

February 2019

Carpenter Lake

(48.96283 N, -99.97991 W)

Rolette County

- Carpenter Lake is a large, natural lake in northern North Dakota (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/carpenter2010.pdf>).
- Carpenter Lake is accessible by one public boat ramp on the south side of the lake.
- The Carpenter Lake watershed is about 2,700 acres of mostly open water, agricultural land and deciduous forest (Table 1). The most common crops are alfalfa, other hay/non-alfalfa and winter wheat (Table 1).
- Carpenter Lake 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.”
- Historically, the lake has been managed for northern pike, but walleye fingerlings were stocked in 2017 and 2018. The most recent sampling survey by the ND Game and Fish found northern pike and yellow perch, with only small individuals of the latter found.
- Carpenter Lake was last sampled in 1995-1996.

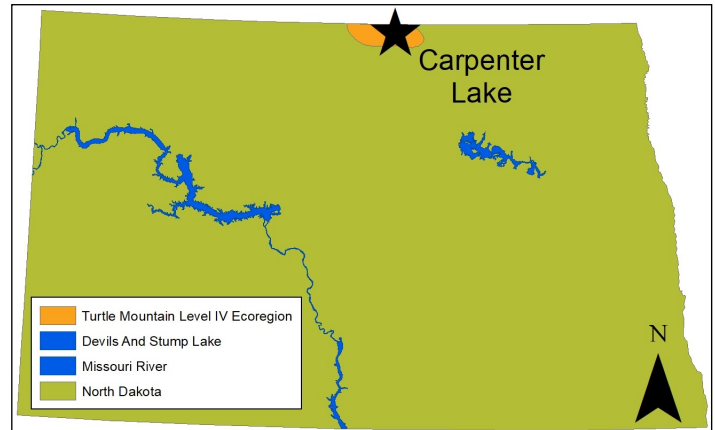


Figure 1. Location of Carpenter Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2014). Value listed of crop type represents percentage of total production

Land Cover Type	% in Watershed	% within 500 meters
Open Water	33.4%	4.1%
Agriculture	26.4%	30.7%
Alfalfa	39.9%	36.2%
Other Hay/Non-Alfalfa	34.4%	19.2%
Winter Wheat	18.5%	NA
Deciduous Forest	20.1%	37.9%
Grassland/Pasture	3.4%	6.2%
Wetlands	1.0%	1.7%

Temperature and Dissolved Oxygen

- Carpenter Lake rarely stratifies in the summer, with a well-oxygenated water column from top-to-bottom.
- There was no thermal stratification observed in 2015, with temperature changes of 0.12 degrees Celsius (°C), 1.08°C, and 0.42°C in May, July and September, respectively (Figure 2).
- All samples showed the lake as well-oxygenated.

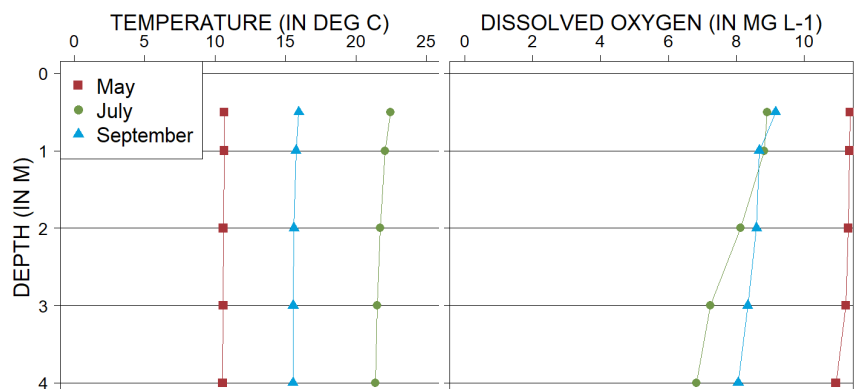


Figure 2. 2015 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter ($mg L^{-1}$)

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.
- Carpenter Lake is a eutrophic lake (Figure 3) that has moderate nutrient concentrations and moderate algal growth.
- Trophic state has declined compared to historical indices.
- There have been no confirmed **harmful** algal (cyanobacteria) blooms at Carpenter Lake.

