

December 2021

Buffalo Lodge Lake

(48.330720 N, -100.755042 W)

McHenry County

- Buffalo Lodge Lake is a large natural lake in northern North Dakota (Figure 1). See map at (<https://gf.nd.gov/gnf/maps/fishing/lakecontours/buffalolodge2020.pdf>).
- Buffalo Lodge Lake is accessible by one public boat ramp on the west side of the lake.
- The Buffalo Lodge Lake watershed is about 130,000 acres of mostly agriculture and grassland/pasture. The most common crops in the watershed are spring wheat, soybeans and other hay/non-alfalfa (Table 1).
- Buffalo Lodge Lake is a Class III fishery, which are “capable of supporting natural reproduction and growth of warm water fishes (e.g., northern pike and walleye) and associated aquatic biota.”
- The lake is primarily managed for walleye, with fingerlings stocked annually. Walleye, yellow perch and northern pike were captured by the NDGF in 2020.
- Buffalo Lodge Lake was previously sampled in 1995-1996 and 2005-2006 by the NDDEQ.

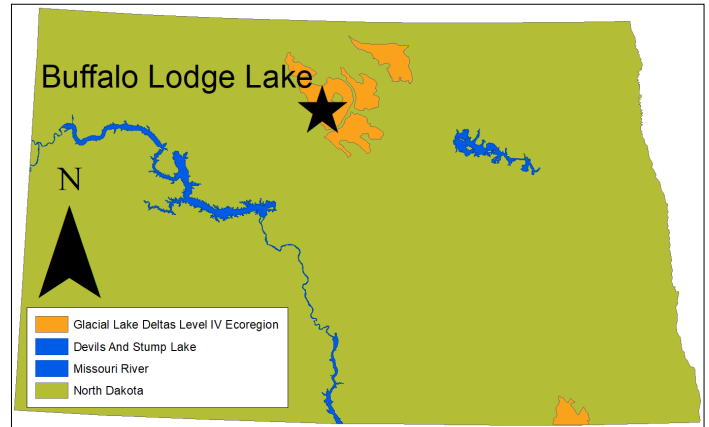


Figure 1. Location of Buffalo Lodge Lake within the state

Table 1. Percentage of land cover in the watershed and near the lake (NASS, 2020). Value listed of crop type represents percentage of total production.

Land Cover Type	% in Watershed	% within 500 meters
Agriculture	54.7%	7.3%
Spring Wheat	31.9%	3.0%
Soybeans	26.7%	0.7%
Other Hay/Non-Alfalfa	8.5%	51.5%
Grassland/Pasture	31.1%	52.1%
Wetlands	6.7%	30.4%
Developed	4.4%	1.2%
Open Water	2.6%	8.7%
Forest	0.4%	0.3%

Temperature and Dissolved Oxygen

- Buffalo Lodge Lake doesn't stratify often in the summer due to its extremely shallow depth.
- There was thermal stratification recorded in June 2021. Temperature change in the water column was 0.2 degrees Celsius (°C), 1.8°C, 0.1°C and 0.0°C in May, June, August and October, respectively (Figure 2).
- All samples in 2021 showed the lake as well-oxygenated throughout the water column.

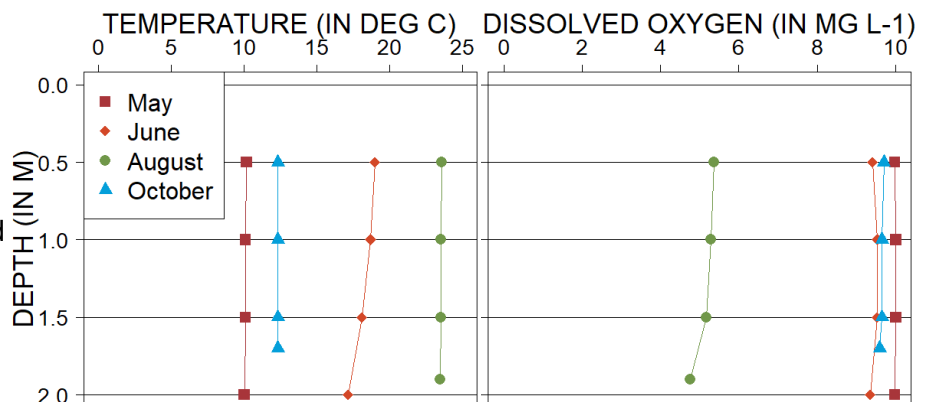


Figure 2. 2021 profiles of temperature (left) and dissolved oxygen (right) in milligrams per liter (mg L^{-1})

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.
- Buffalo Lodge Lake is a eutrophic lake (Figure 3) that has relatively high nutrient concentrations but moderate algal growth.
- TSI score in 2021 was improved compared to historical indices, driven by lower concentrations of chlorophyll-a and higher transparency.
- The lake has been listed as recently as 2021 as an advisory for harmful cyanobacteria blooms.

