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SABBATHDAY LAKE

2022 WATER QUALITY REPORT

JANUARY 2023

2022 SABBATHDAY LAKE WATER QUALITY REPORT

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Special thanks *to long-time Sabbathday Lake Association volunteer Cheryl Fortier for providing a motorboat and good company over the course of the 2022 monitoring season.*

Cover photo: *Sabbathday Lake, July 2022. Unless otherwise noted, all photos were provided by Ecological Instincts.*

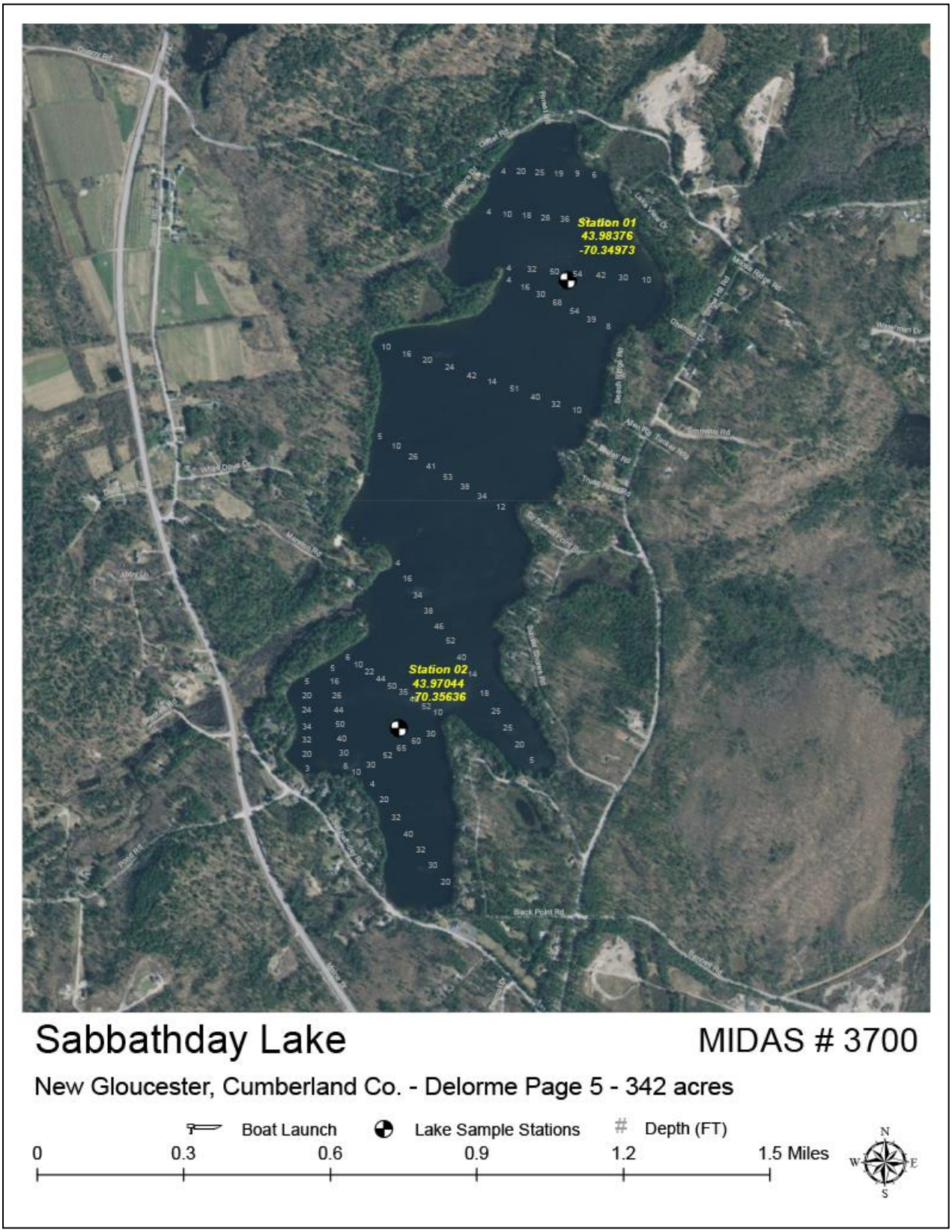

Figure 1. Sabbathday Lake bathymetric map showing deep hole sampling location (Station 1). (Source: lakesofmaine.org)

COMMONLY USED TERMS

EPILIMNION- the portion of the water column from the surface of the lake to the upper part of the thermocline.

CHLOROPHYLL A (CHL-A)- is the green pigment found in all plants, including algae. Measuring it allows us to estimate the amount of algae present in the water column.

DISSOLVED OXYGEN (DO)- is the concentration of oxygen that is dissolved in water. The presence of oxygen is essential to the survival of many organisms that live in aquatic ecosystems.

HYPOLIMNION- the dense bottom layer of water in a thermally stratified lake. The hypolimnion typically contains the coldest water in the summer when the lake is stratified and can be subject to oxygen depletion because it is cut-off from wind-driven surface mixing.

METALIMNION- is the seasonal, thermally stratified layer of a lake characterized by a rapid change in temperature (and often oxygen levels) with depth that effectively separates the waters of the epilimnion from the hypolimnion during summer stratification.

SECCHI DISK TRANSPARENCY (SDT)- represents the lake's water clarity, measured by lowering a black and white Secchi disk from a boat at the surface down into the water column until it is no longer visible.

THERMOCLINE- the thin but distinct transitional layer in a lake located between the warmer water at the surface and the cool deeper water below.

TOTAL PHOSPHORUS (TP)- Total phosphorus (TP) is the concentration of phosphorus found in the water, including organic and inorganic forms. TP is one of the major nutrients needed for plant growth.

TROPHIC STATE- A term used to describe how biologically productive a lake is, determined by various water quality parameters such as water clarity, total phosphorus, and chlorophyll a.

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BACKGROUND & PURPOSE

Photo Credit: Ecological Instincts, 2022

LAKE & WATERSHED FACTS

Watershed Towns:	**New Gloucester, Raymond & Poland, ME**
Watershed Area:	**5.3 mi^2**
Surface Area:	**331 acres**
Max Depth:	**68 ft (21 m)**
Mean Depth:	**28 ft (8 m)**
Flushing Rate:	**0.88 flushes/yr**
Lake Elevation:	**299 ft**
Avg. Clarity:	**6.8 m**

Sabbathday Lake is a 331-acre lake located in the Town of New Gloucester, Maine. The lake is located in the upper part of the larger Royal River watershed and has a direct watershed area of 5.3 square miles. It has a maximum depth of 68 feet (21 m), an average depth of 28 ft (8 m), and a flushing rate of 0.88 times per year.[1] Water flows into Sabbathday Pond from Notched Pond through Westcott Brook, and Shaker Bog, as well as from Mosquito brook which flows into Westcott Brook in the southwest watershed. Water leaves Sabbathday Lake through the outlet at the lake's north end and flows into the Royal River. The lake is widely used for recreation including swimming, boating, and fishing, and also provides valuable habitat for fish, birds, and other wildlife. The lake supports both a coldwater and warmwater fishery and has been stocked with brown trout and brook trout by Maine Inland Fisheries and Wildlife since 1989.

