2023 Sebago Lake Assessment

Portland Water District
Sebago Lake Watershed Monitoring Programs
Lake Monitoring
Presenting data from 1976 to 2023
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Introduction

Sebago Lake is the primary drinking water supply for nearly 200,000 people in 11 Greater Portland communities. Lake water was first delivered to Portland in 1869, from an intake located in the southernmost part of the lake, referred to as Lower Bay. In 1908, the Portland Water District was chartered by the Maine Legislature to provide water services to the cities of Portland and South Portland. The water system has gradually expanded to include 11 cities and towns in Greater Portland. Since its inception, the District has been actively monitoring and working to protect Sebago Lake.

In 1993, the District was granted a waiver to the filtration requirements of the federal Safe Drinking Water Act (SDWA) based in part on the purity of the water and the effectiveness of watershed protection efforts. This waiver agreement requires ongoing monitoring of lake water quality. The District maintains more than 10 monitoring and surveillance programs throughout the watershed and lake. In general, as one moves closer to the intakes, more samples are collected and tested for more parameters.

This report summarizes results of the Lake Monitoring Program

Methods

Lake profile sampling events occur once a month from May to November. Three deep stations of maximum depth in Lower Bay, Big Bay and Jordan Bay are monitored for total phosphorus, chlorophyll *a*, Secchi disk transparency and dissolved oxygen/temperature profiles. Epilimnetic core samples are analyzed for chlorophyll *a* and total phosphorous concentrations. Secchi disk transparency is measured and dissolved oxygen and temperatures are recorded every meter from the lake surface to the bottom. Data from the Lower Bay deep basin station are used in this assessment. The Lower Bay data set represents the longest time period of monitoring data available for Sebago Lake.

Secchi Disk (SD)

Secchi disk transparency measurements are one of the easiest, cheapest and most recognizable lake water quality parameters. The disk represents a measure of water clarity or transparency. Things that interfere with transparency are; algae, silt, detritus and color. Sebago Lake has essentially no color and has enough water volume in the deep basins that Secchi transparency can be considered a surrogate for algae productivity. Larger values represent greater water transparency thus better water quality.

Total Phosphorus (TP)

Phosphorus is the least abundant nutrient in freshwater systems and is considered the limiting factor of biological productivity in Maine lakes. Phosphorous has numerous chemicals forms, some of which are readily available to freshwater biota and some are not. Simple dissolved phosphorus is quickly absorbed into the aquatic ecosystem base by algae, while complex colloidal organic bound phosphorus typical sinks to the bottom of a lake and becomes bound in the sediment, under oxygen saturated conditions. Total phosphorus is a measure of all molecular forms of phosphorus.

Chlorophyll a *(CHL)*

Chlorophyll *a* is the photosynthetic pigment found in algae. Measuring this green pigment is a surrogate measure to estimate the total algal biomass in a lake. There are numerous methods to quantify the "greenness" of a lake. The Portland Water District takes an epilimnetic core sample down to, but not including, the thermocline as determined by the temperature/dissolved oxygen profile. The sample is filtered through a 0.45 *um* glass fiber filter, preserved with MgCO3 and frozen. Samples are ground with a Teflon glass tissue homogenizer and seeped in acetone for 4 hours. Samples are analyzed on a spectrophotometer using the trichromatic method.

