2017 Moose Pond Report

Lakes Environmental Association

Prepared by LEA for the Moose Pond Association

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About LEA

The Lakes Environmental Association (LEA) is a non-profit organization founded in 1970 with the goal of preserving and restoring the high water quality and the traditional character of Maine's lakes, watersheds and related natural resources. Headquartered in Bridgton, Maine, LEA focuses its efforts on 6 towns in the western Maine Lakes Region, although its reach and influence extends across the whole state.

Invasive Plant Program

LEA's Milfoil Control Team successfully eradicated invasive Variable Leaf Milfoil from Brandy Pond and the Songo River in 2015, after over a decade of hard work. The focus shifted to Sebago Cove in 2016, where a dense infestation threatens nearby waterbodies, and in 2017 they began work on Long Lake after an infestation was found there. LEA's program has been a model for the entire state.

Environmental Education

LEA offers environmental education programs to local elementary, middle, and high schools, reaching over 1,000 students annually. LEA also hosts educational programs for all ages at the Holt Pond Preserve, Highland Lake Preserve and Pondicherry Park, all of which LEA played a key role in establishing.

Lake Water Testing

Water testing on over 40 lakes and ponds in the area occurs every year through traditional and advanced testing initiatives. The results are presented in this report.

Landowner and Municipal Assistance

LEA provides technical assistance to residents interested in preventing erosion on their property. This service helps educate landowners about simple erosion control techniques and existing land use regulations. LEA also works with municipalities on comprehensive planning, natural resources inventories and ordinance development.

Courtesy Boat Inspections

Every summer, LEA hires over 30 courtesy boat inspectors to educate boaters at public boat launches about invasive plants and help them perform inspections on their watercraft. This program, begun by LEA, has been adopted across the state.

Maine Lake Science Center

Opened in 2015, LEA's Maine Lake Science Center is a hub for lake research in the state. The center regularly hosts researcher retreats and other events at its remodeled and renovated energy-efficient headquarters located in Bridgton.

Please Join LEA!

LEA is a primarily member-funded operation. If you swim, boat, fish or simply believe Maine wouldn't be Maine without clear, clean lakes and ponds, please join the Lakes Environmental Association and protect Maine's lakes now and for future generations.

You can become an LEA member with a donation of any amount. Just mail a check to LEA, 230 Main St., Bridgton, ME 04009 or join online at www.mainelakes.org.

Water Quality at a Glance

Please See Key on the Next Page.

Lake	Oxygen Depletion	High P at depth	Clarity Trend	Phos. Trend	Chl-a Trend	Coldwater Fish	Other Issues	Degree of Concern
ADAMS POND	👎	👎	⚪	⚪	👎	🟡	—	HIGH
BACK POND	🟡	👍	👍	👍	👎	🟡	Low Al:Fe	HIGH
BEAR POND	👎	👎	⚪	⚪	👎	🟡	—	HIGH
BEAVER P. (Bridgton)	👎	👎	👍	⚪	👍	N/A	—	MOD
BEAVER P. (Denmark)	👍	N/A	N/A	⚪	⚪	N/A	—	AVG
BOG POND	👍	N/A	N/A	N/A	N/A	N/A	—	AVG
BRANDY POND	👎	👍	⚪	⚪	⚪	👎	—	MOD
COLD RAIN POND	👎	N/A	⚪	⚪	⚪	👎	—	MOD
CRYSTAL LAKE	🟡	👍	👎	⚪	⚪	🟡	Low Al:Fe	MOD
DUCK POND	🟡	N/A	N/A	N/A	N/A	N/A	—	AVG
FOSTER POND	🟡	N/A	⚪	⚪	⚪	N/A	—	AVG
GRANGER POND	🟡	N/A	⚪	⚪	⚪	N/A	Algae	MOD
HANCOCK POND	👎	👍	👍	⚪	👍	👎	—	MOD
HIGHLAND LAKE	👎	👎	👍	⚪	👍	👎	Algae	HIGH
HOLT POND	🟡	N/A	⚪	⚪	⚪	N/A	—	AVG
ISLAND POND	👎	N/A	⚪	⚪	⚪	👎	—	MOD
JEWETT POND	👎	👎	⚪	⚪	⚪	N/A	—	MOD
KEOKA LAKE	👎	👎	⚪	⚪	⚪	👎	Gloeo	HIGH
KEYES POND	👎	👎	👍	⚪	⚪	👎	—	MOD/HIGH
KEZAR POND	👍	N/A	N/A	⚪	⚪	N/A	—	AVG
LITTLE POND	🟡	N/A	N/A	👍	⚪	N/A	—	AVG
LITTLE MOOSE POND	👎	👎	⚪	⚪	⚪	N/A	—	MOD
LITTLE MUD POND	👎	N/A	⚪	⚪	⚪	N/A	—	AVG
LONG LAKE (3 BASINS)	👎	👍	⚪	⚪ ⚪ 👍	⚪	👎	Gloeo/Al:Fe/ Milfoil	HIGH
LONG POND	👍	N/A	👎	⚪	⚪	N/A	—	AVG
McWAIN POND	👎	N/A	⚪	👍	⚪	N/A	Gloeo	MOD
MIDDLE POND	👎	👎	👍	⚪	⚪	👎	—	MOD/HIGH
MOOSE POND (Main)	👎	👍	⚪	👍	👍	👎	Gloeo/Al:Fe	HIGH
MOOSE POND (North)	🟡	👎	⚪	⚪	⚪	N/A	—	AVG
MOOSE POND (South)	👎	👎	N/A	N/A	N/A	N/A	—	MOD
MUD POND	👎	N/A	⚪	⚪	⚪	N/A	—	AVG
OTTER POND	🟡	N/A	👍	⚪	👍	N/A	—	AVG
PAPOOSE POND	🟡	N/A	👍	⚪	⚪	N/A	—	AVG
PEABODY POND	👎	👎	⚪	⚪	⚪	🟡	Low Al:Fe	MOD/HIGH
PERLEY POND	👎	N/A	⚪	👍	⚪	N/A	—	AVG
PICKEREL POND	🟡	N/A	⚪	👎	⚪	N/A	—	AVG
PLEASANT POND	🟡	N/A	⚪	⚪	⚪	N/A	—	AVG
SAND POND	👎	👍	👎	⚪	⚪	👎	Algae	HIGH
SEBAGO COVE	👍	N/A	N/A	N/A	N/A	N/A	Milfoil	AVG
STEARNS POND	👎	👍	👍	⚪	👍	👎	—	MOD
TRICKEY POND	🟡	👍	👎	⚪	👎	🟡	—	HIGH
WEBBER POND	👍	N/A	N/A	N/A	N/A	N/A	—	AVG
WOODS POND	👎	👍	⚪	👎	⚪	N/A	—	MOD