Sabbathday Lake is listed on the Maine DEP's Nonpoint Source Priority Watersheds list as "Sensitive" to NPS pollution (Maine DEP, 2020), and on the DEP list of lakes most at risk from new development under Chapter 502 of the Maine Stormwater Management Law. Water quality data was first collected in Sabbathday Lake in 1975, and regularly collected beginning in 1981. Secchi disk transparency (SDT) readings have been collected most consistently, with only two years with no SDT measurements (1984 and 1985) between 1981 and 2022. Total phosphorus (TP) samples have been collected every year since 1990, and Chl-a has been measured every year since 1996. Because of this, a robust data set is available for Sabbathday Lake, allowing for the analysis of long-term water quality trends. Maintaining this dataset is essential to documenting changes in water quality in Sabbathday Lake over time and identifying potential water quality threats. Based on historical water clarity, TP, and chlorophyll-a (Chl-a) data, water quality in Sabbathday Lake is considered above average with intermediate levels of phosphorus, Chl-a, and water clarity (classified as a mesotrophic lake by the Maine DEP).

[1] LakesofMaine, Sabbathday Lake, Sampling Station 1. Accessed online at: https://www.lakesofmaine.org/data/2018_Lake_Reports/3700_1.html

METHODS

Ecological Instincts collected water quality data at Station 1 (deep hole) on Sabbathday Lake over the course of three sampling events in 2022 (July 13, August 19, and September 21). Sampling was conducted in accordance with standard methods and procedures for lake monitoring established by the Maine Department of Environmental Protection (Maine DEP), the U.S. Environmental Protection Agency (USEPA), and the Lake Stewards of Maine (LSM). All water samples were analyzed at the Health and Environmental Testing Lab (HETL) in Augusta.

Collecting an epilimnetic core on Sabbathday Lake, September 2022.

An integrated epilimnetic core (representing lake water from the surface to the upper part of the thermocline) was collected for each sampling event. Epilimnetic core depth varied between 6 and 8 meters over the course of the season due to changes in thermal stratification during this time period. Water quality parameters measured include key trophic state indicators (water clarity, total phosphorus, chlorophyll-a), as well as color, alkalinity, pH, dissolved oxygen, and water temperature profiles.

RESULTS

WEATHER & CLIMATE CHANGE

Variation in weather patterns from year to year is an important driver of annual variability in lake water quality. Increased amounts of precipitation also increase the amount of runoff that the lake receives from its watershed, meaning that drier years may result in lower phosphorus levels and better water quality, and years with more precipitation may result in higher phosphorus levels and poorer water quality. The lowest total annual precipitation in the region occurred in 2016, with just 30.5 total inches of rain throughout the year. The highest total annual precipitation occurred in 2012, with 68 inches of precipitation. In 2022, the region experienced **below average levels of precipitation** (44 inches) compared to the average for the past 10 years (48.2 inches). July 2022 rainfall total was 3.75 inches with 0.33" of rain in the 72 hours before sampling compared to 4.21" in August with 0.8" in the previous 72 hours, and 5.56" in September with 1.88" in the previous 72 hours. The total rainfall in September was greater than the September monthly rainfall total since 2013 (Figure 2). A substantial amount of particulates was observed in the water column at all three sampling events with the greatest accumulation in September, corresponding with the large amount of rainfall leading up to sampling.

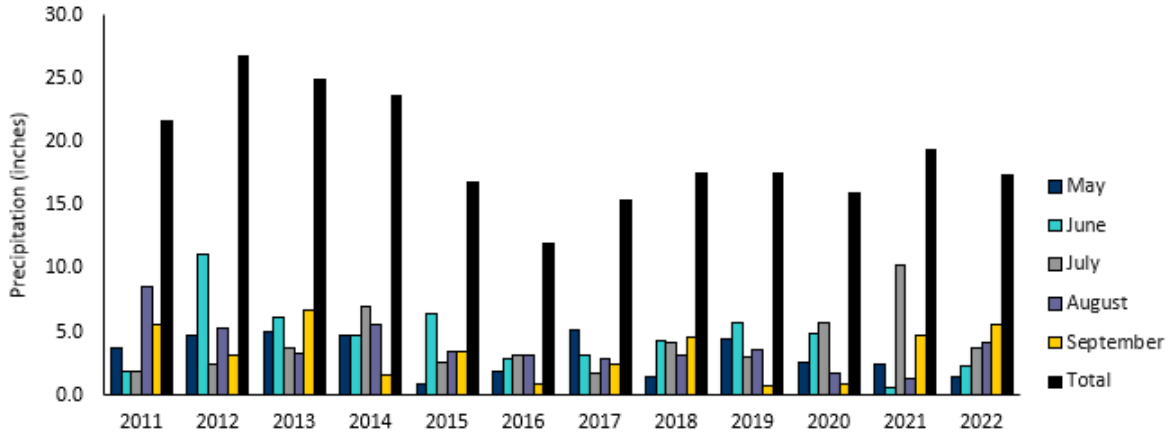

Figure 2. Total and monthly precipitation for Sabbathday Lake from May-September, 2011-2022. (Data source: NOAA NCDC, station GHCND: US1MECM0003 - New Gloucester 3.0, SE, ME, US)

Bigger and more frequent storms are expected as a result of climate change which could lead to an increase in the amount of phosphorus getting to the lake via. Surface water temperatures in northern New England increased 1.4 °F per decade from 1984-2014, which is faster than the worldwide average, with Maine lakes warming on average by nearly 5.5 °F during this time (MCC, 2020). Higher (air and water) temperatures lead to earlier ice-out and later ice-in, resulting in longer and stronger stratification periods, which leads to increased algal growth, greater oxygen demand due to decomposition on the lake bottom, and lower oxygen near the lake bottom.

TROPHIC STATE INDICATORS

Trophic state indicators (SDT, Chl-a, and TP) and are key parameters for measuring how productive a lake is and can be used to calculate a Trophic State Index (TSI) which can be compared to other lakes across the state. In Maine lakes, TSI ranges from 8-136 with a mean of 45. The last TSI index calculated for Sabbathday Lake was calculated in 2016 by Maine DEP with a value of 29.9. Continuing to consistently collect data for these parameters will allow for more recent TSI Index values to be calculated.

Water Clarity

Measuring water clarity (a.k.a. transparency) is one of the most useful ways to show whether a lake is changing from year to year. Changes in transparency may be due to increased or decreased algal growth, or the amount of dissolved or particulate materials in a lake, resulting from human disturbance or other impacts to the lake watershed area. Factors that affect transparency include algae, water color, and sediment. Since algal density is usually the most common factor affecting transparency in Maine lakes, transparency is

Table 1. Average annual water clarity for Sabbathday Lake at Station 1 (1975-2022).

