LAKE & WATERSHED RESOURCE MANAGEMENT ASSOCIATES
PO Box 65 Turner ME 04282
207-336-2980 · lwrma@megalink.net

2019 Water Quality Overview for Ellis (Roxbury, Silver Lake) Pond

Perspective:

The annual characterization of the water quality of Maine lakes has always been a challenge to lake scientists because aquatic ecosystems experience a high degree of "natural variability". One of the strongest influences on this natural process is the weather, and typically, foremost among the many forces of weather on lakes is precipitation. Many Maine lakes tend to be clearer during drier years, ostensibly because of reduced stormwater runoff during such periods, and stormwater runoff is the vehicle that transports phosphorus and other pollutants from watersheds to lakes. Conversely, lakes tend to be less clear during years when there is more precipitation during the period from January through the middle of summer.

While a majority of Maine's lakes "behave" this way, there are exceptions to this simplistic generalization, both in the degree of variability that occurs with individual lakes, and the fact that some lakes respond to precipitation in an opposite manner, for reasons having to do with other weather influences (temperature, wind, etc.), as well as factors pertaining to the unique characteristics of individual lake ecosystems, including the annual flushing rate, watershed geochemistry, bathymetry, geospatial orientation, and others. Highly productive lakes that experience regular algae blooms sometimes benefit from the diluting effects of precipitation, because phosphorus concentrations are already moderately high.

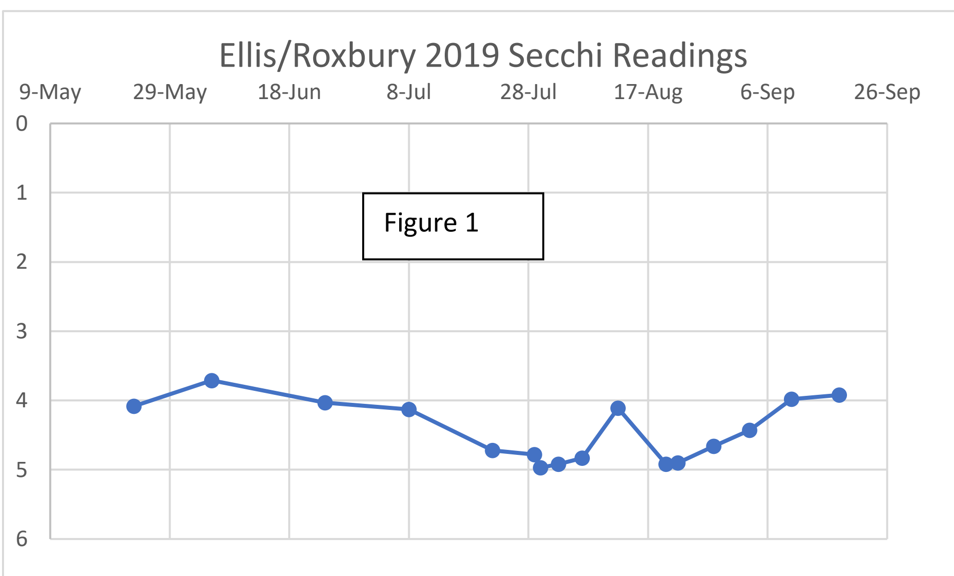
Climate warming is clearly compounding the complexity of tracking, predicting and characterizing lake water quality. Reduced periods of ice cover, resulting in longer periods of sunlight penetration, and warmer lake water, when combined with more severe weather events during the open water season, will very likely have adverse ecological effects on the health of Maine's lakes over time. Some lakes that have historically been "on the edge", as well as others that have been considered stable, but which have known risk factors, have experienced a significant decline in recent years, very likely, in part to a warming climate.