Key to Water Quality at a Glance Table

Oxygen Depletion: Did the lake suffer from low oxygen conditions in 2017?

= severe   = slight   = none

High P at depth: Were deep-water phosphorus levels above 12 ppb in 2017?

= Yes   = No   N/A = not tested

Clarity, Phosphorus, and Chlorophyll-a trends: Data from 1996-2017 was analyzed to determine if these parameters are improving or worsening over time.   N/A = no trend analysis

=Worsening   = Improving   = No change

Coldwater Fish: Did coldwater fish have 2 m of suitable habitat at all times of the year in 2017?

= No   = Yes   N/A = no coldwater fishery

Other Issues: Additional risks that factor into the level of concern. Each issue =

Low Al/Fe: Lake is at a greater risk of phosphorus release from sediments

Algae: An algae bloom has occurred in the past

Gloeo: Lake has a history of elevated *Gloeotrichia echinulata* levels

Milfoil: Invasive milfoil has been found in this lake

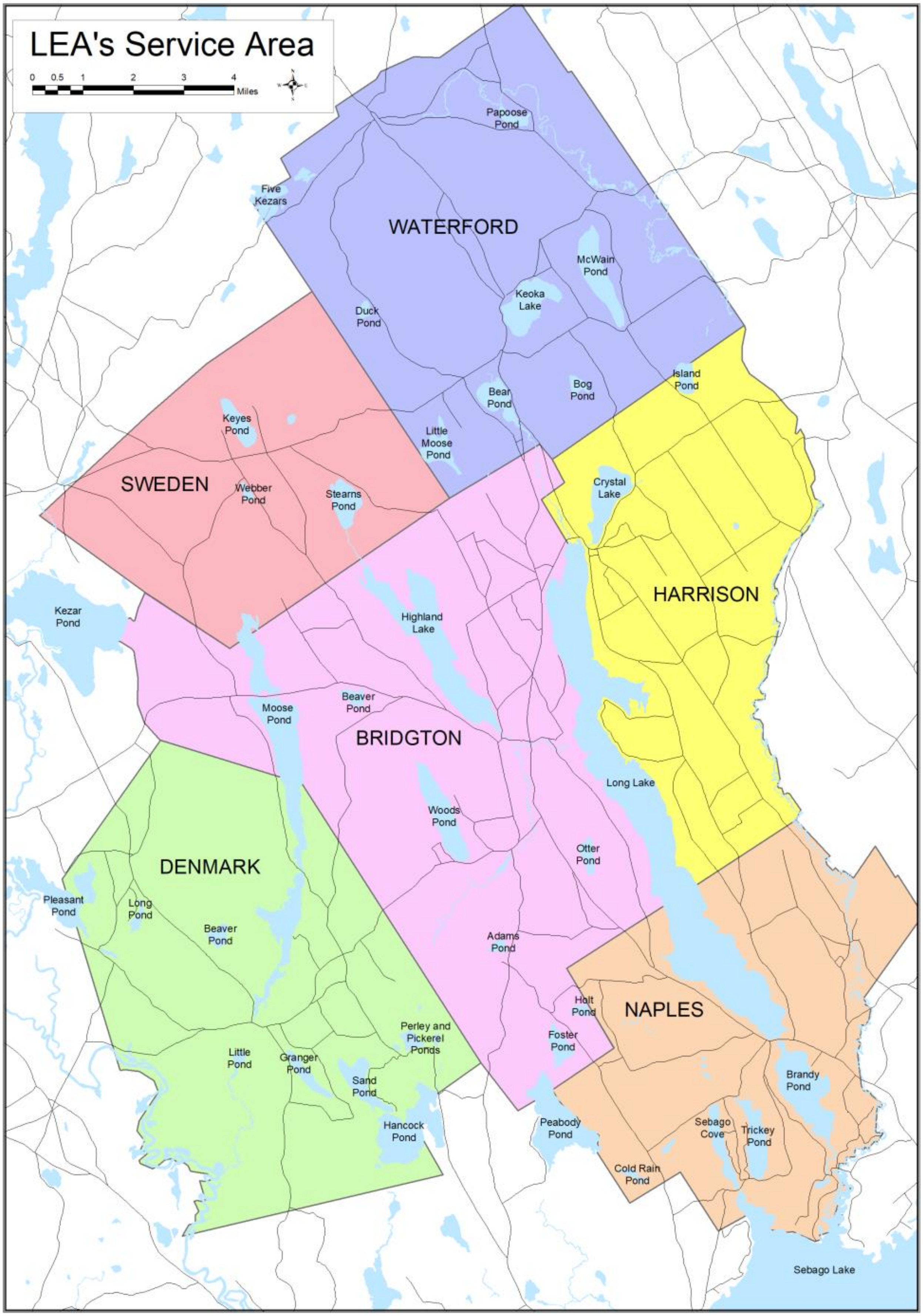
Degree of Concern: LEA's risk assessment for future lake water quality

Average: none or 1

Moderate:

Moderate/High:

High: or a worsening chl-a trend



LEA's Service Area
0 0.5 1 2 3 4 Miles
WATERFORD
SWEDEN
HARRISON
BRIDGTON
DENMARK
NAPLES
Papoose Pond
Five Kezars
McWain Pond
Keoka Lake
Duck Pond
Island Pond
Bog Pond
Bear Pond
Keyes Pond
Little Moose Pond
Crystal Lake
Webber Pond
Stearns Pond
Kezar Pond
Highland Lake
Beaver Pond
Moose Pond
Long Lake
Woods Pond
Otter Pond
Pleasant Pond
Long Pond
Beaver Pond
Adams Pond
Holt Pond
Foster Pond
Perley and Pickerel Ponds
Little Pond
Granger Pond
Sand Pond
Brandy Pond
Hancock Pond
Peabody Pond
Sebago Cove
Trickey Pond
Cold Rain Pond
Sebago Lake

LEA would not be able to test the 41 lakes and ponds of this area without strong support from our surrounding community. Every year, we rely on volunteer monitors, lakefront landowners, summer interns and financial support from Lake Associations and the Towns of Bridgton, Denmark, Harrison, Naples, Sweden, and Waterford to continue to monitor and analyze lake water quality. **Thank you for all your help!**

2017 Volunteer Monitors and Lake Partners

Paul America
Bill Ames and Paulina Knibbe
Richard and Andy Buck
Steve Cavicchi
Jeff and Susan Chormann
Janet Coulter
David Ehrman
Jane Forde
Joe and Carolee Garcia
Carol Gestwicki
Shelly Hall
Carl and JoAnne Harbourt
Aiden Ireland
Jim Kelly
Kokosing
Lydia Landesberg
Amy March
Julie and Dan McQueen
Dorothy Mayberry
Bob Mahanor
Bob Mercier
Bill Muir
Papoose Pond Campground
Barry and Donna Patrie
Nancy Pike
Jean Preis
Don Rung
Stephanie Scearce
Arthur and Jean Schilling
Jane Seeds
Linda and Orrin Shane
Foster and Marcella Shibles
Bob Simmons
Barry Smith
Paul Stander
Carolyn Stanhope
Tom Stockwell
Tom Straub
Don and Pat Sutherland
Charlie Tarbell
David Thomae
Chip and Rhona Wendler
Camp Wigwam

2017 Water Testing Crew

Isabella Davis
Kayla Gray
Grace Kimzey
Erin Levasseur
Jacob Moulton
Chloe Wendler

Lake Association Partners Who Contribute to Advanced Testing Initiatives

Five Kezar Ponds Watershed Assoc.
Hancock and Sand Ponds Association
Island Pond Association
Keoka Lake Association
Keyes Pond Env. Prot. Assoc.
McWain Pond Association
Moose Pond Association
Peabody Pond Protective Assoc.
Trickey Pond Env. Prot. Assoc.
Woods Pond Water Quality Comm.

Lake Stratification 101

To understand much of LEA's water quality data, you must understand the concept of lake stratification.

Lake stratification is the separation of water in a lake or pond into distinct layers. This is caused by density differences in water at different temperatures. However, wind also plays a key role in maintaining and breaking down stratification. This layering happens in both the summer and winter and breaks down in the spring and fall, allowing for "turnover" — full mixing throughout the water column.

In Maine, three layers often form; the epilimnion, metalimnion (also called the thermocline), and the hypolimnion.

The epilimnion is the warm surface layer of the lake and the hypolimnion is the cold bottom layer. The thermocline is a narrow zone in between these layers where temperature and oxygen levels change rapidly. The exact depths of each layer change over the course of the summer and from lake to lake and year to year.

Due to the nature of stratification, which does not allow for exchange between the top and bottom layers, oxygen and nutrient concentrations often differ significantly between the upper and lower portions of a stratified lake. This is especially true in late summer.

This has several consequences for the lake. Light penetration is greatest near the top of the lake, meaning that algae growth primarily occurs in the epilimnion. Algae growth will sometimes peak near the thermocline, often in lakes with deep light penetration and higher hypolimnetic phosphorus levels.

Oxygen levels in the epilimnion are constantly replenished through wind mixing, but the hypolimnion is cut off from the atmosphere, leaving it with a fixed volume of oxygen which is slowly used up over the summer. This can affect coldwater fish species in some lakes.

Phosphorus, the limiting element controlling algae growth in our lakes, is often more abundant in the hypolimnion because it is stored in sediments.

When oxygen levels are low at the bottom of the lake, as often happens later in the summer, a chemical reaction occurs that releases stored phosphorus from sediments. However, due to the density barrier at the metalimnion, these nutrients do not move easily into the epilimnion. This often causes a buildup of phosphorus in the hypolimnion.

Smallmouth Bass

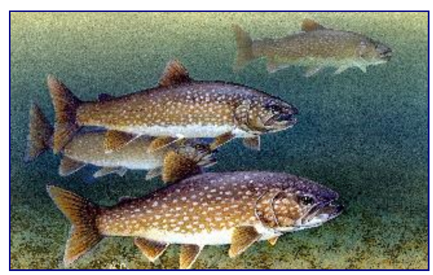
Epilimnion

The warm upper waters are sunlit, wind-mixed and oxygen rich.

Landlocked salmon

Metalimnion

This layer in the water column, also known as the thermocline, acts as a thermal barrier that prevents the interchange of nutrients between the warm upper waters and the cold bottom waters.



Lake trout, also known as togue

Hypolimnion

In the cold water at the bottom of lakes, food for most creatures is in short supply, and the reduced temperatures and light penetration prevent plants from growing.

