Determining the Water Quality of Lake Norconian

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Table of Contents

Abstract

The question at hand is, “What makes the water at Lake Norconian healthy for the fish and birds it provides for?” My hypothesis to this is as follows: If the fish and birds on the lake are thriving, then the water’s dissolved oxygen levels should be between 4-15 mg/L. Also, the water’s pH level should be between 6.0 and 9.0, and the water temperature should be within 0 and 25 degrees Celsius. The research done at the Lake Norconian was tested mostly once a week on weekends, testing the lake’s water temperature, dissolved oxygen levels, and pH levels. The data collected at the lake for the past few months support this hypothesis for the most part. All of the data collected fell under the desired water temperature, pH level, and dissolved oxygen level range, with the exception of a few outliers in the dissolved oxygen data. The data was collected through the protocols and methods given by the GLOBE program. However, before collecting data, I was required to calibrate the thermometer using the GLOBE protocol. The dissolved oxygen kit and pH paper were said to be already calibrated by the company. To improve for the future, I should use a different kit for collecting dissolved oxygen and pH where I would calibrate the equipment myself, ensuring that the data I collect can be trusted.

Keywords: temperature, pH, dissolved oxygen, calibrate, supported

Research Questions and Hypothesis

The question at hand is, “What makes the water at Lake Norconian healthy for the fish and birds it provides for?” My hypothesis to this is as follows: If the fish and birds on the lake are thriving, then the water’s dissolved oxygen levels should be between 4-15 mg/L. Also, the water’s pH level should be between 6.0 and 9.0, and the water temperature should be within 0 and 25 degrees Celsius.

Research Methods and Materials (Including GLOBE data)

Before I started collecting data at the lake, I had to make sure that my measuring instruments were correct and ready to be used accurately. The pH paper and the dissolved oxygen kit were already calibrated by their companies. However, I had to calibrate the thermometer myself. I did this by following the GLOBE protocol for calibrating thermometers. I began by making an ice bath out of distilled water. I know that distilled water's freezing point is 0° Celsius (C), so I used that as my standard. When I put my thermometer in the ice bath, I expect it to read 0°C if it is accurate. I calibrated five thermometers and found that each had a different reading. One thermometer read 3°C instead of 0°C, while two thermometers read 2°C. The fourth thermometer read 0.5°C, but the fifth thermometer read exactly 0°C. This became my gold standard, and it is the one I used for all my water temperature measurements at the lake. This exercise made me realize that not all measurement equipment are accurate, and that they must be calibrated so the measurements they make can be trusted as accurate.

Now that all of my instruments are accurate and calibrated, I then need procedures and methods when collecting my data at the lake. When collecting data, I try to keep a consistent time of the day when I would go. For all of my data collected, I collected the data from 7 a.m. to 10 a.m. on Fridays, Saturdays, or Sundays. Before I can fill out any information, I first have to fill out the top portion of the *Hydrosphere Investigation Data Sheet*. For all of my procedures, I followed the GLOBE protocols. However, for some, the GLOBE protocol said to follow the protocol that the kits came with.

To get started, I followed the GLOBE Field Guide for collecting a water sample in a bucket. I first had to rinse the bucket with lake water and disposed the water away from the sampling site.

Next, I tied a rope to the bucket, and threw the bucket as far from the shore as possible. I then pulled the rope and retrieved the bucket with my sample water and started collecting data within ten minutes of obtaining the water.

The GLOBE protocol for water temperature was quite straightforward. First, I put on my gloves and goggles. The goggles are for my safety, and the gloves lower the chances of contamination of my water samples while I take my data. Then, I would submerge the bulb end of the thermometer in the water sample for a depth of 10 cm. This is to ensure that the thermometer bulb won't leave the water and disrupt my data collection. I would submerge the thermometer in the water for 3 minutes to let the thermometer reach its temperature point. Without taking the thermometer out of the water, I would read the temperature reading on the thermometer, and then allow the thermometer to sit for another minute. This extra minute is to allow the alcohol within the thermometer to reach its point, even if it takes longer than 3 minutes. If after the minute the thermometer reads the same, then I know that the number it reads is the temperature of the water, and I would record it on the *Hydrosphere Investigation Data Sheet*. However, if the thermometer read a different value after the minute than it previously did, then I would let it stay in the water for another minute. I would keep allowing it more minutes until I see the thermometer reading stays the same. I would do this procedure three times with different water samples and make sure all the temperature values are within 1°C from the average of all three measurements. This will ensure that I have a precise data range. If any of the measurements are not within 1°C, I would repeat the entire process again for all three measurements.

The GLOBE protocols for water pH and dissolved oxygen in water were given differently. For water pH, I used pH paper, and for the dissolved oxygen in water, I used a test kit. For both of these protocols, if not already on from a previous procedure, I would put on gloves and goggles.

Then I would rinse the beaker with sample water, throw the water out, and fill the beaker with new sample water from the bucket. The precautions are to avoid contaminating the water and corrupting my data. The GLOBE protocol then says to follow the procedure and directions that came with the dissolved oxygen kit and pH paper.

