATIFICATION”-University of Michigan and Michigan State University).

List of Materials

Thermometer
Clean Container
Oxygen CHEMets Kit (CHEMetrics with 30 glass ampoules and 1 25 mL cup)
Writing and paper to record data

Method

Mill Creek and Harrison Lake

1. Go to either Mill Creek (North of West Unity under US127) or Harrison Lake (Fayette, Ohio) once every week
2. Take the temperature (in Celsius) of the water
3. Take 2 samples of the water (every week)
4. Fill the sample cup to 25 mL mark with the sample to be tested
5. Place the ampoule, tip first, into the sample cup
6. Snap the ampoule tip off by pushing it against a ridge in the bottom of the cup
7. Wait until the ampoule self fills
8. Take self-filling ampoule out and slowly move it around until the color is a shade of blue
9. Compare what level of oxygen it is by placing the ampoule between the color standards until the best color match is found
10. Put collected data in graph

Variable Study

The independent variable which was changed was the location from which the water was collected. The dependent variable was doing the testing on the same day and about the same time. Other variables which would affect the amount of dissolved oxygen are using the same Oxygen CHEMets Kit and doing the same procedure.

Data

Date of test	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19	12/9/19	12/16/19	1/5/20	1/12/20
Mill Creek	9 ppm	11 ppm	11 ppm	7 ppm	8 ppm	9 ppm	11 ppm	10 ppm	9 ppm	6 ppm
Harrison Lake	7 ppm	9 ppm	10 ppm	6 ppm	5 ppm	7 ppm	9 ppm	8 ppm	7 ppm	6 ppm

10/27/19; A very clear day with no rain.

11/3/19; A cloudy day with no rain.

11/10/19; A cloudy day with no rain.

11/17/19; A cloudy day with little rain.

11/24/19; Just rained, mostly cloudy.

12/1/19; A clear day with no rain.

12/9/19; Murky recent rain.

12/16/19; A cloudy day with no rain.

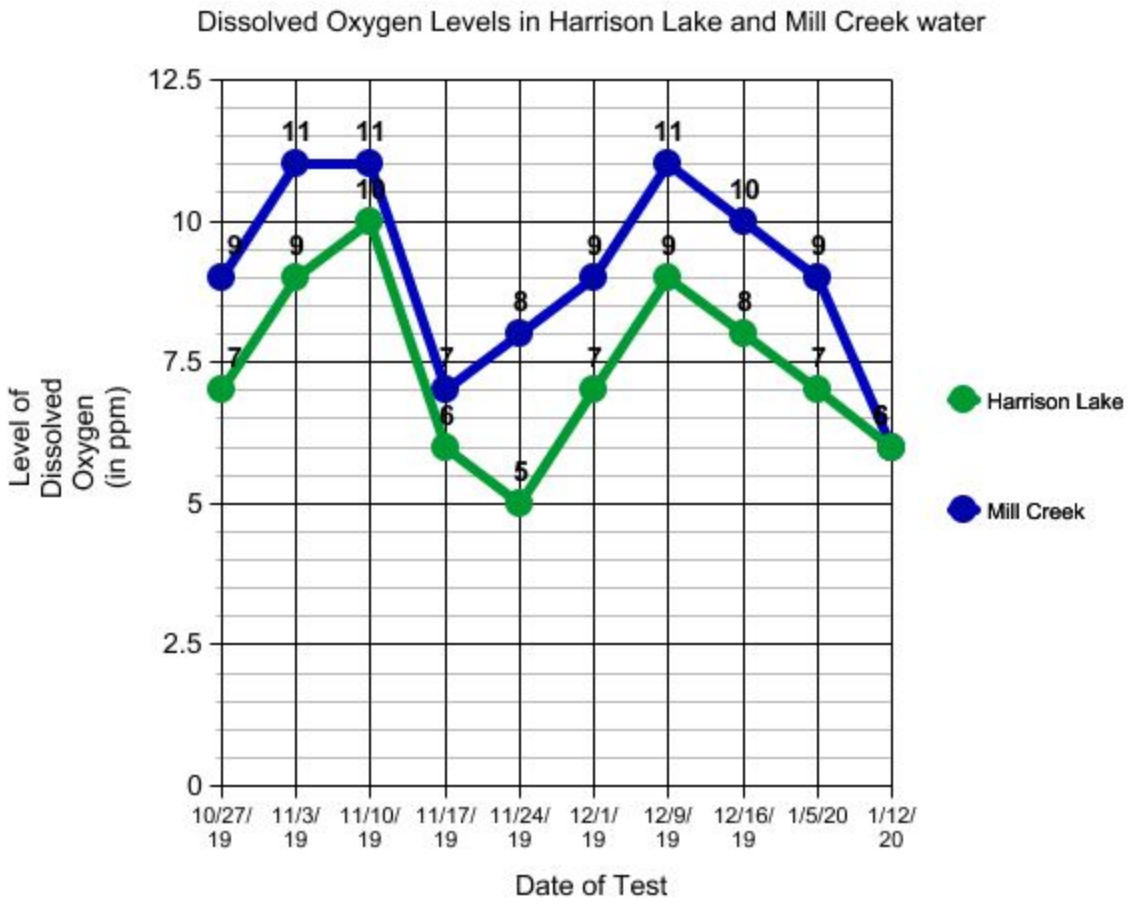
1/5/20; A mostly cloudy day with little rain.

