“Good Ol' Onondaga!”

A Comparative Analysis of Nutrient Contributions from 3 Major Inflows to a Restored Urban Lake

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Mike (Left), Garrit (Center) and Conner (Right)

Introduction

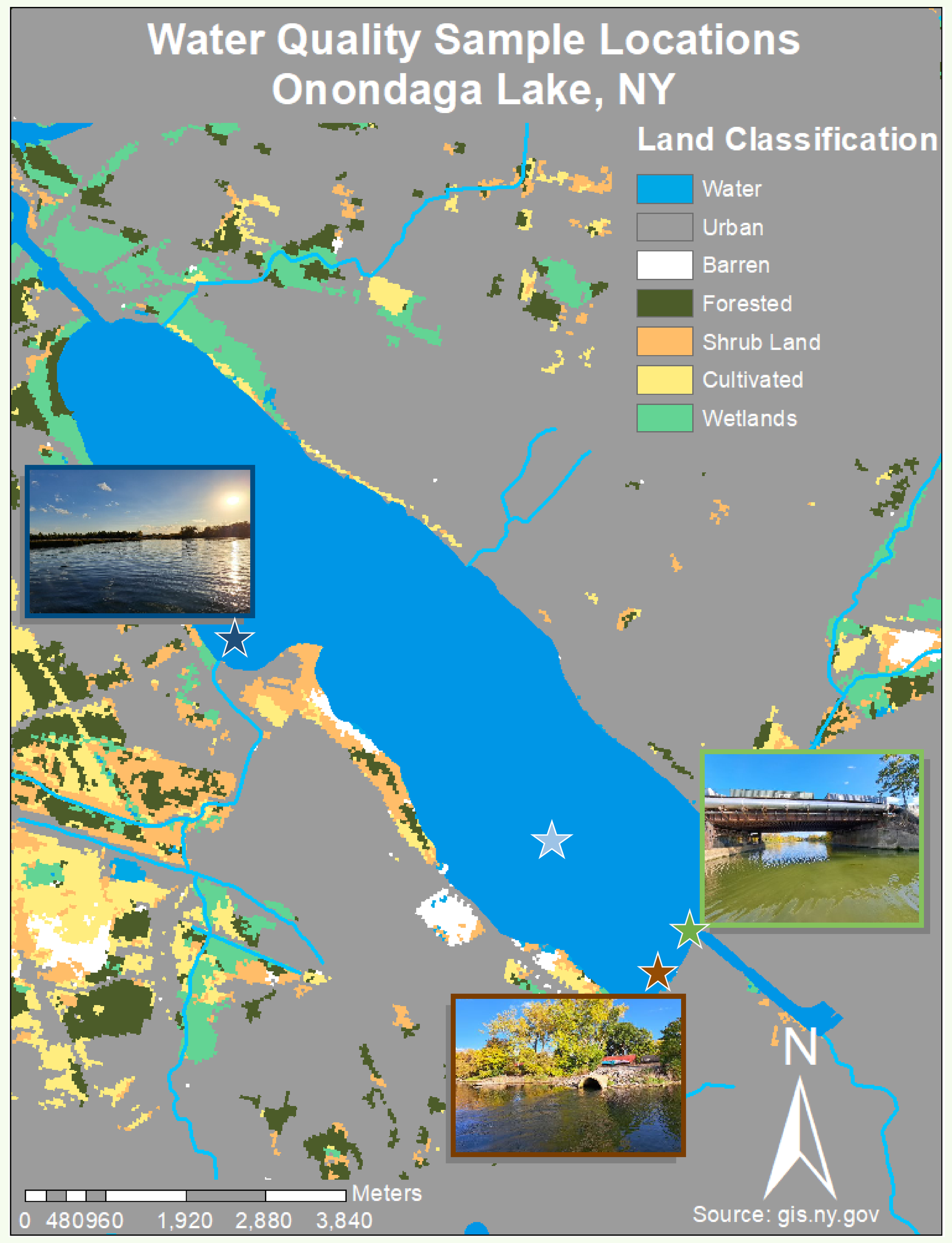

Figure 1: Map of Onondaga Lake and sampling locations: Onondaga Creek, Nine Mile Creek, Metro, and the Lake Basin.