Ellis (Roxbury, Silver) Pond 2019 Overview and Summary of Findings:

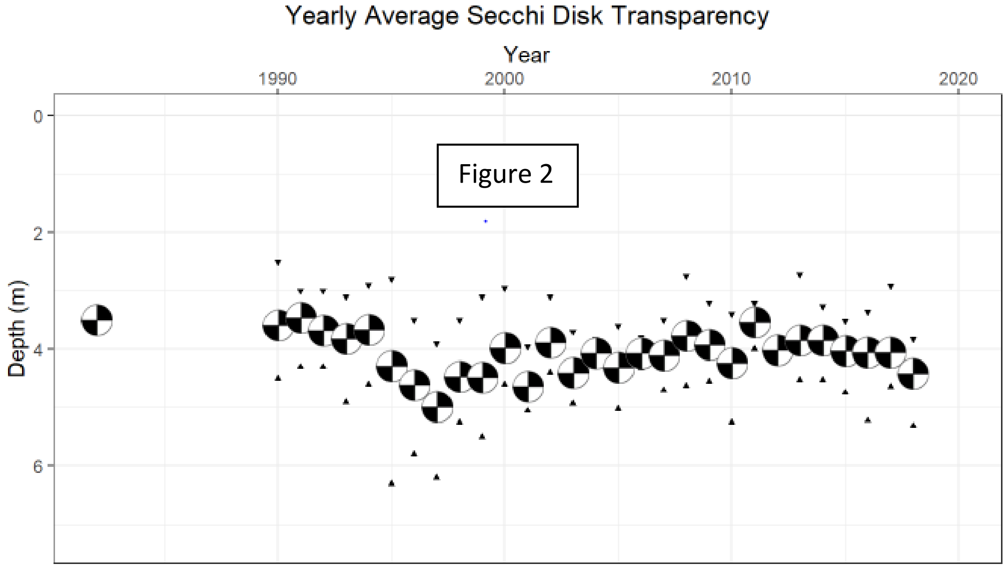
The following summary information is based on sampling conducted on Ellis Pond by LWRMA staff on July 29 and August 22, 2019. Significant additional Water clarity/Transparency and temperature and dissolved oxygen data gathered by Certified LSM Lake Monitor, Ross Swain from May through September have also been included in the analysis and preparation of this report. Summary historical data reference sources are the Maine Department of Environmental Protection, Lake Stewards of Maine (www.lakesofmaine.org), and LWRMA field records and reports.

Please refer to Table 1, below regarding all data obtained in 2019.

Overall, the water quality of Ellis Pond in 2019 was slightly better than the historical average for the lake, in that the water was slightly clearer, and the concentration of total phosphorus and chlorophyll-a (algal pigment) were somewhat lower (Table 1). The two graphics below illustrate the annual and seasonal variability in water clarity that occurs in the lake. Figure 1 illustrates the variability that occurred from May through September, 2019. Figure 2 illustrates annual variability since 1990 (including a single reading in 1982). Some of the changes that have taken place from year to year may be partially influenced by the frequency and timing of readings taken. Note that the vertical axes of both graphs are inverted. Seasonal and annual transparency in lakes is common.



Graph Legend: Secchi symbols = average Secchi Disk Transparency Values; tick marks = maximum and minimum values for each year.