1/12/19; Mostly cloudy and just rained.

Conclusion

In conclusion, the Mill Creek water has more dissolved oxygen than Harrison Lake water. The Mill Creeks Dissolved Oxygen was higher almost every time, only once were the Mill Creeks and Harrisons Lakes DO levels the same. For example, on November 24th 2019, Mill Creek had 8 ppm and Harrison Lake had 5 ppm. Many variables affect this, like the temperature, amount of sunlight, and plants and animals living in or around the water.

Graphs


Dissolved Oxygen Levels in Harrison Lake and Mill Creek water
Level of Dissolved Oxygen (in ppm)
12.5
10
7.5
5
2.5
0
10/27/19
11/3/19
11/10/19
11/17/19
11/24/19
12/1/19
12/9/19
12/16/19
1/5/20
1/12/20
Date of Test
Harrison Lake
Mill Creek

Discussion

Mill Creek almost always had more dissolved oxygen than Harrison Lake. Many things can influence why or why not the dissolved oxygen was high or low, but running water like creeks and rivers often have more dissolved oxygen. It also may be because the Mill Creek had a lot of trees around it, so it got a lot of shade so the temperatures were never very high.

There was one time where Mill Creek and Harrison Lake had the same level of DO, this was because it had just rained and both bodies of water were flooded. It takes about 3 days after it rains for the DO levels to go back to their normal levels, it just depends on the weather and the plants and organisms in the water.

Works Cited

"Algal Bloom". *Center for Earth and Environmental Science.* N. pg. On-line. 16 January 2020. Available at https://cees.iupui.edu/algal-bloom

"Dissolved Oxygen". *Environmental Learning Center.* N. pg. On-line. Google. 13 January 2020. Available at https://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen/

"Dissolved Oxygen". *US. Fish and Wildlife Service.* N. pg. On-line. 17 January 2020. Available at https://www.fws.gov/asheville/htmls/podcast_transcripts/2015/Trout-at-Hanging-Rock-State-Park.html

"DISSOLVED OXYGEN AND LAKE STRATIFICATION". *Michigan Sea Grant Home.* N. pg. On-line. 17 January 2020. Available at https://www.michiganseagrant.org/lessons/lessons/by-broad-concept/physical-science/dissolved-oxygen-and-lake-stratification/

"Dissolved Oxygen and Water". *Water Science School*. N. pg. On-line. Google. 14 January 2020. Available at https://www.usgs.gov/special-topic/water-science-school/science/dissolved-oxygen-and-water

"How is the oxygen level in water controlled?". *Campbell Scientific.* N. pg. On-line. 15 January 2020. Available at https://www.campbellsci.com/faqs?v=261

Hubbard, Allison- "Why test for dissolved oxygen?". *A Beginner's Guide to Dissolved Oxygen Measurement.* N.pg. On-line. Google 14 January 2020. Available at https://blog.hannainst.com/beginners-guide-to-dissolved-oxygen-measurement

"Range of tolerance for dissolved oxygen in fish". *Limno Loan.* N. pg. On-line. 13 January 2020. Available at http://limnoloan.org/waterquality/dissolved_oxygen/

"The Effects of Sewage on Aquatic Ecosystems". *Sciencing.* N. pg. On-line. 17 January 2020. Available at https://sciencing.com/effects-sewage-aquatic-ecosystems-21773.html

"The importance of dissolved oxygen in irrigation water". *HortiDaily.* N. pg. On-line. 16 January 2020. Available at https://www.hortidaily.com/article/6025147/the-importance-of-dissolved-oxygen-in-irrigation-water

"Water Quality". *Utate State University Extension.* N. pg. On-line. 15 January 2020. Available at https://extension.usu.edu/waterquality/learnaboutsurfacewater/propertiesofwater/dissolved oxygen

Acknowledgements

I want to thank Mrs. Smith for letting me do Science Fair this year, and for letting me use her Dissolved Oxygen Testing Kit, and for being an awesome teacher. I want to thank my mom for taking me to do my testing at Mill Creek and Harrison Lake. Lastly, I thank my grandma for letting me go to her house to test the water from Mill Creek.