Onondaga Lake has a history of anthropogenic pollution including industrial, urban wastewater, and agricultural inputs, but has improved significantly in recent decades due to restoration efforts. The lake has three major sources of inflow, accounting for 80% of all inputs, Onondaga Creek (31.4%), Nine Mile Creek (30.4%) and Metro (18.9%).[1] Onondaga Creek and Metro border an urban setting, whereas Nine Mile Creek borders agricultural land. The goal of this study is to determine the nitrogen and phosphorus contributions, chlorophyll-*a* (Chl-*a*) concentrations, and biological oxygen demand (BOD) resulting from each inflow. These parameters can be used to assess the impacts on overall water quality of Onondaga Lake.

Hypotheses:

- The largest contribution of nitrogen and phosphorus (mg/L) will be from Metro due to the inflow of municipal waste
- The highest concentration of Chl-*a* (ug/L) will be measured at Nine Mile Creek due to the high levels of agricultural runoff
- The lowest concentration of Chl-*a* (ug/L) will be measured at Onondaga Creek as there will be low water quality caused by the Tully mud boils (Kappel et al., 1997)
- The value of BOD (mg/L) will be highest in Metro due to the decomposition of municipal waste.

Methods and Materials

Biological Oxygen Demand Analysis

- Bioassay bottles were used, dissolved oxygen (DO) was measured with a YSI directly after collecting samples, then again after 5 days of incubation at 20 °C.

$$BOD = \frac{DO_i - DO_f \times 200mL}{600mL}$$

Nutrient Analysis

- Total Nitrogen (TN) and Total Phosphorus (TP) as well as total dissolved nitrogen (TDN) and total dissolved phosphorus (TPN) were determined using an auto analyzer. Samples for TDP and TDN were filtered before processing.

Chlorophyll-*a* Analysis

- Samples of 3 volumes were filtered for each site (200mL, 250mL, 300mL). Acetone buffer was added to filter paper to extract pigment. 3 Chl-*a* concentration values (µg/L) were acquired using a Turner Designs fluorometer and averaged.

Sampling was conducted on Saturday October 15th at 4:30pm. The day before, Friday October 14th, was rainy and slightly windy. All samples were taken at the mouth of the three inflows and each parameter was sampled three times. Samples were collected using a Van Dorn at 1 meter depth (Epilimnion).

Collecting water samples with Van Dorn

Preparing samples in test tubes for fluorometer readings

Results

■ Onondaga Creek ■ Nine Mile Creek ■ Metro ■ Lake Basin

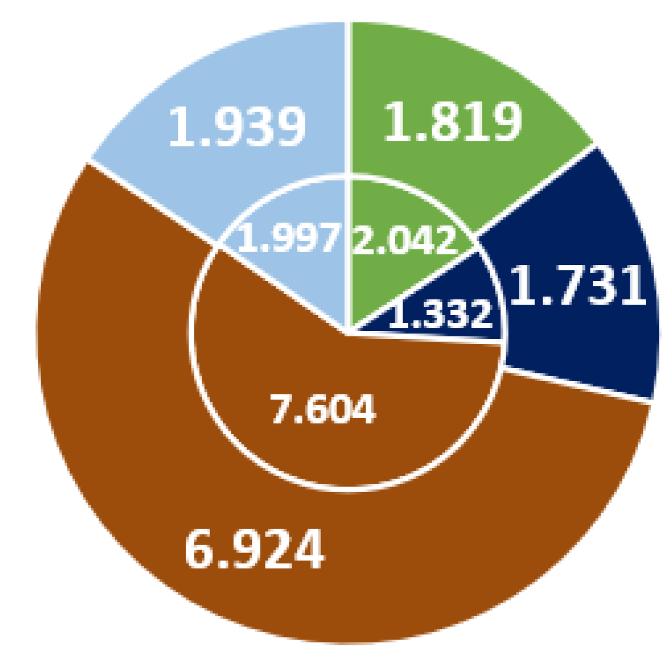

Figure 2: TN (Outer) and TDN (Inner) (mg/L) of samples from each location. The highest concentrations of TN and TDN were observed in Metro.