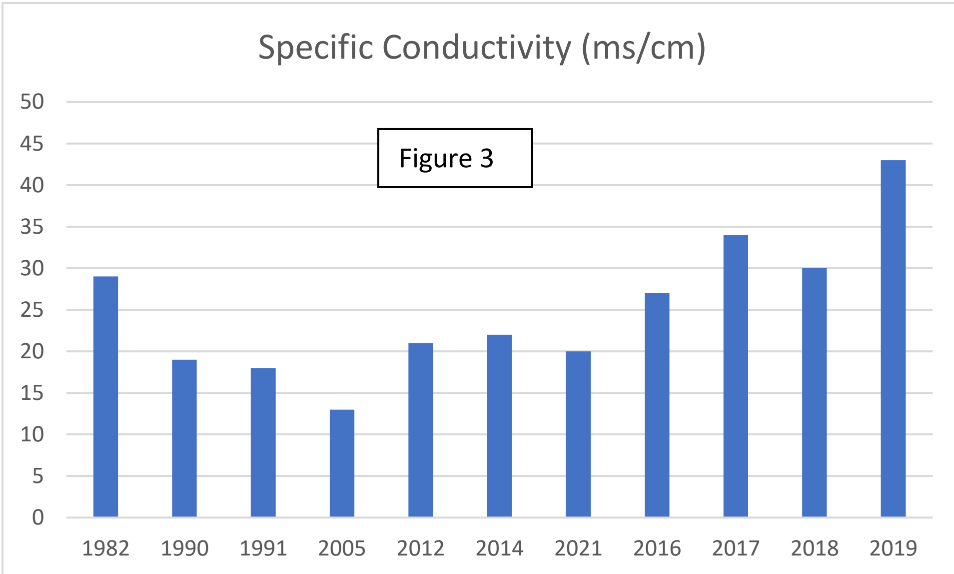
The total phosphorus average for the two months (8 ppb in both July and August) was lower than the historical average (11ppb) for the lake. However, samples taken near the bottom of the deepest point in the lake in both July and August were approximately three times higher than surface readings, at which times the concentration of dissolved oxygen was critically low (0 mg/l) in the deepest area of the lake, suggesting that the low oxygen had triggered the release of phosphorus from the bottom sediments. The lake was strongly thermally stratified on both sampling dates.

The chlorophyll-a (measures planktonic algae density) average (3 ppb) for the two samples taken was slightly lower than the historical average of 4.2 ppb for the lake, as indicated in the Figure 1 table below.

True Color, measured in August (11 SPU) was significantly lower than the historical average of 24 SPU. This may also have been a factor that positively influenced lake clarity in 2019.

pH results from the August sampling were very close the historical average for the lake.

Total Alkalinity was slightly lower than the historical average. However, Specific Conductance was significantly higher than the historical average for the lake. Future monitoring should help to determine whether or not the 2019 sample was an anomaly, or part of a trend. Limited historical data are available for this indicator. Samples taken in recent years appear to suggest an increasing concentration (Figure 3)



The high Specific Conductance in 2019 could be the result of a change in the rate of winter salt application on public and private roads during the previous winter. However, a number of Maine lakes sampled in August, 2019 showed spikes in specific conductance, possibly due to some unknown (at this time) influence of weather. The majority of historical samples taken for these additional indicators have been taken in the month of August.

Gloeotrichia (cyanobacteria) colonies were observed in 2019 in both July and August, at relatively low concentrations (1.0 on a scale of 1-6). Few have been documented in the historical data.

Substantial Metaphyton growth (littoral filamentous algae) was observed in the stream that enters the lake under the one-lane bridge near the church on the easterly side of the lake. Large surficial mats of metaphyton were observed in the stream, and in the shallow inlet area of the lake. The duration of the mats was approximately two weeks, after which the biomass largely dissipated through stream flow and dilution.

Both Gloeotrichia and Metaphyton are forms of lake algae that have been increasingly present in many Maine lakes in recent years. Gloeotrichia has the ability to sequester phosphorus from lake sediments during the winter resting phase of its life cycle. In the spring and early summer, Gloeo colonies rise to the surface. As the colonies degrade during the summer, some research suggests that phosphorus released during the process may contribute to the proliferation of other forms of algae. Very little is known about the possible significance of metaphyton in lakes.

Temperature and dissolved oxygen profiles taken in July and August showed severe dissolved oxygen loss as early as July 8, and continuing through early September, after which thermal stratification broke down and the lake mixed. (Thanks to data documented by Ross Swain throughout this period) It is likely that periodic partial mixing of the lake occurred during significant wind events during the summer months. However, oxygen depletion was documented in the deepest 3-4 meters of the lake for several weeks. Phosphorus samples taken close to the bottom at the deepest area in July and August were significantly elevated from surface levels, suggesting that anoxic conditions may have triggered the release of P from the sediments.

