NORTH Dakota | Environmental Quality

Be Legendary.™

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November 2020

Lake Upsilon

(48.96079 N, -99.84173)

Rolette County

- Lake Upsilon is a large, natural lake in northern North Dakota (https://gf.nd.gov/gnf/maps/fishing/lakecontours/upsilon2004.pdf).
- Lake Upsilon is accessible by one public boat ramp on the northeast side of the lake.
- The Lake Upsilon watershed is about 2,800 acres of mostly deciduous forest, open water, and developed land (Table 1). The most common crops are other hay/non-alfalfa and alfalfa (Table 1).
- Lake Upsilon is a Class II, cool-water fishery, which are "capable of supporting natural reproduction and growth of cool water fishes (e.g., northern pike and walleye) and associated aquatic biota."
- The lake is primarily managed for walleye, with fingerlings stocked annually. Walleye, northern pike, bluegill and yellow perch were captured during the last sample by the ND Game and Fish in 2019.
- Lake Upsilon was previously sampled in 1995-1996, 2005-2006 and 2016.

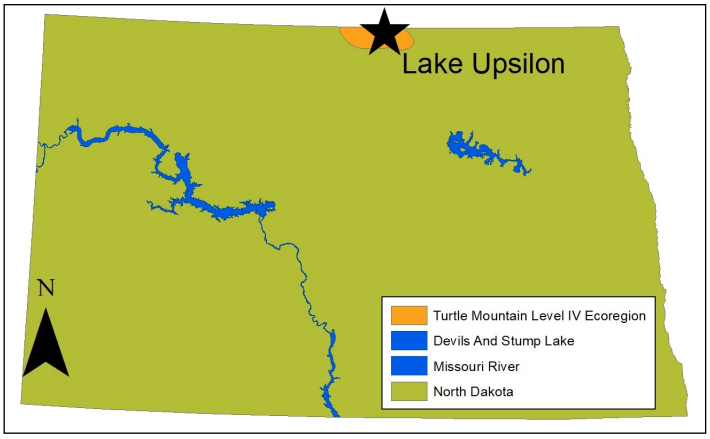

Figure 1. *Location of Lake Upsilon within the state*

Table 1. *Percentage of land cover in the watershed and near the lake (NASS, 2019). Value listed of crop type represents percentage of total production.*

Land Cover Type	% in Watershed	% within 100 meters
Deciduous Forest	57.0%	66.3%
Open Water	30.0%	13.8%
Developed	4.3%	5.9%
Agriculture	4.1%	6.4%
Other Hay/Non-Alfalfa	*62.1%*	*44.9%*
Alfalfa	*29.9%*	*28.4%*
Canola	*5.3%*	*4.4%*
Wetlands	3.7%	4.7%
Grassland/Pasture	0.7%	1.4%
Shrubland	< 0.1%	< 0.1%

Temperature and Dissolved Oxygen

- Lake Upsilon commonly stratifies in the summer, with warm, well-oxygenated water at the top of the water column, and cold, low-oxygen water near the bottom.
- There was some thermal stratification recorded in summer 2020. Top-to-bottom temperature changes at the lake were 0.2ºC, 2.8ºC, 6.8ºC and 0.0ºC in May, June, July and October, respectively (Figure 2).
- Most samples showed the lake as well-oxygenated, with only some near-bottom anoxia during thermal stratification.

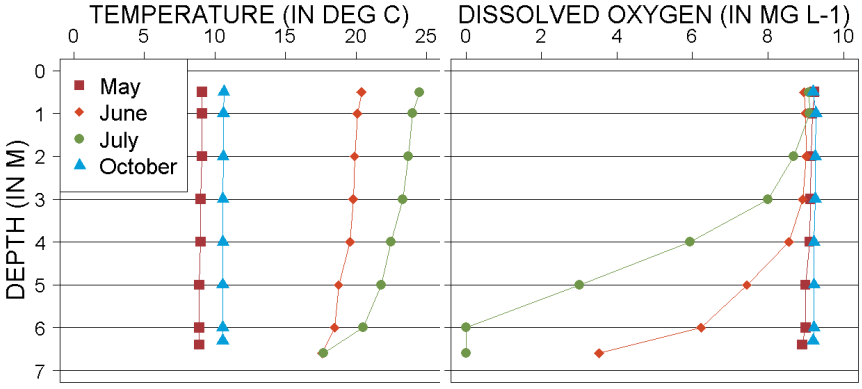

Figure 2. *2020 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L^{-1})*

Trophic State Indices

- Trophic state is a measure used by scientists to assess the condition (where lower scores indicate better water quality) of a lake using three common measures: total phosphorus (TP), Secchi disk transparency and chlorophyll-a concentration.
- Lake Upsilon is a mesotrophic lake (Figure 3) that has low nutrient concentrations and low algal growth.
- Trophic state has improved slightly compared to historical indices.
- There have been no confirmed ***harmful*** algal (cyanobacteria) blooms at Lake Upsilon.

