Black Lake Nutrient Loading - 2023 Capstone Project

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Project Statement

Black Lake is a 4,593-acre freshwater lake within St. Lawrence County of northern New York. A popular tourism destination, the lake has become a major source of revenue for the towns in the surrounding area. However, Black Lake has been plagued by algal blooms and invasive Eurasian milfoil in the past few decades that have threatened the ecosystem and the economic stability of towns nearby with the risk of lost tourism. It has also become a problem for homeowners on the lake who can no longer recreate on the lake they call home. Previous and ongoing studies have focused on the water quality of Black Lake and the management of invasive aquatic plant species. Only one study, done by the USEPA in 1974, tested influent and effluent points. Given significant changes to agricultural practices since that time there currently is not enough understanding of the influent contributors to the lake.

The purpose of this senior capstone project was to evaluate the nutrient pathways into and out of the lake. This study was designed to measure basic water quality conditions of and nutrient loading in three major tributaries feeding into Black Lake, as well as the lake effluent. The goal was to compare water quality conditions to previous studies and national trends.

Figures 1 & 2: Black Lake & Eurasian Milfoil

Nutrient Issues at Black Lake

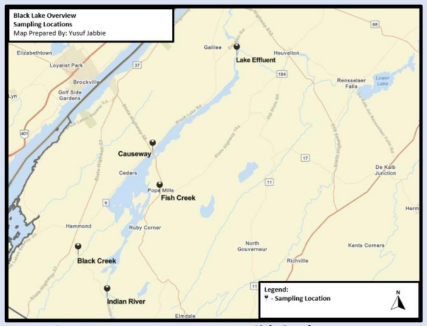
Black Lake has had water quality issues that have been studied for 50 years. Nutrients have caused invasive species to grow out of control in the lake such as Eurasian milfoil, the most commonly found invasive plant in the lake. Nutrients have also caused algal blooms, which are harmful to other aquatic species due to the consumption of dissolved oxygen by the algae. Since Black Lake is surrounded by farms, there are nutrients entering the lake via tributaries or direct runoff. The DEC studied the nutrient levels at different tributaries between 1972-74 in an attempt to identify the main source of nutrient loading into the lake.

A problem with previous studies of Black Lake is that very few have focused on the tributaries. The 1972 DEC study and the Spring 2022 SUNY Canton Capstone Project are two of the only studies that have focused entirely on the tributaries and lake effluent. Remediation such as cutting the milfoil by boat has been completed in the past in an attempt to salvage portions of the lake for recreational purposes for homeowners and tourists.

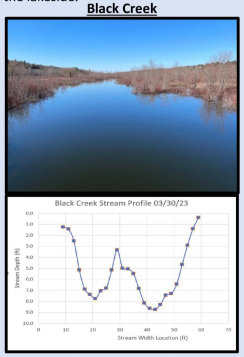
Figure 3: Milfoil remediation at Black Lake via harvester

Site Overview

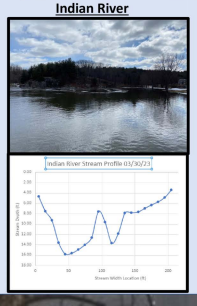
- Black Lake is a major lake within the Oswegatchie River watershed. It receives water from three inlets: Black Creek, Indian River, and Fish Creek. The Oswegatchie River is the only outlet from this lake. These 4 locations were sample collection location sites. The lake is located in the Northwestern New York in St. Lawrence County south of the St. Lawrence River and west of the village of Heuvelton. It is a popular destination for many people looking for recreational activities including swimming, fishing, and camping. Various cabins and camps can be seen all along the lakeside.



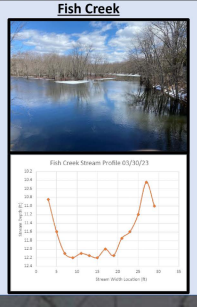
Black Creek



Indian River



Fish Creek



Spile Bridge

Field Testing

Field testing occurred on March 31st and April 13th at three tributaries (Black Creek near Hammond, NY; Indian River in Rossie, NY; and Fish Creek in Pope Mills, NY) and and the lake effluent (the Oswegatchie River at Spile Bridge near Heuvelton, NY).

In the field, basic water quality parameters were measured using the following equipment:

- Oakton PCTS250 Multimeter (temperature, pH, conductivity, total dissolved solids)
- HACH 2100Q portable Turbidimeter (turbidity)
- Fisher Scientific Orion Str A223 DO meter (dissolved oxygen)
- Ohio sediment stick (total suspended solids)

Water samples were collected for laboratory nutrient analysis. Additionally, the flow was measured via a flow meter at various increments along each tributary. With the use of a flow meter and a weighted tape measure, a stream profile was generated for the three tributary sites. Velocity was measured at each increment, and increment area was calculated. With this, total stream discharge was calculated and used to calculate nutrient loading.