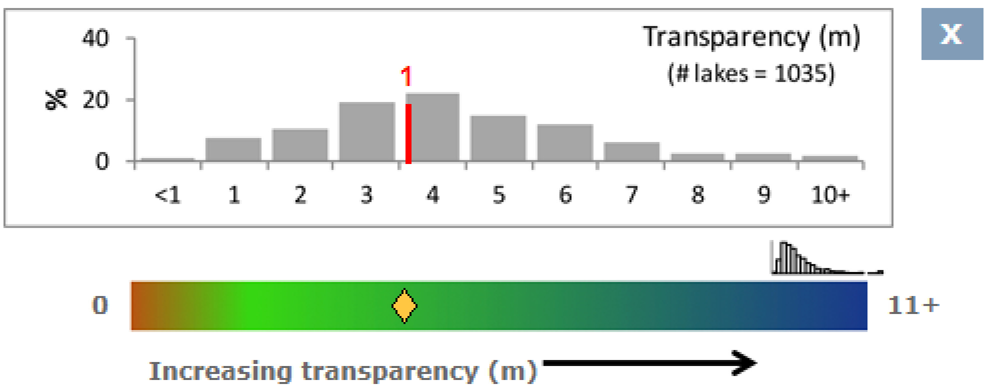
The baseline ratio of the photosynthetic pigment phycocyanin, to other forms of chlorophyll was measured in August. The purpose of this analysis is to observe the extent to which the ratio may change over time– a possible indicator of a shift from the normal assemblage of algal species in the lake to one that is more dominated by cyanobacteria/bluegreen algae. This was only the second year during which this analysis has been conducted. Data cannot be interpreted until multiple years of information has been gathered and a statistical baseline is established.