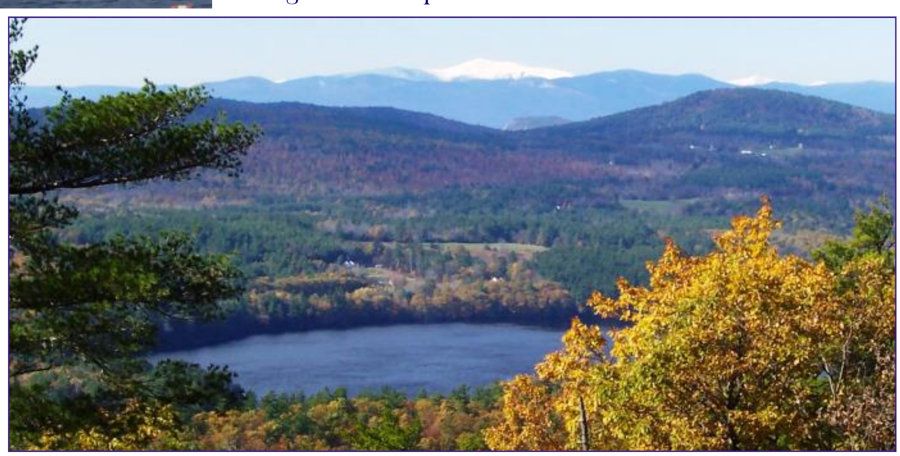
A year in the life of a lake

Winter is a quiet time. Ice blocks out the sunlight and also prevents oxygen from being replenished in lake waters because there is no wind mixing. With little light below the ice and gradually diminishing oxygen levels, plants stop growing. Most animals greatly slow their metabolism or go into hibernation.

Spring is a period of rejuvenation for the lake. After the ice melts, all of the water is nearly the same temperature from top to bottom. During this period, strong winds can thoroughly mix the water column allowing for oxygen to be replenished throughout the entire lake. This period is called spring turnover. Heavy rains, combined with snow melt and saturated soils are a big concern in the spring. Water-logged soils are very prone to erosion and can contribute a significant amount of phosphorus to the lake. Almost all soil particles that reach the lake have attached phosphorus.

Summer arrives and deeper lakes will gradually stratify into a warm top layer and a cold bottom layer, separated by a thermocline zone where temperature and oxygen levels change rapidly. The upper, warm layers are constantly mixed by winds, which “blend in” oxygen. The cold, bottom waters are essentially cut off from oxygen at the onset of stratification. Coldwater fish, such as trout and landlocked salmon, need this thermal layering to survive in the warm summer months and they also need a healthy supply of oxygen in these deep waters to grow and reproduce.

Fall comes and so do the cooler winds that chill the warm upper waters until the temperature differential weakens and stratification breaks down. As in Spring, strong winds cause the lake to turn over, which allows oxygen to be replenished throughout the water column.



Water Quality Testing Parameters

LEA's testing program is based on parameters that provide a comprehensive indication of overall lake health. Tests are done for transparency, temperature, oxygen, phosphorus, chlorophyll, color, conductivity, pH, and alkalinity.

Clarity is a measure of water transparency. It is determined with a Secchi disk and measured in meters. Clarity is affected by water color and the presence of algae and suspended particles.

Chlorophyll-a is a pigment found in all algae. Chlorophyll (the –a is dropped for simplicity) sampling in a lake is used to estimate the amount of algae present in the water column. Chlorophyll concentrations are measured in parts per billion (ppb). Samples are a composite of the top layer of water in a lake.

Phosphorus is a nutrient needed by algae to grow and reproduce. It is used to determine the potential for algae growth in a lake. Phosphorus is measured in parts per billion (ppb). Upper layer phosphorus samples are a composite (blended sample) of the top few meters of the water column, while deep-water phosphorus samples are taken at individual depths using a grab sampler.

Dissolved oxygen is measured at one-meter intervals from the surface to the bottom of the lake. It is measured in parts per million (ppm). Over the course of the summer, oxygen in the bottom waters is consumed through organic matter decomposition. If dissolved oxygen concentrations reach zero at the bottom of the lake, phosphorus can be released into the water column from bottom sediments, which can cause increased algal growth that fuels further lake oxygen depletion. Phosphorus release is inhibited in lakes with high sediment aluminum levels. Oxygen depletion can be a natural occurrence in some lakes due to the lake's shape. It is a special concern in lakes that support coldwater fish. In this report, "oxygen depletion" refers to dissolved oxygen levels below 4 ppm. During the fall, cooler temperatures and winds cause the lake to de-stratify and oxygen is replenished in the deep waters as the lake mixes.

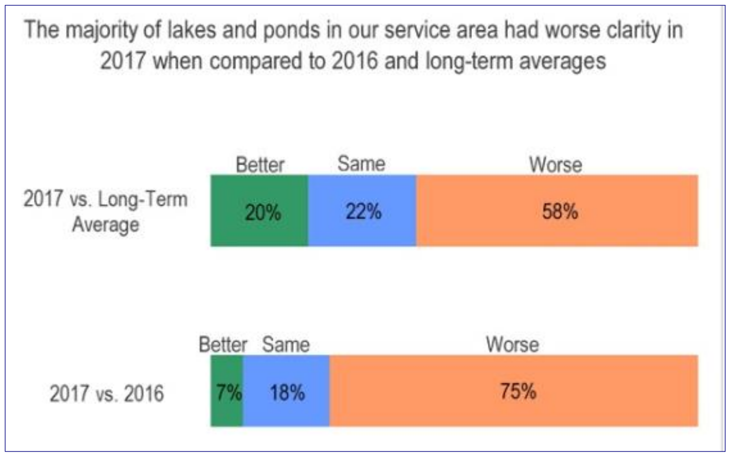
Temperature is measured at one-meter intervals from the surface to the bottom of the lake. This data is used to assess thermal stratification. Lakes deep enough to stratify will divide into three distinct layers: the epilimnion, metalimnion and hypolimnion. The epilimnion (upper layer) is comprised of the warm surface waters. The hypolimnion is made up of the deep, colder waters. The metalimnion, also known as the thermocline, is a thin transition zone of rapidly decreasing temperature between the upper and lower layers. Temperature is recorded in degrees Celsius.

Other Measurements: We collect data on these parameters, but they tend to remain stable over long periods time. They are not reported on unless unusual conditions were observed.

