

February 2019

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 alfalfa and non-alfalfa hay (Table 1).
- Lake Upsilon is a Class II 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, and yellow perch are the most common sport fish in Lake Upsilon, with some large bluegill present as well.
- Lake Upsilon was previously sampled in 1995-1996 and 2005-2006.

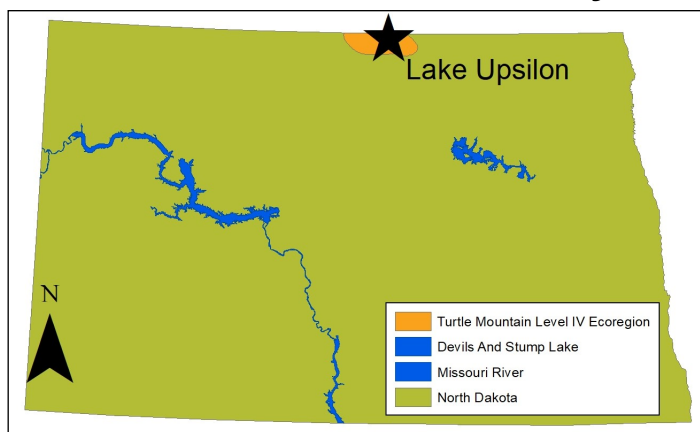


Figure 1. Location of Lake Upsilon within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2015). Value listed of crop type represents percentage of total production.

Land Cover Type	% in Watershed	% within 100 meters
Deciduous Forest	54.5%	61.4%
Open Water	33.1%	21.4%
Developed	4.7%	10.1%
Wetlands	3.2%	3.9%
Agriculture	3.0%	1.5%
Alfalfa	63.4%	19.2%
Other Hay/Non-Alfalfa	32.4%	38.5%
Millet	2.1%	30.8%
Grasslands/Pasture	1.6%	1.8%

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 thermal stratification in July 2016, with a temperature change of nearly 6°C in the deeper bays (Figure 2).
- Most samples showed the lake as well-oxygenated, with only near-bottom levels without oxygen (anoxic).

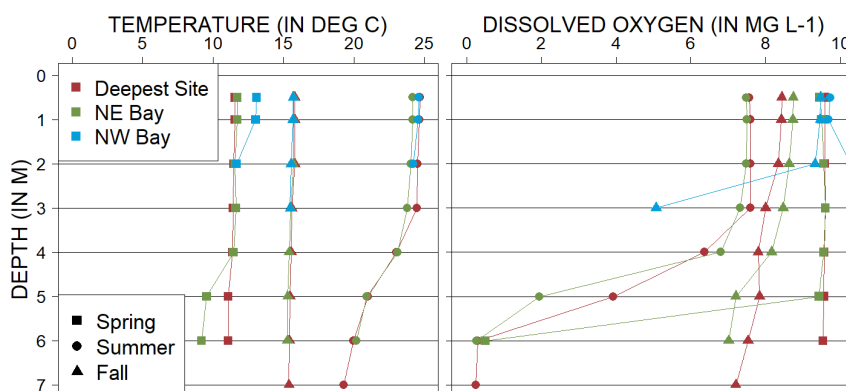


Figure 2. 2016 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L^{-1})

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 relatively low nutrient concentrations and low algal growth.
- Trophic state has not changed compared to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Lake Upsilon.

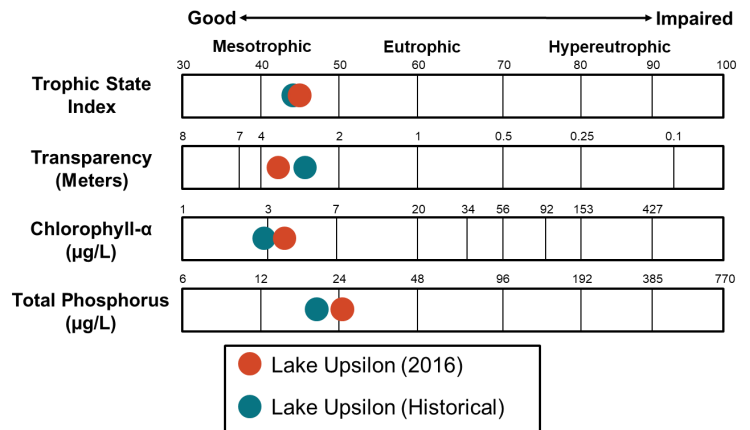


Figure 3. Trophic state indices for 2016 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) was lower in 2016 compared to the historical median and 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 similar to TN.
- Median TP concentration was the same in 2016 as historical concentrations and less than the median for the Turtle Mountains (Figure 4).
- Median concentration of dissolved phosphorus was slightly less than TP.
- Ammonia and nitrate plus nitrite were rarely above detection limits in Lake Upsilon in 2016.

Nutrient Concentrations (in mg L⁻¹) in Lake Upsilon

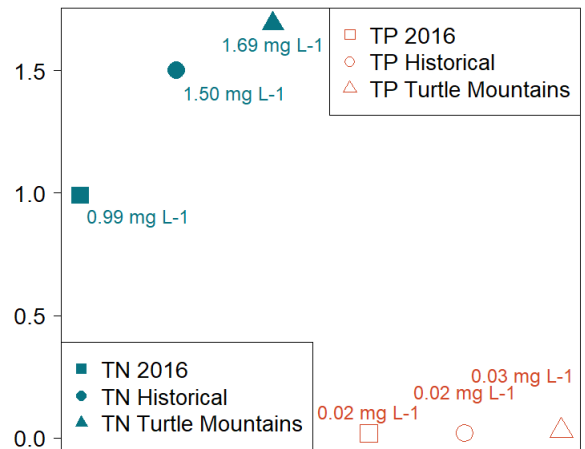


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2016 and historical samples and from all Turtle Mountain natural lakes.

Measure	2016 Median	Historical Median	Ecoregion Median
Alkalinity	234 mg L ⁻¹	273 mg L ⁻¹	290 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	266 mg L ⁻¹	303 mg L ⁻¹	325 mg L ⁻¹
Calcium (Ca ²⁺)	26.8 mg L ⁻¹	33.5 mg L ⁻¹	32.4 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	10 mg L ⁻¹	13 mg L ⁻¹	12 mg L ⁻¹
Conductivity	478 µS cm ⁻¹	568 µS cm ⁻¹	685 µS cm ⁻¹
Dissolved Solids	266 mg L ⁻¹	313 mg L ⁻¹	382 mg L ⁻¹
Magnesium (Mg ²⁺)	45.2 mg L ⁻¹	53.5 mg L ⁻¹	61.9 mg L ⁻¹
Sodium (Na ⁺)	8.0 mg L ⁻¹	9.1 mg L ⁻¹	8.9 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	27.7 mg L ⁻¹	33.9 mg L ⁻¹	60 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 lower than the historical median for the lake and for the Turtle Mountains.

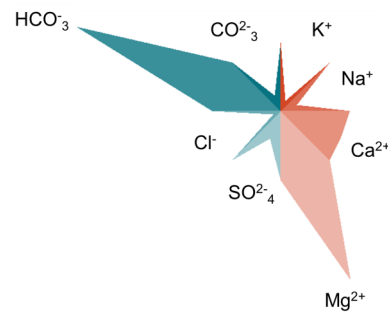


Figure 5. Maucha diagram showing ionic balance based on 2016 data