Water Clarity (m)			
Years	**Annual SDT**		
	Mean	Min	Max
2022 Sabbathday Lake	**8.1**	**7.6**	**8.6**
Historical Average (1975-2022)	6.8	5.5	8.1
10-Year Average (2013-2022)	7.4	6.7	8.1
Avg. Maine Lakes	5.3	0.2	21.3

an indirect measure of algal abundance. Water clarity is measured using a Secchi disk, obtained by lowering a black and white disk into the water until it is no longer visible.

Water clarity in Maine lakes ranges from 0.2 m to 21.3 m with an average statewide of 5.3 m. Transparency readings of 2 m or less generally indicates an algal bloom. In 2022, **annual average water clarity at Sabbathday Lake was the best on record** at 8.1 m, while the historical minimum annual water clarity is 5.5 m (1989). The historical average water clarity for Sabbathday Lake is 6.8 m. Average annual average clarity over the historical sampling period has remained steady (Figure 3 & 4) with an average SDT over the first 10 years of continuous sampling (1986-1995) of 6.5 m, vs. an average SDT over the last 10 years (2013-2022) of 7.4 m (Figure 3). A statistical analysis of the long- and short-term water quality trends indicate a slight improvement in water clarity between 2012-2018 (Attachment A, Figure 1).[2]

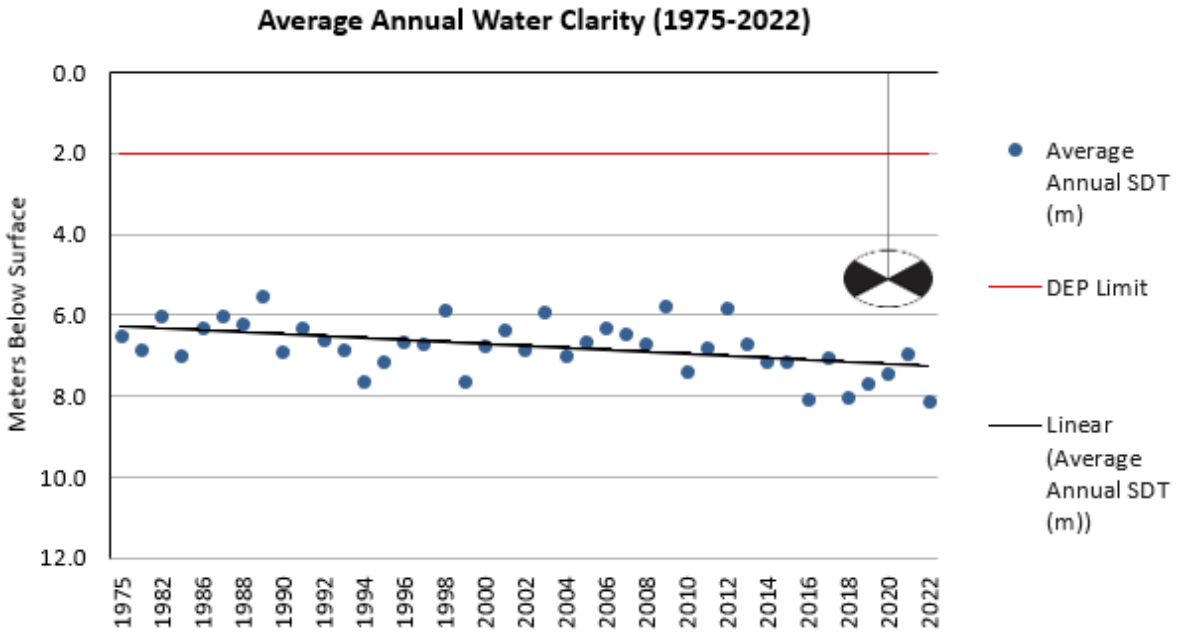

Figure 3. Average annual water clarity for Sabbathday Lake, Station 1 (1975-2022). Data from MDEP, FB Environmental, and Ecological Instincts.

Total Phosphorus

Total phosphorus (TP) is the concentration of phosphorus found in the water, including organic and inorganic forms. TP is one of the major nutrients for plant growth. It is generally present in small amounts and limits plant growth in freshwater ecosystems. As phosphorus increases, the amount of algae generally increases. Humans can add phosphorus to a lake through stormwater runoff, lawn, or garden fertilizers, and leaky or poorly maintained septic tanks.

[2] The statistical analysis completed by DEP utilized only the data available in the state database at the time of the analysis (through 2018). A follow-up analysis should be completed when data from 2019-2022 are added.

Total phosphorus at Sabbathday Lake was measured by collecting an "integrated core sample" from the epilimnion of the lake (representing the water column from the surface of the lake to the bottom of the epilimnion). During the summer of 2022, the epilimnion ranged from 6 - 8 m in depth and was determined based on the dissolved oxygen and temperature profiles (see next section).

Table 2. Average Annual TP for Sabbathday Lake, Station 1 (1982-2022).

Total Phosphorus (ppb)			
Years	**Annual TP**		
	Mean	Min	Max
2022 Sabbathday Lake	**5.7**	**5**	**6**
Historical Average (1982-2022)	6	4	8
10-Year Average (2013-2022)	6	4	7
Avg. Maine Lakes	11.2	1	426

TP in Sabbathday Lake has ranged from 3 ppb (1995) to 15 ppb (2000). In 2022, TP in Sabbathday Lake ranged from 5 parts per billion (ppb) in July to 6 ppb in August and September. The average TP over the past 10 years is 6 ppb, the same as the average over the entire sampling period, but the 10-year maximum (7 ppb) is slightly lower than the historical maximum (8 ppb). The lowest annual average on record in 4 ppb (2018). Statewide, TP ranges from 1 - 426 ppb with an average of 11.2 ppb. The data indicate that **Sabbathday Lake has low levels of phosphorus compared to lakes statewide**, and phosphorus concentrations have remained consistent over the historical monitoring period (Table 2, Figure 4).

Chlorophyll a

Chlorophyll a (Chl-a) is the third trophic state indicator, and measures the green pigment found in all plants, including microscopic plants such as algae. It is used as an estimate of algal biomass; higher Chl-a equates to greater amount of algae in the lake. Chl-a in Sabbathday Lake was measured by collecting an "integrated core sample" from the epilimnion of the lake, representing the water column from the surface of the lake to the bottom of the epilimnion.

Table 3. Average Annual Chl-a monitoring results for Sabbathday Lake, Station 1 (1975-2022).