> **Conductivity** measures the ability of water to carry electrical current. Pollutants and minerals in the water will generally increase lake conductivity.
>
> **Color** is a measure of tannic or humic acids in the water.
>
> **pH** is important in determining the plant and animal species living in a lake. pH is used to measure the acidity of lake water.
>
> **Alkalinity** is a measure of the amount of calcium carbonate in the water and it reflects the ability of the water to buffer pH changes.

2017 as a Year

The water quality results for 2017 show a mediocre year for water quality in the lakes region. Several factors influenced the results seen in 2017. The winter of 2016-2017 deposited a larger than average amount of snow in the region, leading to higher water flows in the spring. There was also a significant amount of rainfall in the spring and early summer. More water running off into lakes meant more erosion bringing particulates and pollution, as well as higher water levels. Tornadoes in the Long Lake and Moose Pond watersheds in early July also caused severe erosion and extensive damage to shorefront property and vegetation. Relatively cold temperatures in the spring delayed stratification and meant that ice-out occurred around its average date, despite a trend of increasingly earlier ice-out over the last few decades. While rainfall was high early in the season, later in the summer the region experienced mild drought conditions. The lack of rain increased clarity in many lakes toward the end of the season, but because of low readings early in the season, the majority of lakes saw worse than average clarity in 2017.



Clarity, a measure of how transparent the water is, was the same or better on 42% of lakes and worse on 58% when compared to long-term averages. Chlorophyll-a, a measurement of the algae concentration in a lake, was stable or improved over the long-term average in 62% of lakes and worse than average on 38% of lakes. Phosphorus, the limiting nutrient that controls algae growth, was also the same or better in the upper layer of the water column on 62% of lakes and worse on 38%. Phosphorus levels at depth appeared to be lower overall in 2017 compared to previous years. This may be explained by the delay in the set up of stratification in the spring, which resulted in less severe oxygen depletion and meant there was less phosphorus release from lake sediments. Weather is often the driving force behind water quality in any given year. The weather in 2017 affected water quality in both positive and negative ways. Fortunately, no major water quality declines or algae blooms were reported in 2017.

On a longer timescale, water quality trends are impacted by climate, changes in land use, non-point source pollution, and best management practices. This means that any changes we make to protect our lakes — such as installing water bars, pumping septic systems, or planting a vegetated buffer on a shoreline — do not often result in visible benefits for several years, but are extremely important to the long-term health of our lakes. With strong support and investment in the future of our lakes, we can keep the Lakes Region resilient and protected for years to come.

Interpreting Water Testing Data

Water Quality Classification

Each basin's clarity, chlorophyll, and phosphorus readings are the basis for determining water quality classification. Most lakes in LEA's service area are in the moderate range for all three parameters. The following table shows the range of values in each category (low, moderate, etc.) for each parameter.

Clarity in meters (m)		Phosphorus in parts per billion (ppb)		Chlorophyll-a in parts per billion (ppb)	
10.0 +	excellent	less than 5.0	low	less than 2.0	low
7.1 – 10.0	good	5.1 – 12.0	moderate	2.1 – 7.0	moderate
3.1 – 7.0	moderate	12.1 – 20.0	high	7.1 – 12.0	high
less than 3.0	poor	20.1 +	very high	12.1 +	very high

Trends and Long-Term Averages

Each data summary starts with an explanation of clarity, chlorophyll, and phosphorus trends. These trends are a regression analysis of all the data LEA has collected on each basin since 1996 (some parameters were not measured until later years on the main and north basins, and the south basin was not measured at all until 2015). If the p-value of the regression is less than 0.05, it is a worsening or improving trend (depending on the direction of the trend). If the p-value is above 0.05, there is no detectable trend. These trends show water quality changes over time.

The long-term average is a simple mean of all the data we have on record for each parameter (clarity, chlorophyll, and phosphorus). The long-term average doesn't tell us specifically how each parameter changes over time like the trend analysis does; it is instead used see how the current year's data compares to historical values. The long-term average uses all the data available, rather than just data collected in or after 1996.

This means that the trend and the long-term average can be at odds. For example, the overall clarity trend might be improving over time, but if the current year had particularly bad water clarity, the yearly average may be worse than the long-term average. The trend shows how the parameter has changed over time, while the long-term average is used as a benchmark to assess the current year's data.

Coldwater Fish Habitat

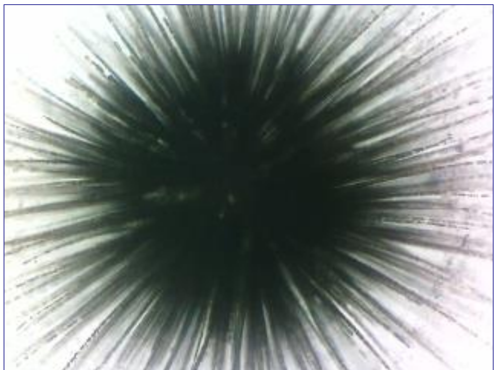
Suitable habitat is defined as being below 15.5 °C and above 5 ppm dissolved oxygen. Marginal habitat is between 15.5 and 20 °C and above 5 ppm oxygen. Coldwater fish habitat is considered a water quality issue in lakes with coldwater fisheries that do not have at least 2 meters' worth of suitable habitat at all times during the testing season.

Degree of Concern

Each basin is also given a degree of concern category ranking. The average, moderate, moderate/high, and high degree of concern categories are based on the number of water quality issues the basin faces. An increasing chlorophyll trend automatically results in a high level of concern. Recent algae blooms also raise the degree of concern by one level. You can see more about these rankings in the "Water Quality at a Glance" table and key on pages 2 and 3.

Gloeotrichia echinulata Monitoring

Gloeotrichia echinulata (also known as "Gloeotrichia" or simply "Gloeo") is a colonial cyanobacteria species. Each colony is made up of numerous hair-like filaments that radiate outward, creating the characteristic "fuzzy ball" appearance of this species. The colonies are approximately 1-3 mm in diameter and tend to be free-floating in the water column, only forming surface scums at extremely high concentrations.