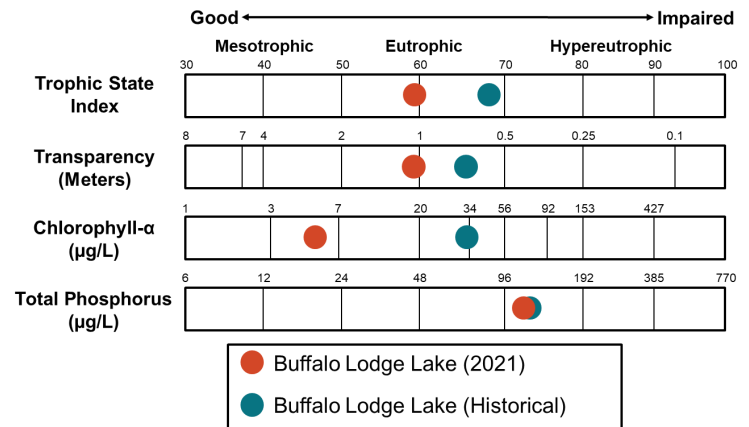


Figure 3. Trophic state indices for 2021 and historical samples

Nutrients

- Median concentration of total nitrogen (TN) at Buffalo Lodge Lake in 2021 was greater than the historical median for the lake and for the Glacial Lake Deltas Level IV Ecoregion (hereafter, Ecoregion) (Figure 4).
- Median TP concentration in 2021 was comparable to the median for the lake but greater than the median for the Ecoregion (Figure 4).
- Median concentration of dissolved nutrients were similar to concentrations of total nutrients.
- Ammonia and nitrate-plus-nitrite were detected in most samples in 2021, with most concentrations being low to moderate.

Nutrient Concentrations (in mg L⁻¹) in Buffalo Lodge Lake

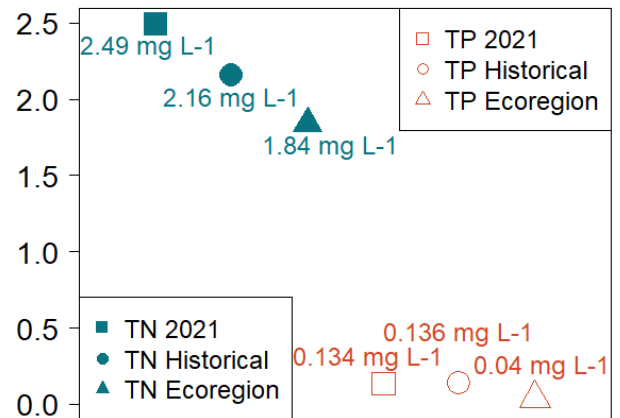


Figure 4. Median concentrations of TN and TP in mg L⁻¹ compared to regional medians

Water Chemistry

Table 2. Median concentrations of selected constituents for 2021 and historical samples and from all Ecoregion natural lakes.

Measure	2021 Median	Historical Median	Ecoregion Median
Alkalinity	455.5 mg L ⁻¹	427 mg L ⁻¹	444 mg L ⁻¹
Bicarbonate (HCO ₃ ⁻)	505 mg L ⁻¹	453 mg L ⁻¹	483 mg L ⁻¹
Calcium (Ca ²⁺)	74.6 mg L ⁻¹	49.8 mg L ⁻¹	25.4 mg L ⁻¹
Carbonate (CO ₃ ²⁻)	25 mg L ⁻¹	32 mg L ⁻¹	32 mg L ⁻¹
Conductivity	2,615 µS cm ⁻¹	1,510 µS cm ⁻¹	1,510 µS cm ⁻¹
Dissolved Solids	1,920 mg L ⁻¹	1,000 mg L ⁻¹	993 mg L ⁻¹
Magnesium (Mg ²⁺)	177 mg L ⁻¹	85.2 mg L ⁻¹	84.6 mg L ⁻¹
Sodium (Na ⁺)	301 mg L ⁻¹	176 mg L ⁻¹	176 mg L ⁻¹
Sulfate (SO ₄ ²⁻)	978 mg L ⁻¹	378 mg L ⁻¹	224 mg L ⁻¹

- Sulfate is the dominant anion in Buffalo Lodge Lake, while sodium and magnesium are co-dominant cations (Figure 5).
- Median concentrations of most cations and anions are greater than the historical median for the lake and the median concentration for the Ecoregion.

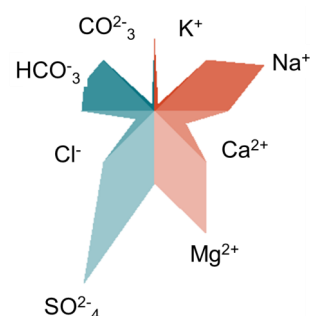


Figure 5. Maucha diagram showing ionic balance based on 2021 data