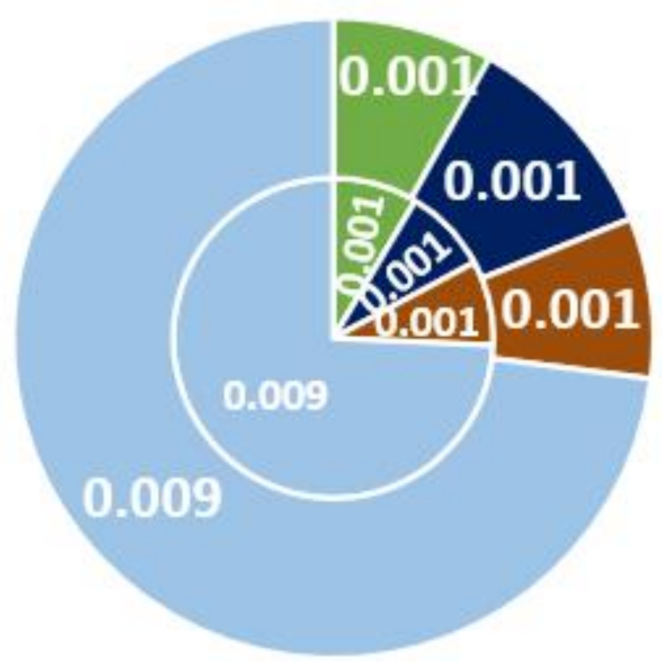

Figure 3: TP (Outer) and TDP (Inner) (mg/L) of samples from each location. The highest concentrations of TP and TDP were observed in the Lake Basin.

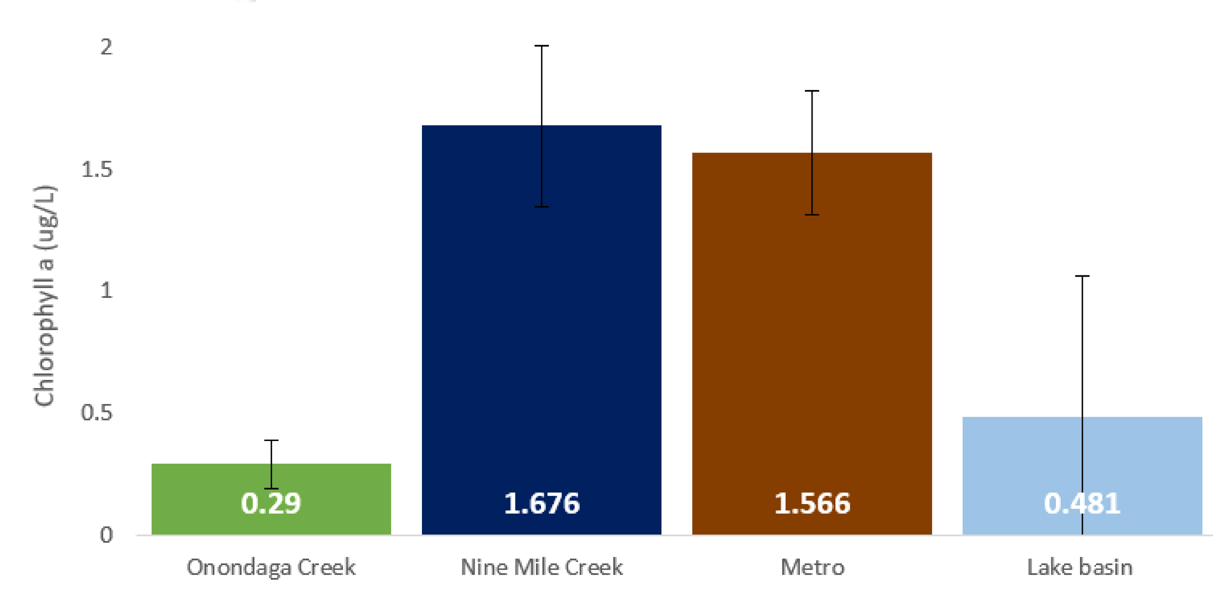

Figure 4: Chl *a* concentrations (µg/L) of samples taken from each location. Average Chl *a* concentrations were highest in Nine Mile Creek and Metro.