Chlorophyll a (ppb)			
Years	**Annual Chl-a**		
	Mean	Min	Max
2022 Sabbathday Lake	**3.3**	**2.0**	**4.0**
Historical Average (1975-2022)	3.7	2.0	5.6
10-Year Average (2013-2022)	3.0	2.0	4.0
Avg. Maine Lakes	5.7	0.1	208

Chl-a in Sabbathday Lake has ranged from 1.6 ppb (1998, 1999, 2000) to 10.6 ppb (1998). In 2022, Chl-a ranged from 2 ppb in July to 4 ppb in August and September. Statewide, Chl-a ranges from 0.1 - 208 ppb with an average of 5.7 ppb. The 10-year average for Sabbathday Lake is slightly lower than the historical average (Table 3). Levels of Chl-a in Sabbathday lake are lower than the statewide average and have exhibited a **relatively stable long-term trend with a significant decrease over the past decade** (Figure 4 & Attachment 1, Figure 3).

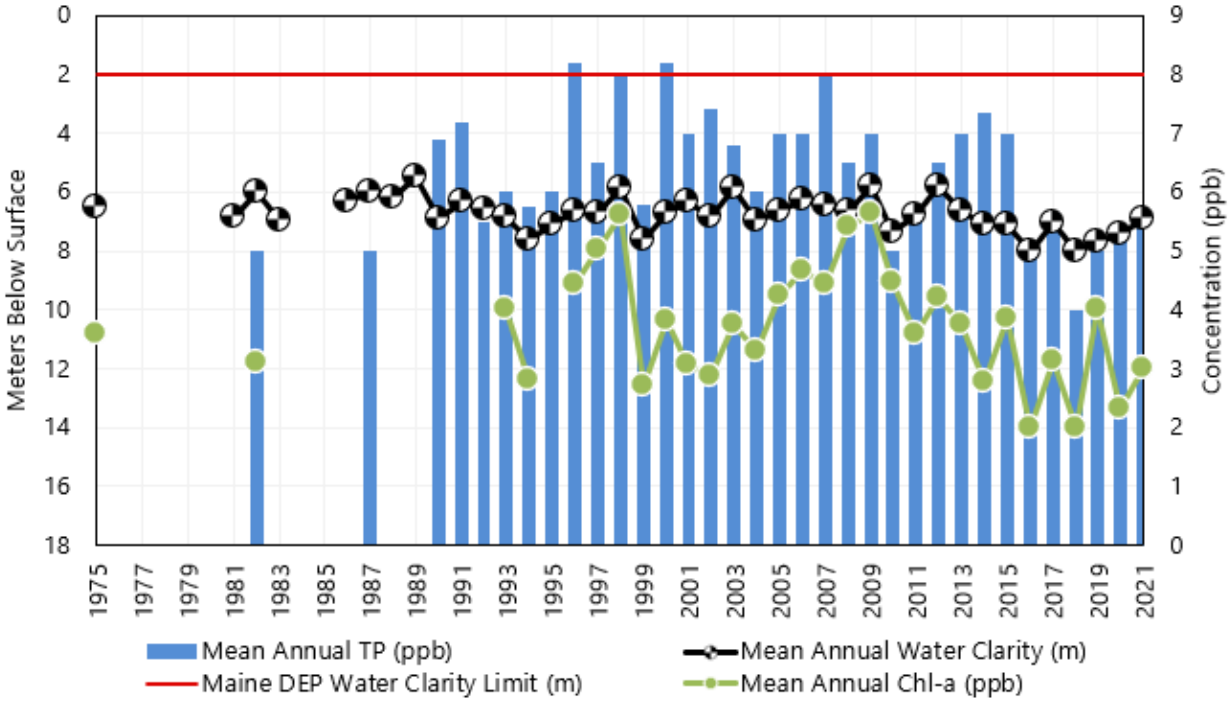

Figure 4. Average annual water quality data for trophic state indicators (water clarity, total phosphorus (TP), and Chlorophyll-a (Chl-a) for Sabbathday Lake, Station 1. 2019-2022 annual averages include only data collected by FB Environmental and Ecological Instincts on behalf of SDLA.

Gloeotrichia echinulata or "Gloeo" is a genus of planktonic freshwater cyanobacteria that forms tiny spheres that are visible to the naked eye floating in the water column. *Gloeo* grows at the sediment-water interface and then rises through the water column to the surface waters where it completes its life cycle, dies, and sinks back down to the bottom of the lake where it will stay through the winter months until conditions are again suitable for growth (King & Laliberte, 2005). The presence of *Gloeotrichia* has been documented in Sabbathday Lake in the past but was not observed in 2022.

DISSOLVED OXYGEN & TEMPERATURE

Sabbathday Lake's cold, deep water provides habitat for coldwater fish including brown trout and brook trout, along with warmwater fish such as largemouth bass, smallmouth bass, white sucker, chain pickerel, and black crappie. Coldwater fish need at least 5 parts per million (ppm) of dissolved oxygen (DO) to survive, and even higher levels for young fish to grow and thrive. These fish generally prefer water that is less than 18°C (64°F) but can tolerate temperatures up to 24°C (75°F).

In the summer, the sun warms the surface water, forcing coldwater fish to retreat to deeper, cooler, and more oxygenated water. In lakes with elevated phosphorus levels due to inputs from the watershed, cycles of de-oxygenation can form in deep water when the lake is stratified in the summer, reducing the amount of coldwater habitat available to fish. Decreased DO levels can also cause internal release of phosphorus from the sediments, contributing to elevated TP levels and increasing the likelihood of nuisance algae blooms. Sabbathday Lake has a history of DO depletion below 8 m developing annually in late summer.

Dissolved Oxygen

The 2022 DO profiles in Sabbathday Lake indicate that the lake is well oxygenated through the epilimnion (0-4 m), increases in the metalimnion (transition area between the warm surface water and cold deep waters between 5 m and 10 m), and then consistently decreases to the bottom of the lake through the hypolimnion (Figure 5). DO fell below 5 ppm at 14 m in July, 11 m in late August, and 10 m in September. **DO was 2 ppm or less (upper threshold for anoxia) in August at 14 m and in September at 11 m.** The metalimnetic maximum, or "oxygen bubble" is typical for the area of the lake where algae are most productive, taking up carbon dioxide, and giving off oxygen. Below this depth light becomes limited which in turn limits algal growth.

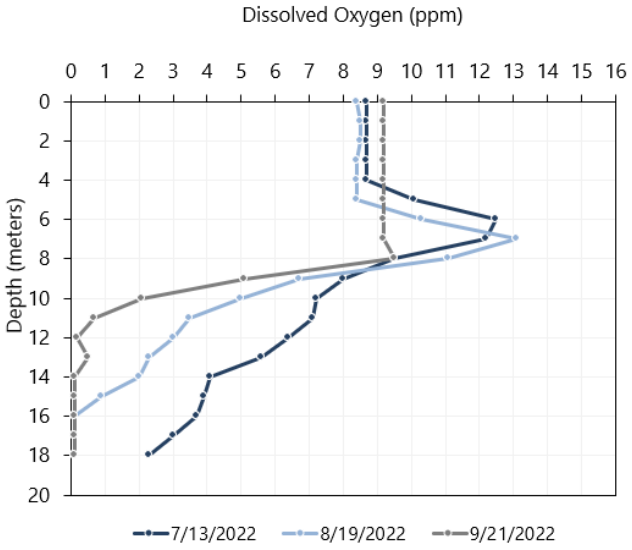

Figure 5. 2022 dissolved oxygen profiles for Sabbathday Lake, Station 1.