Results and Discussion
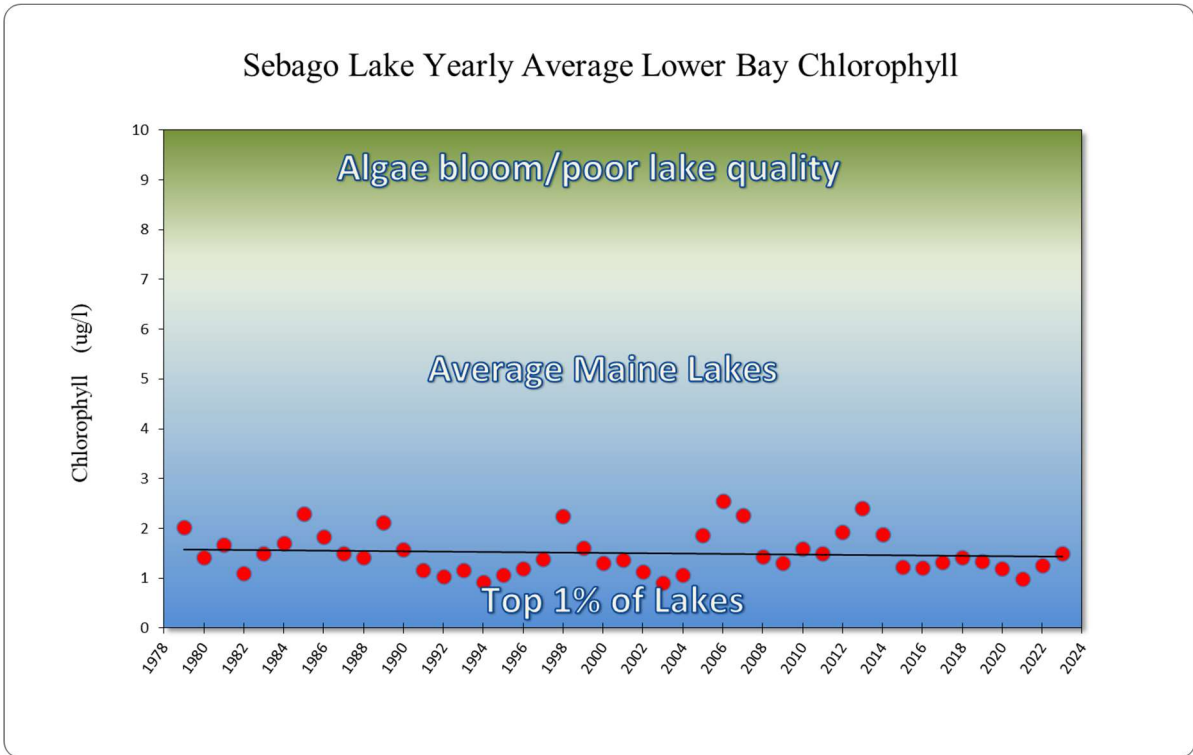
Lower Bay Transparency

The average Secchi Disk Transparency in Lower Bay since 1976 is 10.4 meters. The linear regression trend since 1976 shows no statistical change. Sebago Lake is consistently one of the clearest lakes in Maine. 2023 was below average clarity for Sebago. Heavy rainfall storm events though out the year were the likely cause.