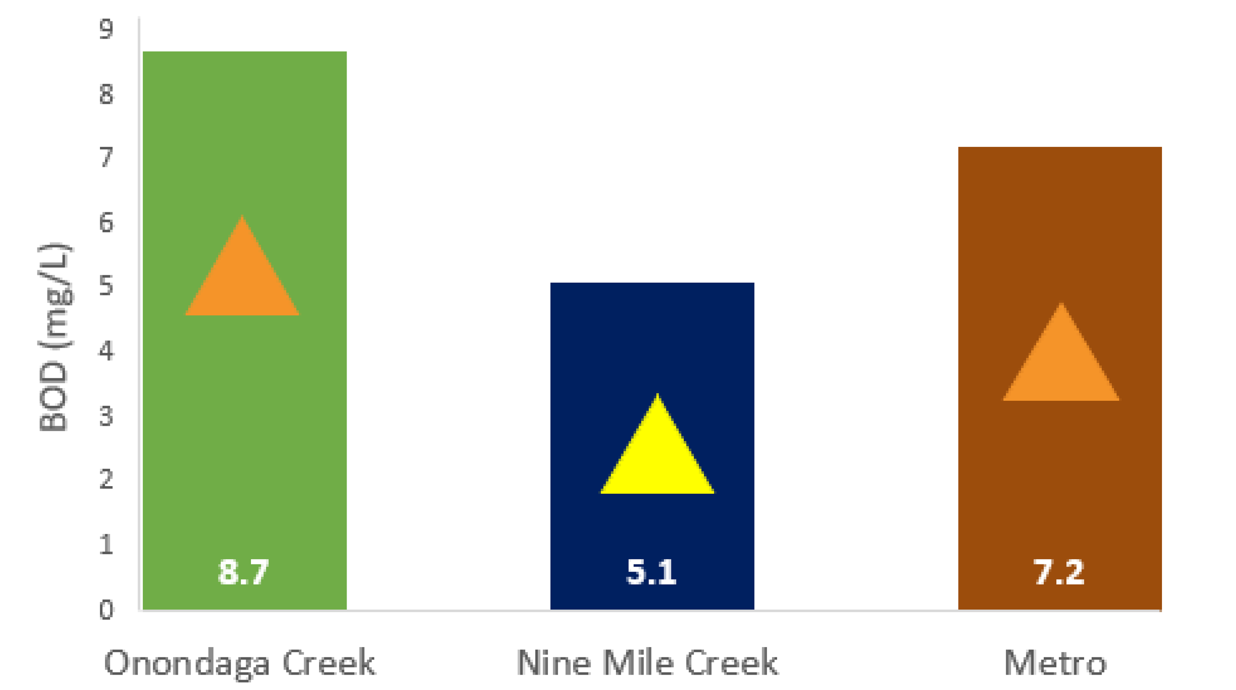

Figure 5: BOD (mg/L) of samples taken from the three inflows. The colored triangles represent water quality using Table 1. BOD measurements indicated Onondaga Creek and Metro have poor water quality and Nine Mile Creek has fair water quality (Table 1).

Table 1: Water quality conditions represented by calculated BOD values.