For pH paper, the instructions were quite simple. First, I would take a piece of about 3 to 4 inches of pH paper from the roll. I would then dip the paper in the solution. Though these steps were simple and relaxed, the next steps were stricter and more crucial. I then have to remove the paper quickly and compare it to the color chart immediately. I imagine that this is because if I leave the paper in the water too long or leave it out to dry, it could ruin the paper or the color could change to an inaccurate reading. After following the instructions on the kit, I then went back to following the procedure on the GLOBE protocol. I would record the measurements taken, and repeat two more times. Each of the measurements must be within 1.0 pH units of the average of all three. If they are not within these constraints, then I would repeat all the measurements again.

For the dissolved oxygen kit, I would first start by rinsing the sample cup that came with the kit as I did with the beaker. After rinsing the cup, I filled it with a new water sample from the bucket. Using the ampoule in the kit, I would break off the tip inside the water sample and leave it submerged until the ampoule fills up, only leaving a bubble for mixing. To mix the solution, I would invert the ampoule several times, allowing the bubble to reach each end before inverting. Next, I would dry the ampoule and wait for 2 minutes for its color to develop. Once the color has developed, I would compare it to the color standards provided in the kit and decide which standard matches the sample the most. After following these instructions, I would go back to the GLOBE protocol. I would record this value on the *Data Sheet* and take two more samples, following the same protocol and instructions. To make sure my values are precise, I would make sure that each

measurement is within 1 mg/L of the average of all 3 measurements. If not, I would repeat the protocol and instructions again.

Results and Discussion

As expected, the water temperature of the lake rose and dropped in accordance with the seasons. I started to collect data at the start of August, which would be the middle of summer. Throughout August, the water temperature kept slowly rising at the beginning of September, reaching its peak at 28°C. And as autumn began, the temperature began to drop in the lake as well. From September all the way to the beginning of January, the water temperature kept dropping until it reached its low of 11°C. Starting late January, the temperature started to rise again, with the latest water temperature of 15°C. See chart on Figure 1. These water temperature readings are well within the required levels in order for fish to survive in the lake, per the Environmental Learning Center website.[1]

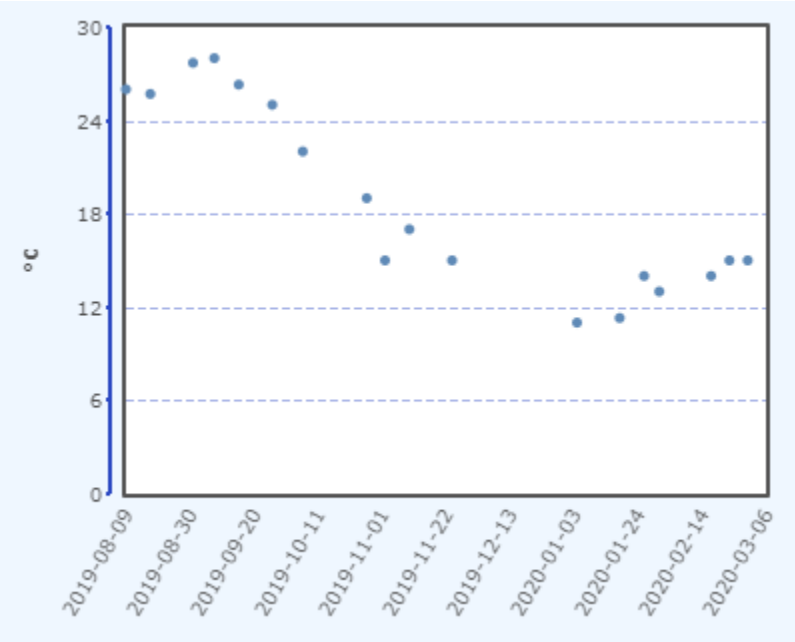

FIGURE 1. Water temperature data taken at Lake Norconian from Aug 2019 to Mar 2020

The data on the lake's pH levels was the most consistent data category that I collected at the lake. Though the pH levels seem to fluctuate, the lake has not exceeded the accepted neutral pH level. In the beginning of my research, the pH started out a bit more basic than acidic, having a pH level of 8. The pH level kept constant throughout August and September, but began to become neutral starting in October. Expectedly, after another two months or so, the lake becomes more acidic, dropping to 6 pH units. For the past two months, the pH level has been consistent. According to the Environmental Learning Center website, optimum pH level for fish are from 6.5 to 9.0.[2] The data I have gathered, as shown in Figure 2, supports the reason why fish are thriving at Lake Norconian.