Figure 4: Fish Creek Bridge

Figure 5: Field testing

Figure 6: Flow meter

Parameter	Sample Bottle Type	Sample Size	Method of Preservation	Holding Time
True and Apparent Color	Amber	200 mL	4°C	24 hours
Nitrate	Amber	1 mL	4°C Acidify if held for greater than 24 hours	24-48 hours
Nitrite	Amber	20 mL	4°C	24-48 hours
Orthophosphate	Plastic Acid Rinsed	20 mL	4°C	Maximum 48 hours
Total Phosphorus	Amber and Plastic	25 mL	4°C Acidify if held for greater than 24 hours	28 days
Sulfate	Amber	10 mL	4°C	7 days

Lab Testing

Lab testing was conducted in the Nevaldine South 135 water lab on Friday, April 1st and Friday, April 14th.

Parameter	ASTM Methods	HACH Method Number	Range	Sensitivity
True and Apparent Color	ASTM D1209	Method 8025	15 - 500 units	± 16 - 17 units
Nitrate	ASTM D3867	Method 10020	0.2 - 30.0 mg/L NO_3—N	± 0.2 mg/L NO_3—N
Nitrite	ASTM D3867	Method 8153	2 - 250 mg/L NO_2-	± 1.4 mg/L NO_2-
Orthophosphate	ASTM D515	Method 8048	0.02 - 2.50 mg/L PO_4^{3}-	± 0.02 mg/L PO_4^{3}-
Total Phosphorus	ASTM D515	Method 8190	0.06 -3.50 mg/L PO_4^{3}-	± 0.02 mg/L PO_4^{3}-
Sulfate	ASTM D516-02	Method 8051	2 - 70 mg/L SO_4^{2}-	± 0.4 mg/L SO_4^{2}-

Figure 7: Lab testing

Figure 8: Spectrophotometer

Results

After running the tests in the lab, the results from the 3/30 sampling event, indicated that the three main tributaries of Black Lake are not heavily impacted by nutrients, at least at this time of year. Dubrovsky et al. and the USGS (2010) defined median values for nutrients for agriculturally impacted streams. The results from 3/30 are shown in the table below *(green = values below national median, yellow = matching national median, red = above national median)*. When comparing the levels of nitrate + nitrite, orthophosphate, and total phosphorous from the tributaries at Black Lake to the national median levels, nearly all samples were below the national median. Analysis of samples collected on 4/13 is on going, after which nutrient loads will be calculated and comparison of data to previous river studies will be performed.

National Medians for Agriculturally Impacted Streams Defined by Dubrovsky		Nitrate + Nitrite (mg/L)	Orthophosphate (mg/L)	Total Phosphorus (mg/L)
		2.7	0.08	0.25
Site	Date / Sample			
Black Creek	03/30/23 Sample 1	3.05	0.05	0.08
	03/30/23 Sample 2	2.06	0.08	0.14
Indian River	03/30/23 Sample 1	2.04	0.04	*0.65**
	03/30/23 Sample 2	2.03	0.03	0.20
Fish Creek	03/30/23 Sample 1	2.04	0.04	0.11
	03/30/23 Sample 2	2.05	0.05	0.21
Spile Bridge	03/30/23 Sample 1	1.02	0.05	0.11
	03/30/23 Sample 2	1.06	0.05	0.02
*data may not be viable due error in lab testing				

The low nutrient levels see in the first sampling event, does not eliminate the tributaries as a main contributor to Black Lake's nutrient issues, though. For example, the time of year that the sampling events occurred needs to be considered. Very little agricultural activity occurs in the winter in the region, so levels of nutrients may be lower than they are in the summer or fall. Variable stream flow conditions throughout the year could impact results. While preliminary evaluation indicates that there may not be significant nutrients in the tributaries, in comparison to other agriculturally impacted streams nationwide, the water quality issues in the lake indicate that they are contributing enough to cause problems.

Conclusion

Nutrient loading is a major concern in various lakes and watersheds through the country. Primarily a result of agriculture and industries, the impact on water quality can be significant. These issues need to be remediated and should not be disregarded. Some possible short term remediation methods may include:

- Milfoil & algae harvesting
- Alternate fertilizer use to minimize nutrient runoff
- Better agricultural irrigation systems and drainage
- Crop and land use management
- Limiting fertilizer amount used in the surrounding area

Longer-term remediation may be required to completely eliminate nutrient overload present in the lake. This would require much more time and money than the short-term remediation methods, but would also be a more permanent solution to the problem.

References

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