A Gloeo colony under the microscope

Cyanobacteria (also known as blue-green algae) such as Gloeo are not actually algae, but photosynthetic bacteria. There are several cyanobacterial species that are notorious for causing toxic blooms in high-nutrient lakes. Gloeo do not form sludgy, green "pea soup" blooms like other cyanobacteria, but they can produce toxins under certain conditions. Rather than pea soup, Gloeo tend to look like small yellow spheres floating throughout the water column, and their large size makes them very noticeable even at low concentrations.

While algae blooms are typically associated with high nutrient lakes, Gloeo is known for its proliferation in low nutrient lakes, such as those in the Lakes Region. One concern with Gloeo is that it may be enriching these lakes by moving phosphorus from the sediments into the water column.

Gloeotrichia is a fairly common sight in late summer throughout New England, and can be found in high concentrations in several lakes in Maine each summer. They are not an invasive species or particularly new to our waters. Evidence of Gloeo is present in sediment cores from various lakes, and a report on Waterford Lakes from 1973 shows that Gloeo was common in McWain Pond and Keoka Lake 45 years ago.

While Gloeo can be seen in the water column from June through September, the highest levels of Gloeo are typically seen within a two week span in late July and early August. The amount of Gloeo present in a lake depends primarily on light, temperature, and nutrient levels, as well as several smaller contributing factors. Temperature in particular can be used to explain the timing of peak Gloeo concentrations.

High density of Gloeo colonies seen near the shore of Moose Pond, August 2017.

Gloeotrichia in the Lakes Region

LEA began sampling for Gloeo in 2013. Samples are collected in shallow areas of lakes and ponds using a plankton tow net made of fine mesh, which strains the algae from the water. Sites of sample collection have remained consistent since sampling began, but not all sites were visited in all years. Abundance is measured in a unit called "colonies per liter" (abbreviated col/L), which is the number of Gloeo that would be seen in an average liter of lake water (it helps to imagine the size of a 1 liter soda bottle).

Lakes Sampled for *Gloeotrichia* in 2017:

- ADAMS POND 🟢
- BACK POND 🟢
- BEAR POND 🟡
- BRANDY POND 🟡
- CRYSTAL LAKE 🟡
- FOSTER POND 🟢
- GRANGER POND 🟢
- HANCOCK POND 🟢
- HIGHLAND LAKE (2 sites) 🟢
- ISLAND POND 🟢
- KEOKA LAKE 🔴
- KEYES POND 🟢
- LITTLE MOOSE POND 🟢
- LONG LAKE (4 sites) 🔴
- McWAIN POND 🔴
- MIDDLE POND 🟢
- MOOSE POND (Main Basin) 🔴
- MOOSE POND (North Basin) 🟡
- MOOSE POND (South Basin) 🟡
- PEABODY POND 🟡
- SAND POND 🟢
- STEARNS POND 🟢
- TRICKEY POND 🟢
- WOODS POND 🟢

🟢 NONE
🟡 LOW (<5 col/L)
🔴 HIGH (>5 col/L)

Lakes that were sampled for Gloeo in 2017 are listed to the right. Several lake associations provided funding for the collection of samples on their lakes. Of the 28 sites tested, only seven have had elevated levels of Gloeo (>5 col/L) over the 5 years of testing. These are Keoka Lake, Long Lake (which has 4 sample sites), McWain Pond, and Moose Pond's Main Basin. These sites were sampled five times over the course of 5 weeks in 2017. Several sites have had low levels of Gloeo present in late summer each year (below 5 col/L). The remaining sites, about 75% of the total sites sampled, have had virtually no Gloeo in any samples.

The lakes with and without significant levels of Gloeo have stayed consistent since LEA began sampling. It is likely that some lakes don't have the ability to support higher concentrations of this species. However, the lake characteristics and conditions needed for Gloeo blooms to occur are not well understood.

The following pages present data from the four lakes with elevated late-summer Gloeo concentrations. Each lake's results are graphed on plots with the same scale on the x-axis and y-axis to facilitate comparison.

Concentrations of Gloeo discussed in the summaries should be interpreted with the knowledge that LEA sampling provides a "snapshot" of the Gloeo present at a particular spot at a particular point in time, which may not be representative for the lake as a whole. Gloeo populations can vary across a single lake due to factors like prevailing winds and substrate quality. Long Lake data is a good example of this: sampling from four sites shows the northern part of the lake consistently has the highest Gloeo concentrations. However, on most other lakes, only one site is sampled. This means we potentially miss "hot spots" of elevated Gloeo on some lakes. That being said, after sampling for 5 years and visiting each lake on the above list twice per month every summer for routine water quality monitoring, we can be reasonably sure in our assessment of the relative Gloeo concentrations on these lakes.

Introduction to High-Resolution Temperature Monitoring

LEA began using in-lake data loggers to acquire high resolution temperature measurements in 2013. The loggers, which are also interchangeably referred to as HOBO sensors, temperature sensors, or thermistors, are used to provide a detailed record of temperature fluctuations within lakes and ponds in our service area. This information allows for a better understanding of the thermal structure, water quality, and extent and impact of climate change on the waterbody tested.

Each year, we attempt to capture the entire stratified period within the temperature record, from when stratification begins to form in the spring to when the lake mixes in the fall. Stratification refers to the separation of lake waters into distinct layers, and is a phenomenon that has important consequences for water quality and lake ecology. See page 6 for more information about stratification.