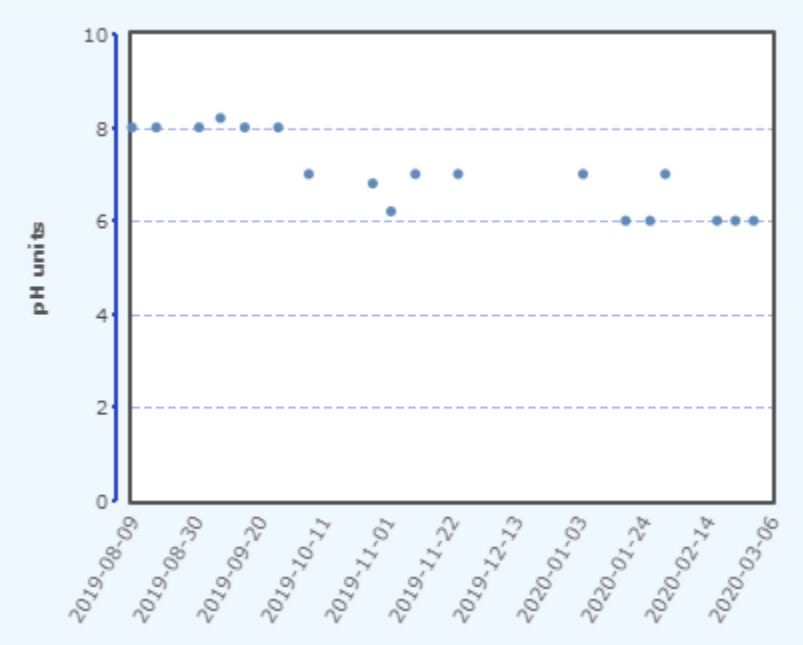

FIGURE 2. pH level data taken at Lake Norconian from Aug 2019 to Mar 2020

For the most part, the dissolved oxygen levels at the lake show a trend most similar with the trend seen with the water temperature levels. In the beginning of my research, there seemed to be a slight increase slope in dissolved oxygen levels. However, much like the trend in water temperature, at around September, the dissolved oxygen levels would begin its downward slope that would continue until February. In contrast with water temperature, there are some outliers in the dissolved oxygen graph throughout November. According to the Water Research Center website, the dissolved oxygen level needs to be above 4 mg/L in order for fish to survive.[3] Since I was getting 2 and 3 mg/L readings in November (see Figure 3), I started to doubt my data since no fish were dying in the lake. Thinking that I may have a bad batch of ampoules in the kit, I decided to order a new batch of ampoules for the kit. Once I took measurements with the new batch of ampoules, the levels I measured were normal again.

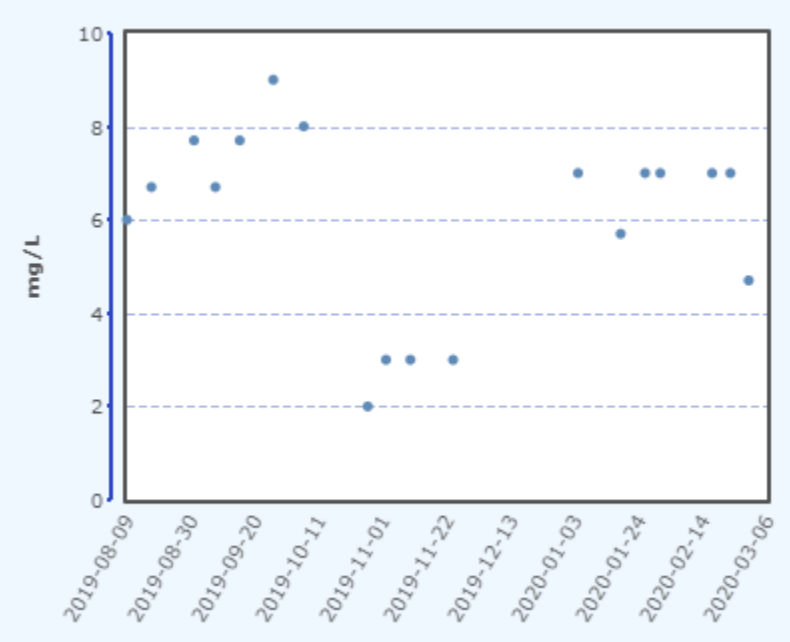

FIGURE 3. Dissolved oxygen level data taken at Lake Norconian from Aug 2019 to Mar 2020

Conclusion

In conclusion, I believe that my hypothesis is well supported by the data I collected at the lake for the past few months. In my hypothesis, I gave a range of values that the water temperature, dissolved oxygen level, and the pH level of the lake must be whenever I see that wildlife thrives in the lake, based on articles by the United States Geological Survey (USGS), the Environmental Learning Center, and the Water Research Center. According to my research at the lake, the data I collected fell well into the range needed for wildlife to thrive, with the exception of a few outliers in the dissolved oxygen levels.

There are a couple of ways I believe I can improve the methods I followed when doing my research. For one, I could buy different kits for pH and dissolved oxygen where I calibrate the equipment myself. By doing this, I can ensure that the equipment is accurate and not just have to rely on the credibility of the company. Having more accurate equipment would hopefully remove any chances of outliers in future data.

Looking to the future, I plan to use a more trusted and accurate test kit to measure dissolved oxygen and pH levels at the lake. I will most likely use the test kit recommended by the GLOBE program, the LaMotte kit. I also plan on adding electrical conductivity measurements in my data. I believe that adding electrical conductivity to my data collection would allow me to compare and determine how electrical conductivity can affect the lake's dissolved oxygen and pH levels. With a more trusted and potentially more accurate test kit, I would get more accurate data which would lead me to better understand the water quality of Lake Norconian.

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