BOD (mg/L)	Water Quality
1-2	Very Good
3-5	Fair
6-9	Poor
10+	Extremely Poor

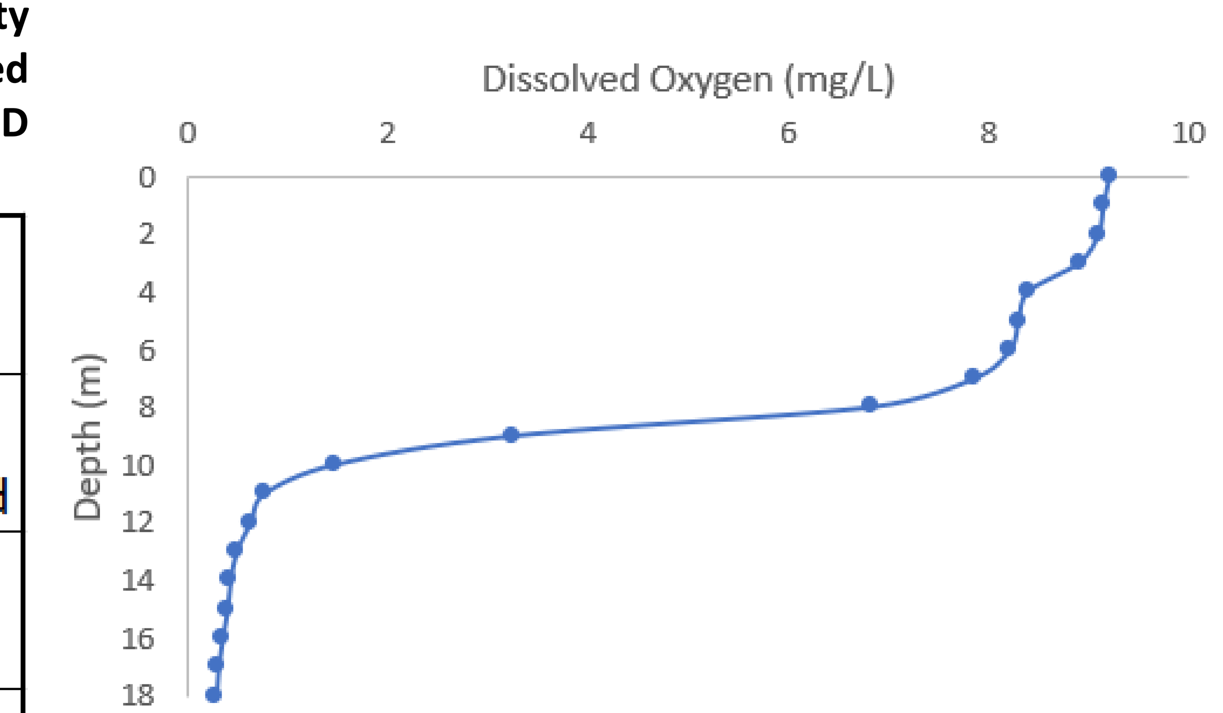

Figure 6: DO concentrations at depth from the Lake Basin of Onondaga Lake (9/21/22). The dissolved oxygen concentration nears 0 mg/L within the hypolimnion.

Discussion and Conclusions

- Observed levels of TN and TDN, supported our hypothesis of highest nutrient concentrations in Metro. Uptake by bacteria within the sediments is likely responsible for decreased TN and TDN within the Lake Basin.[4] The anoxic hypolimnion supports the release of TP and TDP from the iron trap, accounting for increased TP and TP within the Lake Basin.[2]
- Chl-*a* concentrations were highest within Nine Mile Creek, likely due to a higher water quality rather than the predicted agricultural inputs. High levels of Chl-*a* present at Metro are likely because of high nitrogen input.[3]
- High levels of BOD supported our hypothesis that Onondaga Creek would have the lowest levels of Chl-*a* due to poor water quality.
- Our hypothesis that BOD would be highest within Metro was not supported, instead observed BOD was highest within Onondaga Creek. High BOD within Onondaga Creek is caused by the accumulation of DOM from mudboils, its large catchment size and channelization alongside recent rains.[2, 5]
- Higher observed values of TDN compared to TN are likely due to data recording error from the use of an auto-analyzer.
- Future studies should consider the impacts of storm runoff on the nutrient compositions, chlorophyll-*a* concentrations and BOD of the inflows of Onondaga by sampling immediately before and after storm events.

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Resources

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