Low oxygen at the bottom of the lake can result in release of phosphorus from bottom sediments. Collection of phosphorus grab samples (bottom grab) could help determine the influence of anoxia on internal phosphorus loading in Sabbathday Lake. The last bottom grab sample for Sabbathday Lake was collected by Maine DEP in 2011 (10 ppb). 2022 monitoring results do not indicate that a release of phosphorus at the lake bottom is resulting in an increase in phosphorus in surface waters during periods of anoxia. Minimum anoxic depth (MAD) in Sabbathday Lake is highly variable and not significant (Attachment 1, Figure 5).

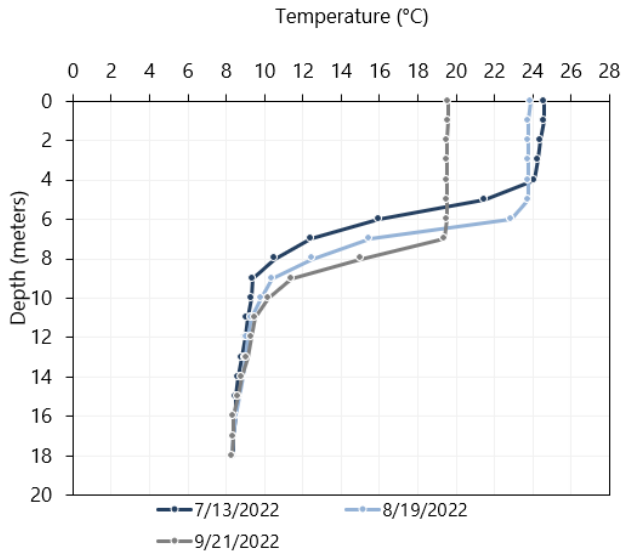

Figure 6. 2022 temperature profiles for Sabbathday Lake, Station 1.

Temperature

The 2022 Sabbathday Lake temperature profiles show strong stratification from top to bottom, with warmer temperatures at the surface (between 0 - 5 m) and a steady decrease in temperature through the metalimnion (5 - 10 m), with the coldest water at the bottom (between 12 - 18 m). The surface of the lake was warmest in late July (24.6°C), and coldest in September (19.6°C) (Figure 6). Habitat for coldwater fish may have been restricted to depths between 6 - 9 m during the summer of 2022 where water temperatures were cooler (<18°C) and well-oxygenated (>5 ppm).

CHEMICAL PARAMETERS

Color

Color is the influence of suspended and dissolved particles in the water as measured by Platinum Cobalt Units (PCU). A variety of sources contribute to the types and amount of suspended material in lake water, including weathered geologic material, vegetation cover, land use activity, and rainfall.

Table 4. Average annual color for Sabbathday Lake, Station 1 (1982-2022).

True Color (PCU)			
Years	**Annual Color**		
	Mean	Min	Max
2022 Sabbathday Lake	**8**	**7**	**9**
Historical Average (2004, 2012-2022)	11	7	16
Avg. Maine Lakes	20.1	0	198

Colored lakes (>25 PCU) can have reduced transparency readings and increased TP values. Color has been measured using two methods in Sabbathday Lake, true color and apparent color. Apparent color, used from 1982-2011, measures the color of the water as it is collected including whatever particulates are present in the water. True color, used for one sample in 2004 and from 2012-2022, measures color after all particulates, including algae cells, have been filtered out. In 2022, true color ranged from 7 PCU (August) to 9 PCU (July) with an average of 8 PCU. Historically, true color has ranged from 6 PCU (2016) to 17 PCU (2012) with an average of 11 PCU (Table 4). **Sabbathday lake is a non-colored lake and has low color compared with the statewide average** (20.1 PCU). Low color lakes typically have good water clarity as compared to more highly colored lakes.

Alkalinity

Alkalinity is a measure of the buffering capacity of a lake, or the capacity to neutralize acids. It is a measure of naturally available bicarbonate, carbonate, and hydroxide ions in the water, which is largely determined by the geology of soils and rocks surrounding the lake. Alkalinity is important to aquatic life because it buffers against changes in pH that could have drastic effects on animals and plants.

Table 5. Average annual alkalinity for Sabbathday Lake, Station 1 (1982-2022).

Alkalinity (ppm)			
Years	**Annual Color**		
	Mean	Min	Max
2022 Sabbathday Lake	**12.3**	**12.0**	**13.0**
Historical Average (1982-2022)	11.0	9.0	13.7
10-Year Average (2013-2022)	11.9	11.3	12.3
Avg. Maine Lakes	11.1	-1.5	190

In 2022, alkalinity ranged from 12 – 13 ppm with an average of 12.3. This is **slightly higher than the historical average (11 ppm), and the 10-year average** (11.9 ppm) (Table 5). Average annual alkalinity in Sabbathday Lake is similar to the statewide average of 11.1 ppm. Lakes with total alkalinity values >20 ppm, are considered well buffered against changes in pH, whereas lakes like Sabbathday Lake, with alkalinity between 10 and 20 ppm fall within the USEPA's "sensitive" category.

pH

pH is the standard measure of the acidity or alkalinity of a solution on a scale of 0-14. Most aquatic species require a pH between 6.5 and 8. As the pH of a lake declines, particularly below 6, the reproductive capacity of fish populations can be greatly impacted as the availability of nutrients and metals changes. pH is influenced by bedrock, acid rain deposition, wastewater discharge, and natural carbon dioxide fluctuations.

pH in Sabbathday Lake has ranged from 6.5 (2022) to 7.5 (2013). In 2022, the pH was 6.5 (August) and 6.6 (July and September). The August 2022 pH value represents **the lowest pH on record for the lake, and the 2022 annual average is the lowest since the first year pH data was collected in 1982** (6.6). These results are slightly lower than both the historic and 10-year average of 7.1 (Table 6). A statistical analysis of pH at Sabbathday Lake points to a decrease in pH between 2012-2018 based on 7 years of data (Attachment 1, Figure 4), however at least 10 years of data is needed to determine the significance of this trend. Compared to the statewide average, Sabbathday lake generally has slightly higher pH.