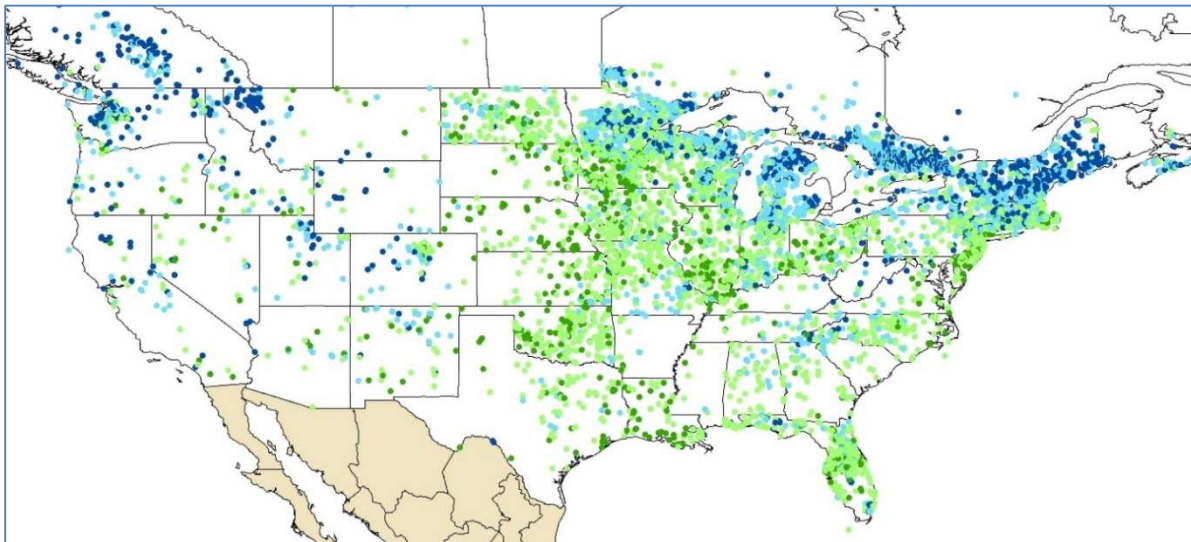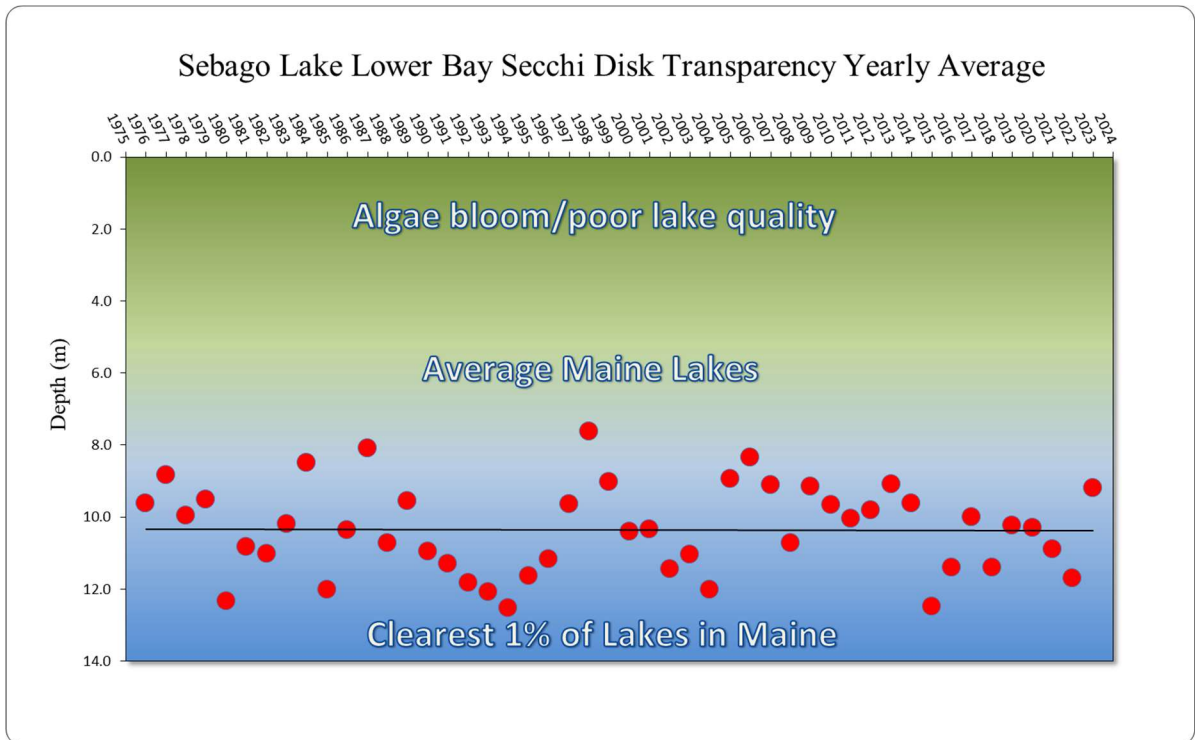
Dots on the map correspond to Secchi Disk readings. Dark blue dots represent clear lakes while dark green dots represent algal bloom lakes. Northeast United States has some of the clearest lakes in America and Sebago Lake is one of the clearest lakes in the Northeast.