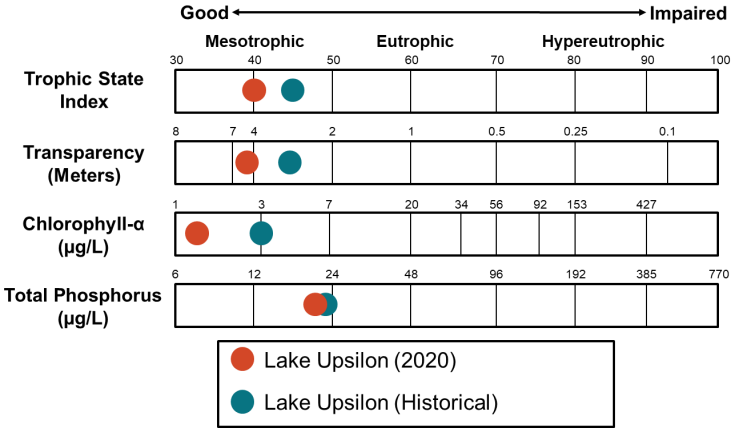

Figure 3. *Trophic state indices for 2020 and historical samples*

Nutrients

- Median concentration of total nitrogen (TN) at Lake Upsilon in 2020 was similar to the historical median for the lake and less than the median for the Turtle Mountains Level IV Ecoregion (Figure 1; hereafter, Turtle Mountains) where Lake Upsilon is located (Figure 4).
- Median concentration of dissolved TN was less than TN.
- Median TP concentration at Lake Upsilon in 2020 was similar to historical concentrations for the lake the median for the Turtle Mountains (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia and nitrate plus nitrite were not detected at Lake Upsilon in 2020.

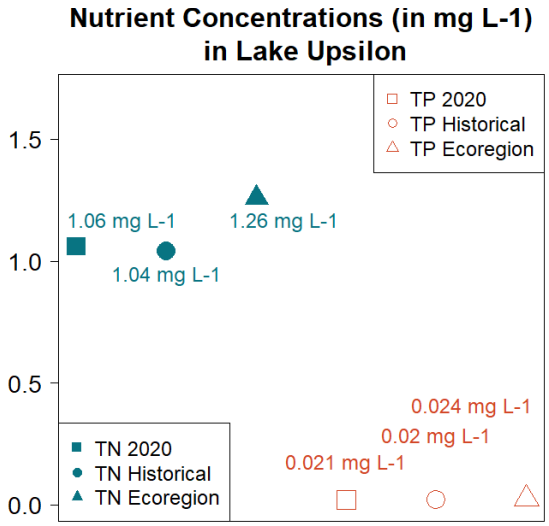

Figure 4. *Median concentrations of TN and TP in mg L^{-1} compared to regional medians*

Water Chemistry

Table 2. *Median concentrations of selected constituents for 2020 and historical samples and from all Turtle Mountain natural lakes.*

Measure	2020 Median	Historical Median	Ecoregion Median
Alkalinity	242 mg L^{-1}	242 mg L^{-1}	277 mg L^{-1}
Bicarbonate (HCO^-_3)	287 mg L^{-1}	285 mg L^{-1}	302 mg L^{-1}
Calcium (Ca^{2+})	25.4 mg L^{-1}	31.6 mg L^{-1}	31.6 mg L^{-1}
Carbonate (CO^{2-}_3)	7 mg L^{-1}	10 mg L^{-1}	13.5 mg L^{-1}
Conductivity	478.5 µS cm^{-1}	498 µS cm^{-1}	585 µS cm^{-1}
Dissolved Solids	264.5 mg L^{-1}	281 mg L^{-1}	336 mg L^{-1}
Magnesium (Mg^{2+})	44.2 mg L^{-1}	48.3 mg L^{-1}	56.2 mg L^{-1}
Sodium (Na^+)	8.1 mg L^{-1}	8.7 mg L^{-1}	8.3 mg L^{-1}
Sulfate (SO^{2-}_4)	24.8 mg L^{-1}	30.8 mg L^{-1}	49 mg L^{-1}

- Bicarbonate is the dominant anion in Lake Upsilon, while magnesium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are slightly less than the historical median for the lake and less than the median for the Turtle Mountains.

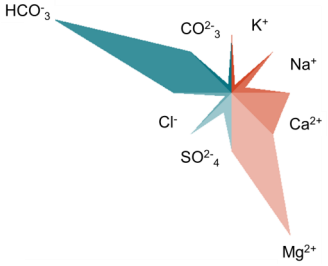

Figure 5. *Maucha diagram showing ionic balance based on 2020 data*