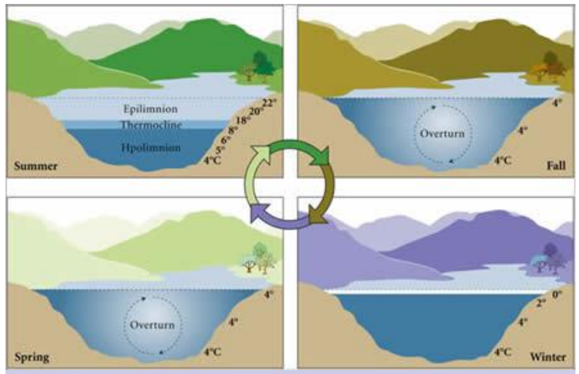
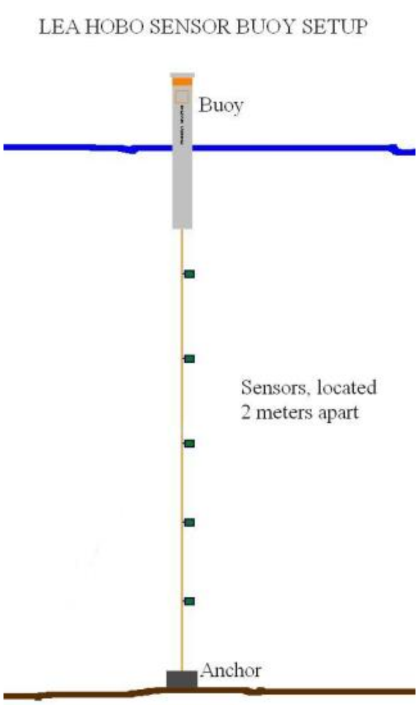


Diagram of Seasonal Stratification and Lake Mixing
Young, M. (2004). *Thermal Stratification in Lakes*. Baylor College of Medicine, Center For Educational Outreach.

Water temperature is critical to the biological function of lakes as well as the regulation of chemical processes. Lake temperature and stratification are greatly influenced by the weather. Air temperature, precipitation, and wind speed and direction can all affect water temperature and stratification patterns from year to year. Lake size, depth, and shape also greatly impact stratification timing and strength. The larger the difference in temperature between the top and bottom layers of the lake, the stronger the stratification is.



With funding and support from local lake associations, LEA has deployed temperature sensors at sixteen sites on twelve lakes and ponds. Sensors are attached to floating line held in place by a regulatory-style buoy and an anchor. The sensors are attached at 2 meter intervals, beginning 1 meter from the bottom and ending approximately 1 meter from the top. Each buoy apparatus is deployed at the deepest point of the basin it monitors. The setup results in the sensors being located at odd numbered depths throughout the water column (the shallowest sensor is approximately 1 meter deep, the next is 3 meters, etc.).

Temperature sensors are programmed to record temperature readings every 15 minutes. LEA has for many years used a handheld YSI meter to collect water temperature data. However, this method is time consuming, resulting in only 8 temperature profiles per year. While temperature sensors require an initial time investment, once deployed, the sensors record over 15,000 profiles before they are removed in the fall. This wealth of data provides much greater detail and clarity than the traditional method ever could. Daily temperature fluctuations, brief mixing events caused by storms, the date and time of stratification set up and breakdown, and the timing of seasonal high temperatures are all valuable and informative events that traditional sampling can't accurately measure.

2017 Monitoring Season

Several weather events in 2017 impacted the thermal structure of the lakes and ponds in the area. The large snow pack coupled with cooler weather in the spring led to relatively late ice-out and high water levels in the spring. Temperature buoys were deployed in late April and early May. Stratification began to set up in mid-to-late May on most lakes, after being impeded by cold temperatures throughout spring and strong winds that caused mixing around May 15th.

Heavy storms at the end of June and beginning of July (including several tornadoes in the Bridgton area) affected stratification on most lakes and some temperature fluctuations at depth can be seen due to these events. Mixing caused by other storms, such as a thunderstorm on August 2nd, can also be seen in some of the graphs.

Many lakes saw temperatures peak on or around July 22nd. Compared to 2016, the timing of the peak was 6 days earlier and the maximum temperatures were slightly lower in most cases. Temperatures gradually cooled from then on, with a steeper decline toward the end of August. High winds on September 1st accelerated mixing in many lakes, although full mixing was delayed by unusually warm temperatures in the fall, particularly at the end of September. The timing of full mixing was later than usual on many basins. Storms between October 29th—31st brought very high winds, but despite this most lakes that were still partially stratified at that time did not fully mix.

High-Resolution Temperature Monitoring: How to Read the Graphs

The temperature monitoring data summary includes a graph displaying all the data collected in the 2017 season. These graphs can be tricky to understand, so here are a few pointers:

A HOBO temperature sensor

- Each colored line represents the temperature over time at a specific depth in the water. The topmost lines represent water near the top of the lake (red = 1 meter below the surface, etc.), with a difference of 2 meters (approx. 6 feet) in depth between each line.
- The graph shows temperature change over time – The horizontal axis (left to right) shows the date, while the vertical axis (up and down) shows the temperature (in degrees Celsius).
- Generally, the lines are close together on the left side of the graph (late April/early May), then widen out (June-August), then come back together on the right side of the graph (September-November). The top few lines may stay close to each other when the graph widens out, indicating these depths are within the epilimnion, or top stratified layer. Then, there is often a gap in the middle, indicating the rough position of the thermocline. Most of the time, the bottom lines stay relatively flat, indicating that they are within the hypolimnion, the deep, cold layer that makes up the lower portion of the lake.
- Large gaps between lines means there is a large temperature difference between one depth and another.
- The pattern in temperature displayed by the top line (the sensor nearest to the lake's surface) is strongly influenced by air temperature.
- During stratification, the epilimnion does not easily mix with the hypolimnion (hence, these lines do not touch each other). It is only when the temperature of the upper water cools down that the lake can fully mix. You can see this process happening on each graph: the temperatures near the surface get cooler and the deeper waters get warmer as the barrier between the two layers weakens and the waters begin to mix. The lines converge one by one until the temperature is the same at each depth. This is known as lake turnover or destratification.

LEA's Algae Monitoring Program

Studies of algae populations are a good way for lake managers to glean information about lakes: their nutrient levels, stratification, and a host of complex details are all made more clear through the study of phytoplankton (the technical term for free-floating algae). Algae are the foundation of lake food webs, meaning that they are the food source that directly or indirectly supports much of the animal life existing in a lake. Of course, algae are also the source of algal blooms, which usually result from an over-abundance of nutrients and can cause a host of problems within a lake system. Algal blooms are often a sign of a water quality issue, and are generally bad for people (impacting recreation, fishing, and aesthetics) and for the lakes themselves.