Table 6. Average annual pH for Sabbathday Lake, Station 1 (1982-2022).

pH			
Years	**Annual Color**		
	Mean	Min	Max
2022 Sabbathday Lake	**6.6**	**6.5**	**6.6**
Historical Average (1982-2022)	7.1	6.6	7.5
10-Year Average (2013-2022)	7.1	6.6	7.5
Avg. Maine Lakes	6.9	3.1	9.9

SUMMARY

Sabbathday Lake has above average water quality compared to the average for Maine Lakes (Table 7). For the most part, 2022 monitoring results were within the normal range for Sabbathday lake with the following observations:

- Annual precipitation was below average compared to the last 10-years, yet the September monthly rainfall total was the highest since 2013.
- Average annual water clarity was the best on record and average annual water clarity has improved slightly since 2008.
- Chl-a decreased between 2008-2018 corresponding with an improvement in water clarity.
- Average annual alkalinity was slightly higher in 2022 compared to both the historical and 10-year averages.
- pH measured in August was the lowest on record, and the short-term pH trend appears to be decreasing.

Table 7. Summary of 2022 data and historical averages for water clarity, total phosphorus (TP), chlorophyll a (Chl-a), color, alkalinity, and pH at Sabbathday Lake. Average Maine lake values were obtained online from Maine DEP/Lake Stewards of Maine.

Date	Water Clarity (m)	TP (ppb)	Chl-a (ppb)	Color (PCU)	Alkalinity (ppm)	pH
7/13/2022	7.6	5.0	2.0	9.0	12.0	6.6
8/19/2022	8.6	6.0	4.0	7.0	12.0	6.5
9/21/2022	8.1	6.0	4.0	8.0	13.0	6.6
2022 Average	**8.1**	**5.7**	**3.3**	**7.0**	**12.3**	**6.6**
Historical Average	**6.8**	**6.0**	**3.7**	**11.0**	**11.0**	**7.1**
Average (Maine Lakes)	5.3	11.2	5.7	20.1	11.1	6.9

RECOMMENDATIONS

- **Continue collecting water samples** at Sabbathday Lake annually to maintain the long-term data set and for tracking of water quality trends over time.
- **Collect a TP bottom grab in the hypolimnion** during periods of peak anoxia to better understand the influence of internal loading under anoxic conditions since last sample was collected in 2011.
- **Add 2019-2022 data to the DEP trend analysis** for the three primary trophic state indicators and pH.
- **Conduct plankton sampling to establish a baseline** of phytoplankton and zooplankton in the lake.
- **Collect water quality data immediately after spring and fall turnover** to better understand the role of internal loading on P levels in Sabbathday Lake.
- **Continue ongoing watershed protection** activities in the watershed through the SDLA LakeSmart program and other educational programs.
- **Continue invasive plant prevention programs** including Courtesy Boat Inspections and Invasive Plant Patrols.

RESOURCES FOR WATERSHED RESIDENTS

- **The Buffer Handbook:**
  http://www.maine.gov/dep/land/watershed/buffhandbook.pdf
- **The Buffer Handbook Plant List:**
  http://www.maine.gov/dep/land/watershed/buffer_plant_list.pdf
- **Caring for Your Septic System**
  https://cdn.branchcms.com/DrynVOJolO-1457/docs/Lake%20Library/Septic-two-pager-11x17-FINAL-5.14.21.pdf

- **Conservation Practices for Homeowners (24 fact sheets):** http://www.maine.gov/dep/land/watershed/materials.html
- **Erosion & Sediment Control BMPs** http://www.maine.gov/dep/land/erosion/escbmps/index.html
- **Gravel Road Maintenance Manual: A Guide for Landowners on Camp and Other Roads:** http://www.maine.gov/dep/land/watershed/camp/road/gravel_road_manual.pdf
- **The Lake Book: A Handbook for Lake Protection** https://www.lakes.me/lakebook
- **Maine Lakes LakeSmart Program:** https://www.lakes.me/lakesmart
- **Maine Stormwater Best Management Practices Manual** http://www.maine.gov/dep/land/stormwater/stormwaterbmps/index.html
- **Sabbathday Lake Online Water Quality Data** https://lakesofmaine.org/lake-overview.html?m=3700&singleton
- **Volunteer Water Quality Monitoring Training & Certification Information** https://www.lakestewardsofmaine.org/volunteer-programs-tools/certification/

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ATTACHMENT 1- STATISTICAL ANALYSIS

A Statistical Analysis of Long and Short-Term Water Quality Trends at Sabbathday Lake (1975-2018)

Prepared by Jeremy Deeds, Maine DEP, December 2022

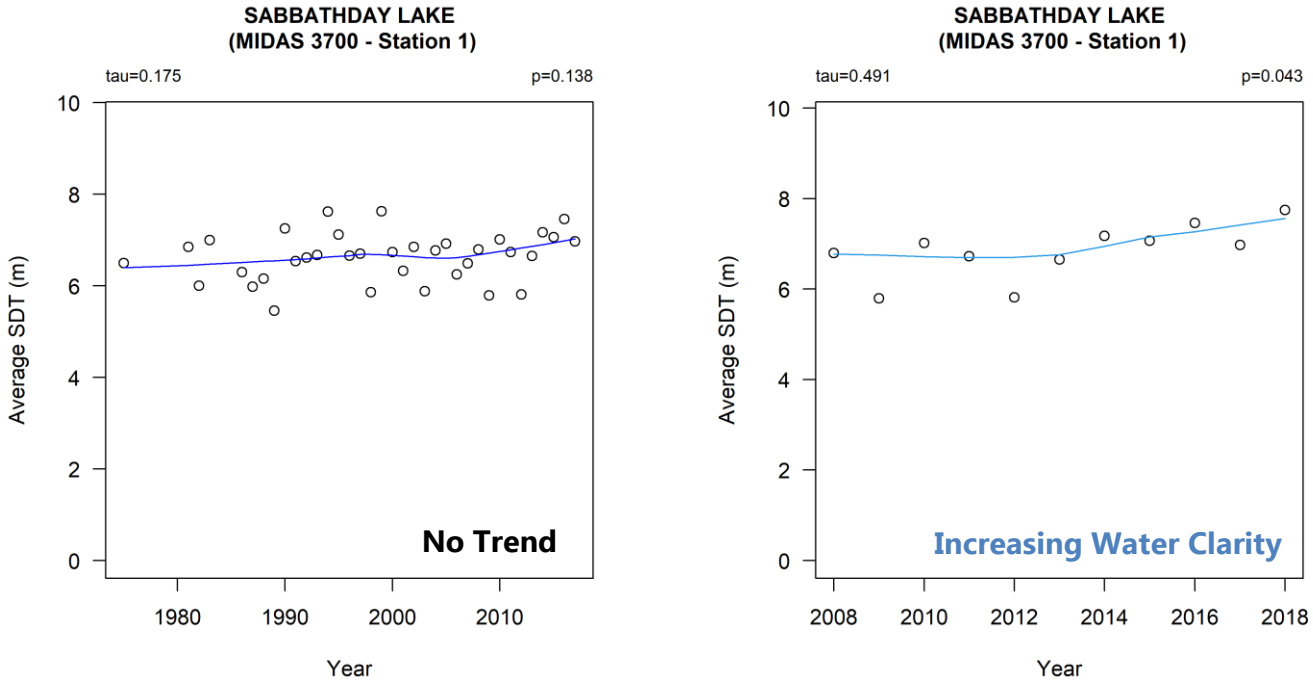

Figure 1. Historical average (left) and 10-year average (right) Secchi disk transparency (SDT) in Sabbathday Lake, Station 1.