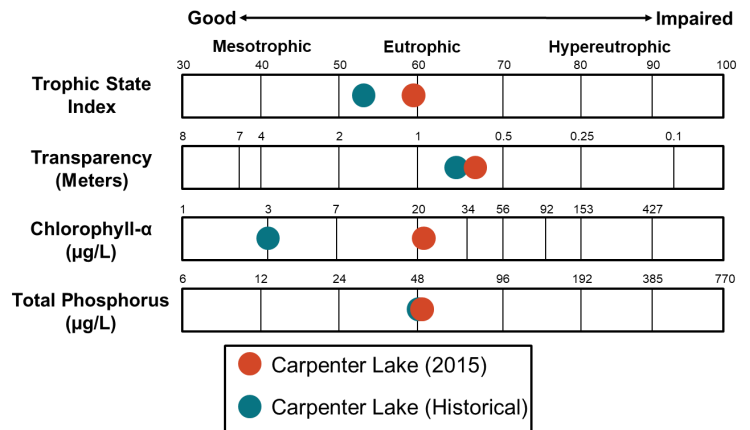


Figure 3. Trophic state indices for 2015 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) was lower in 2015 compared to the historical median and the median for the Turtle Mountains Level IV Ecoregion (Figure 1; hereafter, Turtle Mountains) where Carpenter Lake is located (Figure 4).
- Median concentration of dissolved TN was similar to TN.
- Median TP concentration was greater in 2015 than historical concentrations and the same as the median for the Turtle Mountains (Figure 4).
- Median concentration of dissolved phosphorus were similar to TP.
- Ammonia and nitrate plus nitrite were rarely above detection limits in Carpenter Lake in 2015.

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

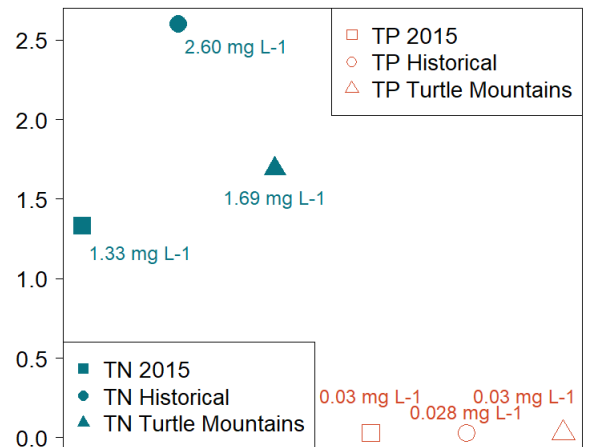


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2015 and historical samples and from all Turtle Mountain natural lakes.

Measure	2015 Median	Historical Median	Ecoregion Median
Alkalinity	285 mg L ⁻¹	332 mg L ⁻¹	290 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	308 mg L ⁻¹	356 mg L ⁻¹	325 mg L ⁻¹
Calcium (Ca ²⁺)	29.1 mg L ⁻¹	34.4 mg L ⁻¹	32.4 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	19 mg L ⁻¹	21 mg L ⁻¹	12 mg L ⁻¹
Conductivity	614 µS cm ⁻¹	848 µS cm ⁻¹	685 µS cm ⁻¹
Dissolved Solids	352 mg L ⁻¹	506 mg L ⁻¹	382 mg L ⁻¹
Magnesium (Mg ²⁺)	59.8 mg L ⁻¹	85.5 mg L ⁻¹	61.9 mg L ⁻¹
Sodium (Na ⁺)	9.0 mg L ⁻¹	11.8 mg L ⁻¹	8.9 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	53.6 mg L ⁻¹	153 mg L ⁻¹	60 mg L ⁻¹

- Bicarbonate is the dominant anion in Carpenter Lake, while magnesium is the dominant cation (Figure 5).
- Median concentrations of most cations and anions are lower than the historical median for the lake but higher than the Ecoregion.

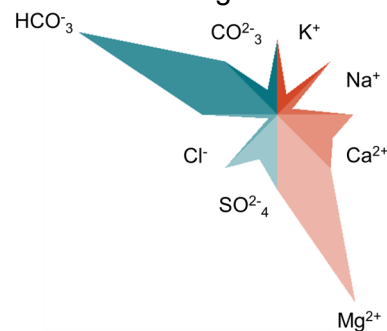


Figure 5. Maucha diagram showing ionic balance based on 2015 data