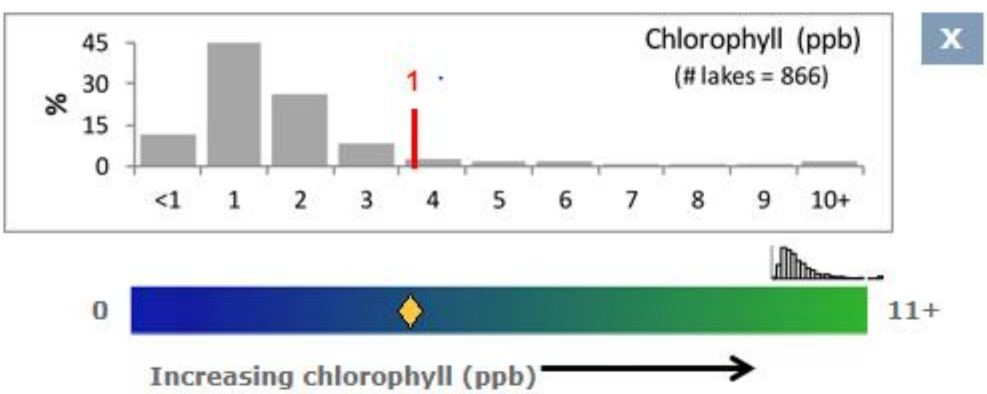
Table 1

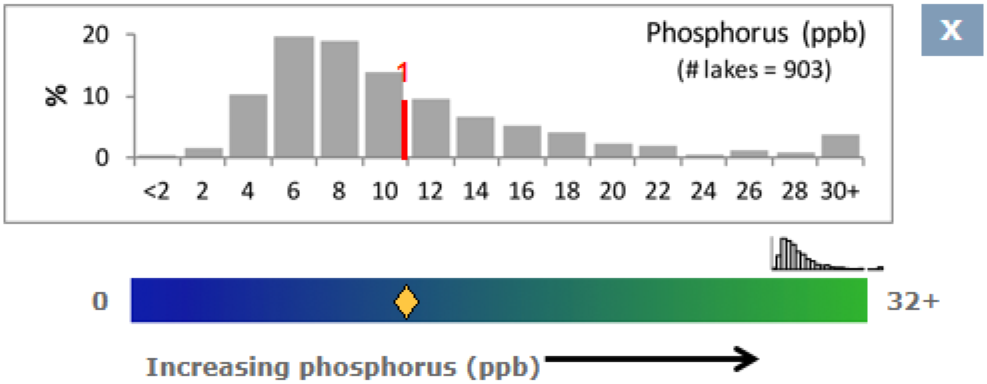
Indicator	Range	2019 Average	Historical Average	Notes
Secchi Transparency in Meters	3.71 (June 5) 4.97 (July 30)	4.28	4.1	
Epi-Core Total Phosphorus in ppb	8 (July 29 & Aug 22)	8	11	
Chlorophyll-a in ppb	3 on July 29 & August 22)	3	4.2	
True Color (SPU)	11 August	11	24	
pH (std units)	6.83	6.83	6.6	
Total Alkalinity in mg/l	4.0	4.0	5.4	
Specific Conductance (MicroSiemens/cm	43	43	23	
Gloeotrichia	1.0 July 29 & August 22)	1.0	N/A	No significant historical
Dissolved Oxygen mg/l	Lowest readings of 0.1 on several dates	N/A	N/A	
Phycocyanin and CHL Ratio	N/A	August: 0.72	N/A	Second year of data – stat analysis not valid

The graphics below illustrate the historical average (yellow star) for each of the three primary water quality indicators (Secchi Transparency, Total Phosphorus and Chlorophyll-a). Each color “ramp” shows the continuum of data for Maine lakes. In each case, the long-term average for Ellis Pond is indicated by the yellow diamond above the bar. Note that while “Increasing Transparency” (water clarity) indicates better water quality, the reverse is true for both chlorophyll (algae pigment) and phosphorus, which is why the diamonds are nearer the lower end of the scale for the latter two indicators. Graphics are courtesy of www.lakesofmaine.org .

The bar chart accompanying each color ramp is a histogram that illustrates the distribution frequency for Maine lakes for each indicator. The red line indicates the historical average for Ellis Pond. This graphic shows where the average is situated, relative to several hundred Maine lakes (indicated by “# of lakes)”.







Summary and Recommendations:

The water quality of Ellis Pond continues to relatively stable, although indicators including persistent dissolved oxygen loss, which may be associated with the release of phosphorus from the bottom sediments, and documented evidence of brief, but intense late season cyanobacteria algal blooms represent a compelling reason to undertake every effort to protect and improve the health of the lake. Toward that end, substantial efforts to address nonpoint sources of soil erosion in the watershed have been successfully undertaken by the Silver Lake Campowners Association for multiple decades. As a result, public awareness of the nature of threats to the health of Ellis Pond has improved, as have very specific efforts to resolve a wide range of issues.

The influences of climate change over time could exacerbate summer oxygen loss in Ellis Pond, thereby increasing the risk factor for future problems, primarily in the form of increasing planktonic algae growth, reduced water clarity, and an earlier occurrences and longer duration of cyanobacteria blooms.

A high percentage of Maine's lakes could experience change in both expected and unanticipated ways in the future as a result of climate change. Our lakes may be more highly colored (and less clear) from increasing humic acids, and also less clear from increasing planktonic algae growth, caused by reduced periods of ice cover and warmer water temps. Some lakes will experience severe cyanobacteria/bluegreen algae blooms, which can result in toxic conditions in the lake. In recent years, several lakes situated in southern and central Maine have experienced unanticipated, severe algal blooms.

Conservation practices that have been promoted by the SLCOA will continue to serve the lake well as our climate warms. The preservation of vegetated buffers throughout the shoreline and watershed is one of the most effective measures for offsetting the effects of a warming climate. Minimizing sources of soil erosion and stormwater runoff will also continue to be very important, as will be efforts to control new shoreline and watershed development.

Prepared by Scott Williams

Senior LWRMA Limnologist