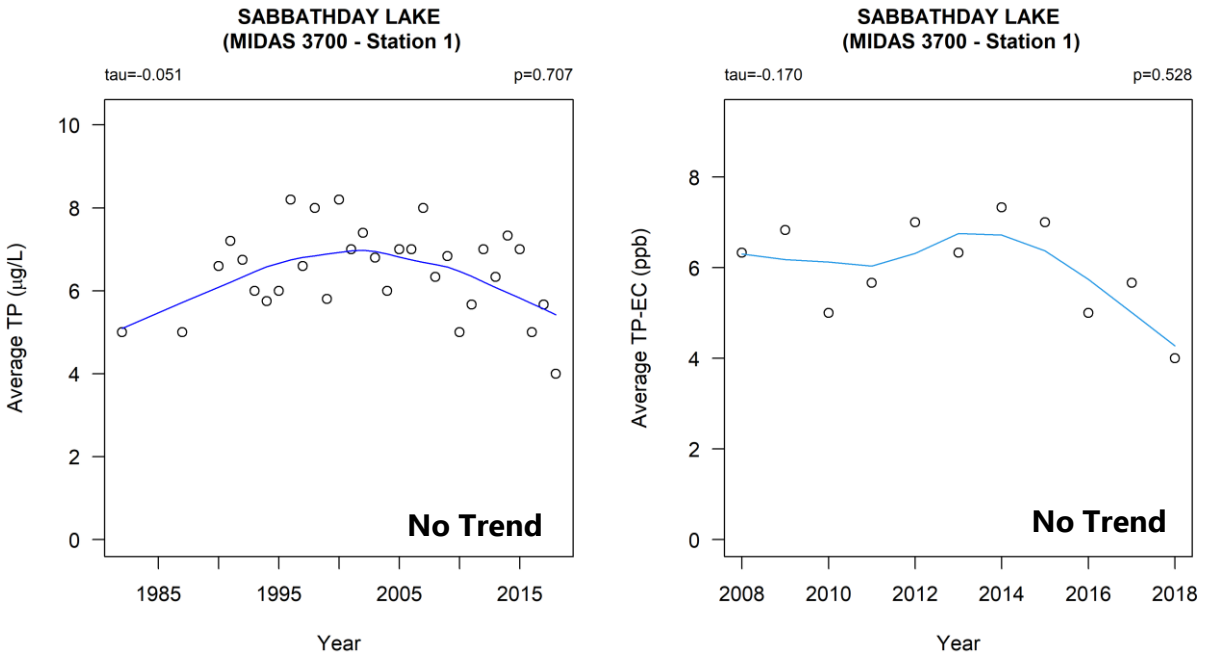

Figure 2. Historical average (left) and 10-year average (right) total phosphorus (TP) in Sabbathday Lake, Station 1.

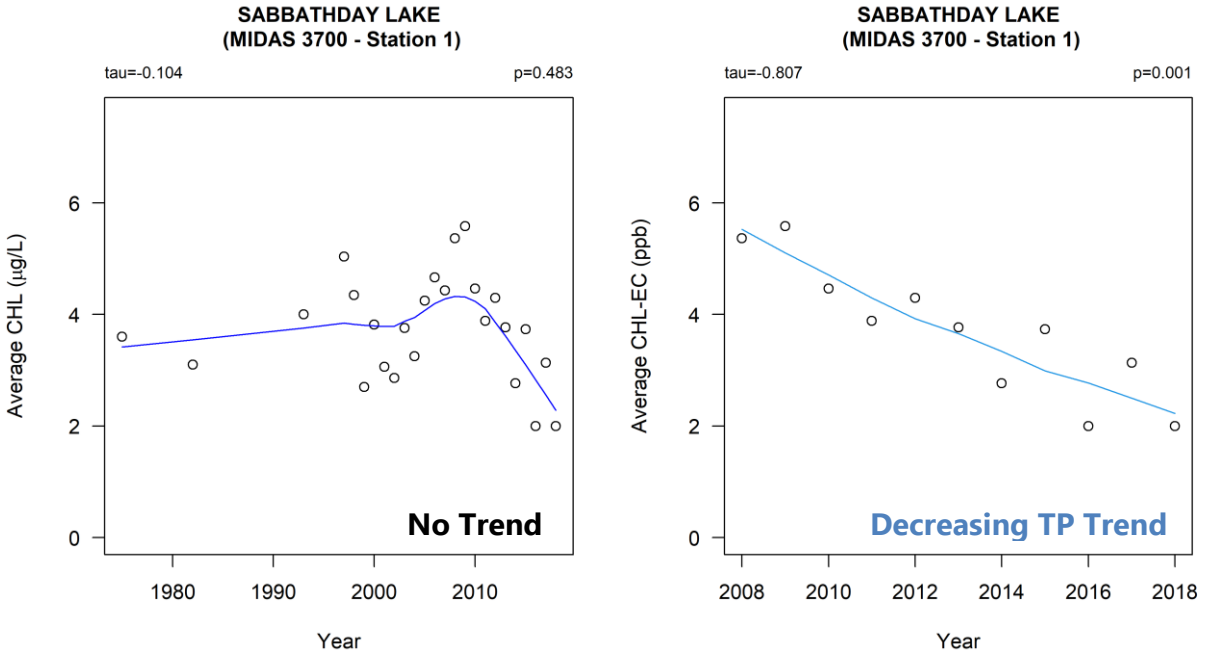

Figure 3. Historical average (left) and 10-year average (right) chlorophyll a (Chl-a) in Sabbathday Lake, Station 1.