Lower Bay Chl a

The average chlorophyll *a* in Lower Bay since 1979 is 1.5 ug/L. The red dot on the chart represents the yearly average. The linear regression trend since 1979 shows no statistical change. There has been **no change in the chlorophyll concentration in Lower Bay since 1979.**

Sebago Lake Yearly Average Lower Bay Chlorophyll

Chlorophyll (ug/l)

Algae bloom/poor lake quality

Average Maine Lakes

Top 1% of Lakes

Lower Bay Total Phosphorus

The average Total Phosphorus in Lower Bay since 1979 is 4.4 ug/L. The red dot on the chart represents the yearly average. The linear regression trend since 1979 is flat. There has been **no change in the Total Phosphorus of Lower Bay since 1979.** 2023 Total P concentrations were above normal. Heavy rainfall storm events though out the year were the likely cause.
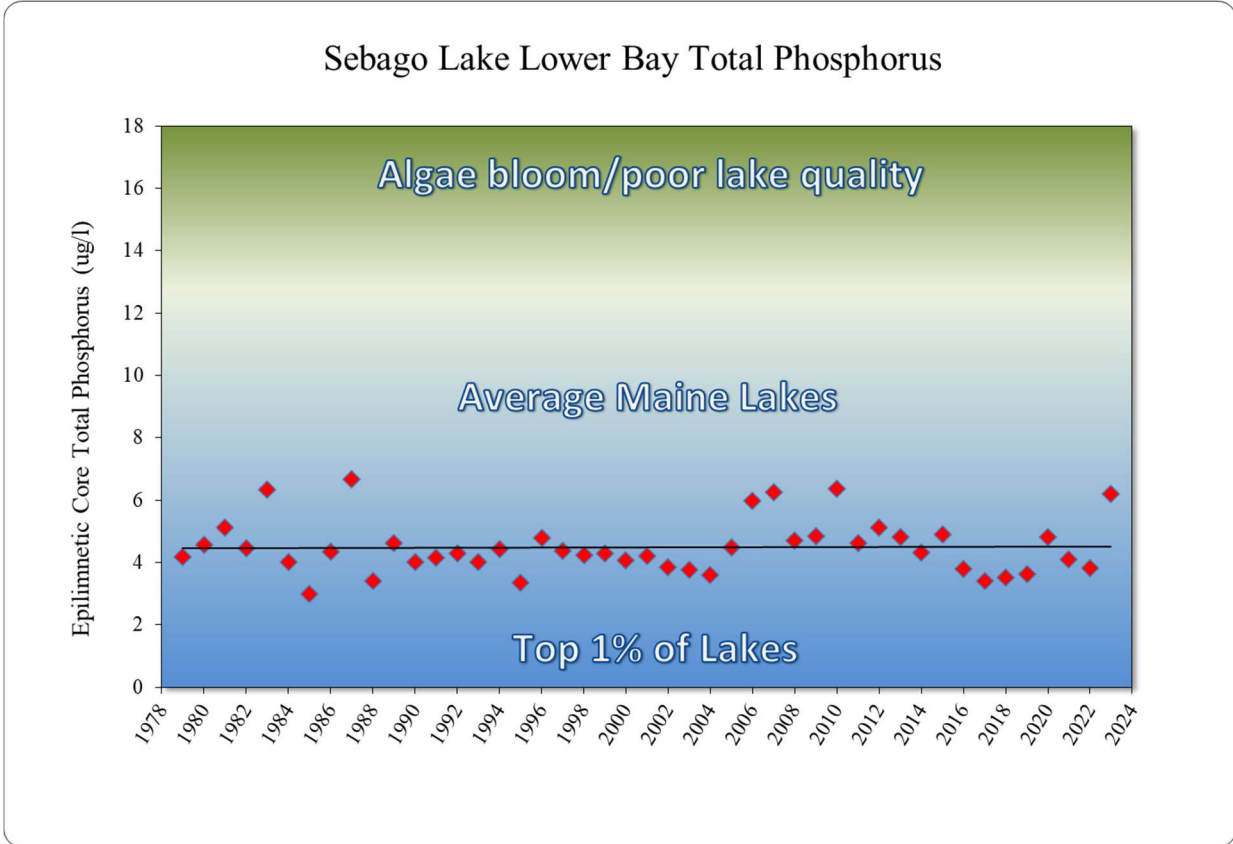
Conclusion

2023 was a less than average year for Sebago Lake water quality. Heavy rain fall events in 2023 were likely the cause. The trophic state of Sebago Lake (based on the Lower Bay sampling station) has been stable since 1976. We focused on the Lower Bay data set because this is the longest dataset available. There are cyclical changes through the data set. However, the long-term trend is stable.

With cyclical data, linear regression analysis can sometimes give misleading results. This is because the slope of the linear line depends on the time period of the analysis. If data collection begins at a high point in a cycle and ends in a low point of the cycle, linear regression will have a negative slope. The opposite is also true; if data collection begins in a trough and ends in a peak, the slope will be positive. This may lead to false conclusions (Foster 2011).

Linear regression becomes more valuable to determine if successive peaks are getting higher and the successive valleys are getting lower with a large data set encompassing numerous periods of peaks and valleys. It can also be useful to analyze water quality data with different statistical methods. Often different statistical analysis can yield a greater insight into the data (Whalen 2011).

Fortunately, hypolimnetic oxygen levels appear to be nearly saturated and stable over time. This phenomenon only occurs in the clearest, most biologically unproductive lakes. Monitoring and understanding the hypolimnetic dissolved oxygen depletion rate is one of the key elements to assess lake water quality. The oxygen/sediment interface plays an important role in internal recycling of phosphorous and ultimately lake primary productivity

Sebago Lake water quality has been better than average for the past five years. Some of this can be can be attributed to the lower-than-average precipitation for the past five years.

References

Burns, N.M., J.C. Rutherford and J.S. Clayton. 1999. A monitoring and classification system for New Zealand lakes and reservoirs. Lake and Reserv. Manage. 15 (4):255-271.

Whalen, Nathan S. 2011. Characterization of Sebago Lake Lower Bay Trophic State Since 1976

Foster, Grant. 2011. Sebago Lake Water Quality

Current and Historical Portland Water District
Sebago Lake Profile Sampling Stations

Crooked-Songo

Jordan Bay

Big Bay

Ward's Cove

Frye Island West

Harmon's Beach

Site #7

Off 1952
Intakes
Lower Bay

PWD Sample Station Dates

- 🔴 1976-1989
- ⚫ 1990-present
- 🟢 2000-2005
- 🟡 2000-present