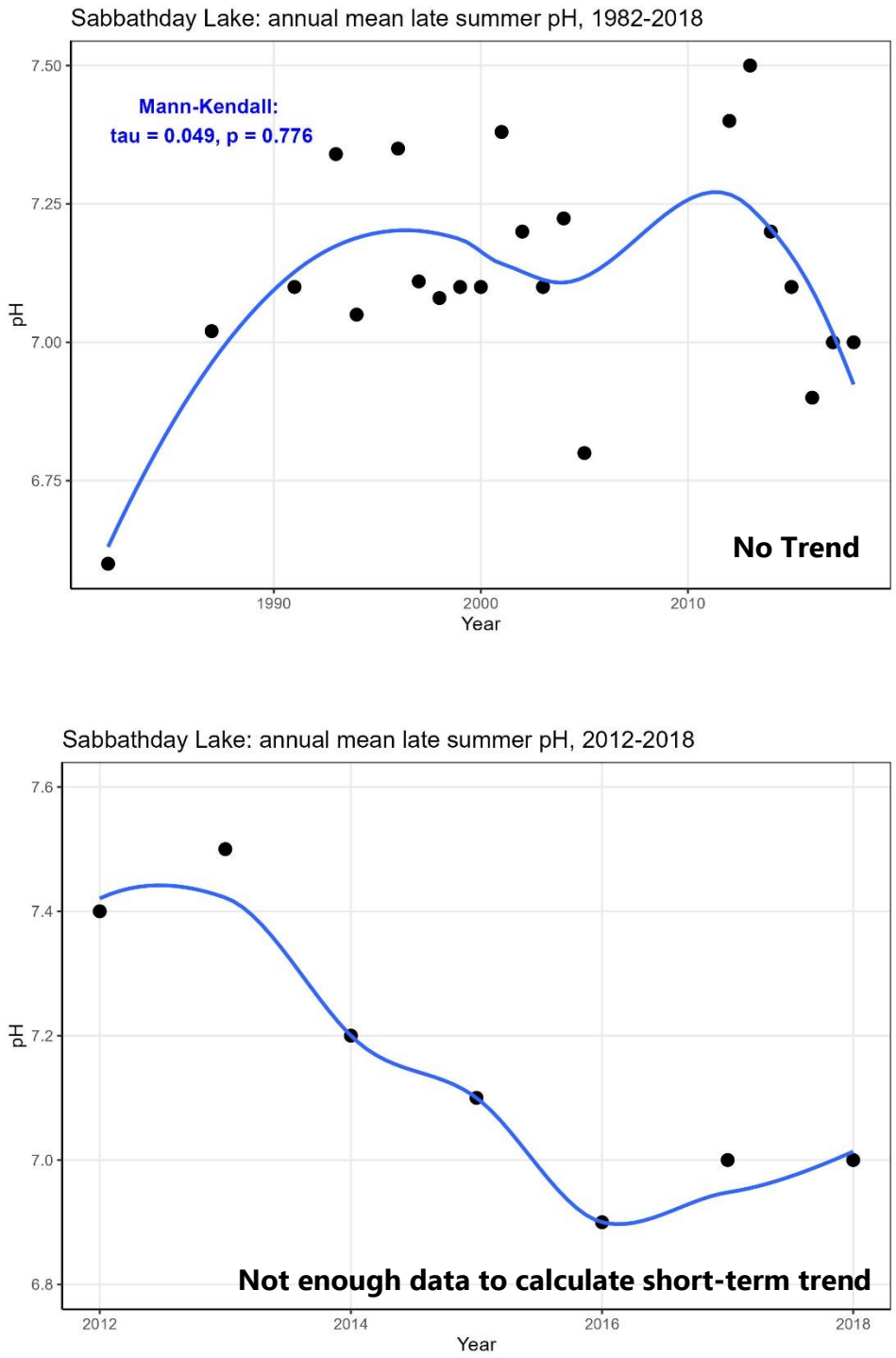

Figure 4. Historical average (top) and 10-year average (bottom) pH in Sabbathday Lake, Station 1.

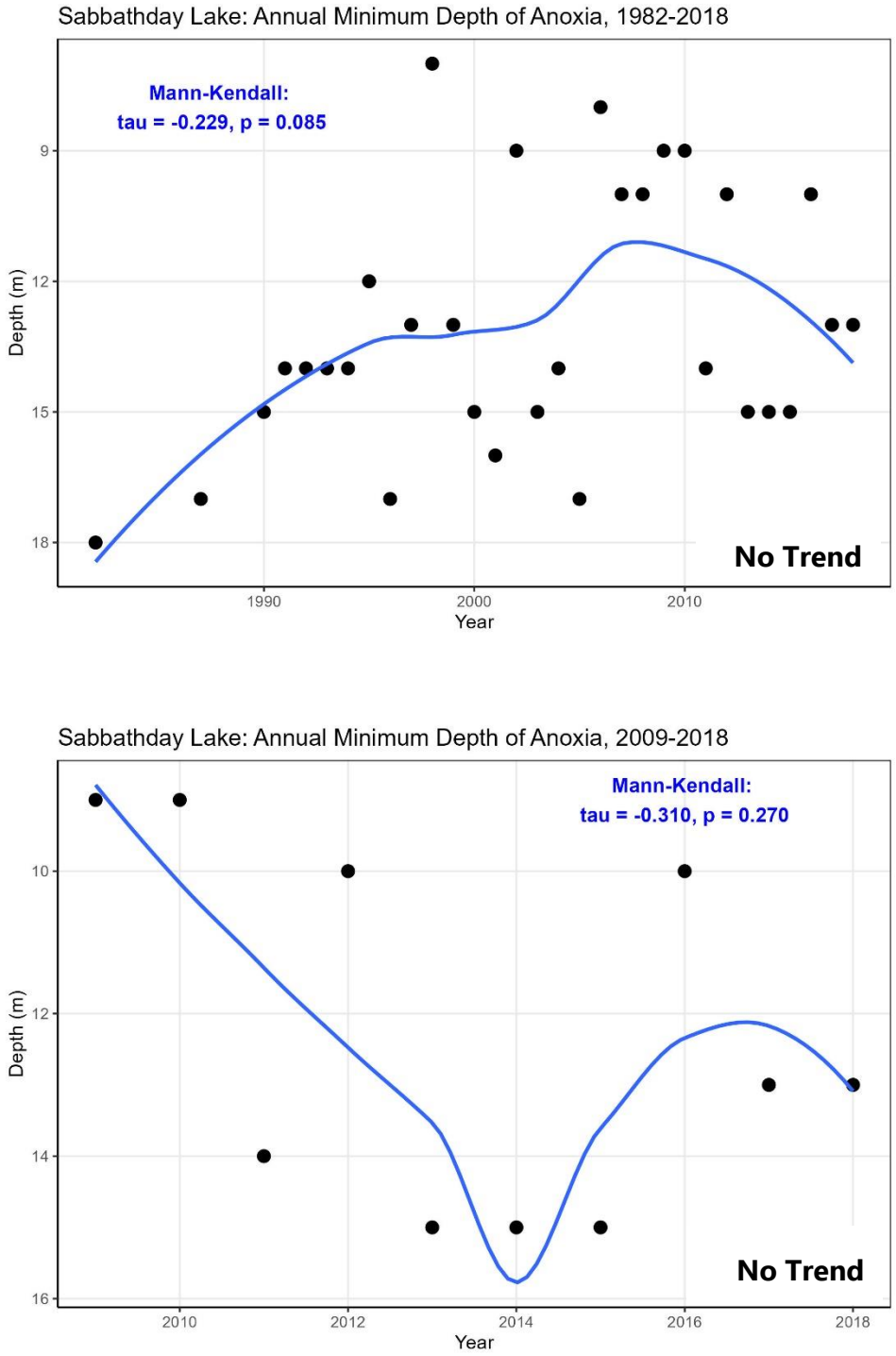

Figure 5. Historical average (top) and 10-year average (bottom) minimum anoxic depth (MAD) in Sabbathday Lake, Station 1.