Sample Sites
Back Pond
Hancock Pond
Keoka Lake
McWain Pond
Middle Pond
Moose Pond (Main Basin)
Moose Pond (North Basin)
Moose Pond (South Basin)
Peabody Pond
Sand Pond
Trickey Pond
Woods Pond

The goal of LEA's algae testing program is to identify the kinds of algae present in our lakes, quantify them, and study how they change over time. The focus is on planktonic algae, which are free-floating in the water, rather than attached to rocks or other material. In 2017, algae samples were collected from twelve lakes once per month for five months (May—September). Samples consisted of lake water from the top layer (ranging from 3-10 meters deep) of the water column. The depth of the sample differed depending on the location of the thermocline in each lake. Collection and analysis of algae samples was made possible by support from local lake associations.

Samples were preserved using Lugol's Iodine at the time of collection. Samples were settled within 3 weeks of collection using an Utermöhl chamber, which consists of a 100 mL tube set over a modified microscope slide. Slides were examined with an inverted microscope at 600x total magnification. Algae were identified to genus level (the level above species) where possible. Random fields were counted until a total of 400 natural algae units was reached. The number of cells per milliliter (cells/mL) was calculated for each sample.

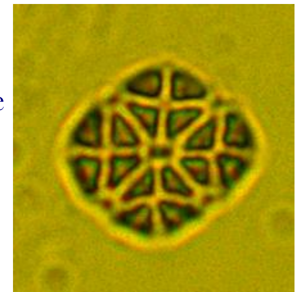
Algae are incredibly diverse, but in general 5-6 algae species will make up about 90% of the biomass in a lake at any given time. The dominant algae change over the course of the summer due to several factors including temperature, nutrient levels, and predation by zooplankton. Samples are taken on a monthly basis to monitor how populations shift throughout the summer.

One important water quality indicator that we can determine through collecting algae samples is the amount of cyanobacteria in a lake. Cyanobacteria are not technically algae, but rather photosynthetic bacteria. Nevertheless, they are treated as a type of algae because they have many of the same characteristics. High levels of cyanobacteria are often correlated with high phosphorus levels, and cyanobacteria such as *Aphanizomenon*, *Dolichospermum* (formerly *Anabaena*), and *Microcystis* are the most common causes of harmful cyanobacterial blooms that can be toxic to both people and animals. Cyanobacteria tend to be most common in the later part of the summer, when temperatures are warmest. Colonial cyanobacterial genera such as *Aphanocapsa*, *Aphanothece,* and *Merismopedia* are common in low-nutrient lakes such as those in the Lakes Region and do not contribute to toxic blooms, although they do contribute to relatively high cell counts in some lakes.

It is important to note that although LEA continues to measure chlorophyll-a concentrations in water as a proxy for algae abundance, lab-based chlorophyll-a measurements are not comparable to cells/mL concentrations found in these summaries because of differences in the amount of chlorophyll-a in algae cells of varying types and conditions.

The Difference Between Natural Units and Cell Counts

The summaries on the following pages discuss results in terms of both natural units and cell counts. One natural unit can be one cell or one colony. Natural units treat all algae equally, no matter how many cells they are made up of. Cell counts are simply a count of all cells. A single-celled algae would be counted as one natural unit and one cell, whereas a colony of cells will be counted as one natural unit and, say, 16 cells (or however many cells are present within the colony). There are several cyanobacterial genera that are large colonies made up of many tiny cells, or long, filamentous chains of cells. Because of this, cyanobacteria dominate cell counts in many algae samples. Colonial cyanobacteria such as *Aphanocapsa* and *Aphanothece* are common in our lakes and can lead to high cell counts, but because they are colonies of picoplankton (tiny cells around 1 µm wide), they contribute little biomass to the algae assemblage and do not often cause water quality issues.



This *Crucigenia* would be counted as one natural unit made up of 16 cells.

Natural units give a clearer picture of which algae are present, regardless of whether they are colonies or individual cells. Most samples were dominated by flagellated algae, which are single-celled algae with a “tail” called a flagella that they use to swim. Their populations are better represented when looking at natural unit counts, since they are single-celled. Cell counts allow for a better understanding of colonial algae presence and are necessary to calculate cells/mL accurately, which allows for better comparisons of results between lakes and over time. Colonies, even of the same genera, often vary greatly in the number of cells they contain – one natural unit of *Dinobryon* could be two cells or one hundred, and knowing this information is important in lake assessment.

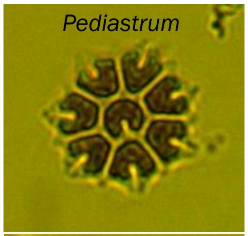
Why we Monitor Algae

One reason for the algae testing program is to collect baseline data. Baseline sampling is important because it provides a record of conditions to which future data can be compared. This data will help in assessing changes over time and determining what a typical algae population looks like in each lake. Because these lakes currently have good water quality, knowing which algae are present, and in what concentrations, is especially important. Any water quality changes in the future will be easier to assess if current water quality conditions are understood.

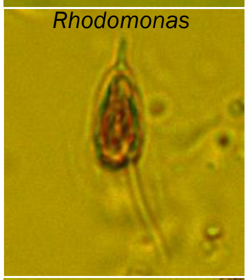
The other reason for algae sampling is to gain more information about water quality. Certain types of algae are only present when specific water quality conditions exist, which makes them good environmental indicators. For example, algae such as *Dolichospermum* and *Aphanizomenon*, two cyanobacterial genera which form algae blooms, are good indicators of eutrophication. Additionally, the dominant algae in a sample can be very informative, since different algae will dominate under varying water quality conditions. Collecting samples at different times throughout the summer enables us to record which algae are present under different conditions for a more complete account of each lake’s algae population.

The 6 Main Types of Algae

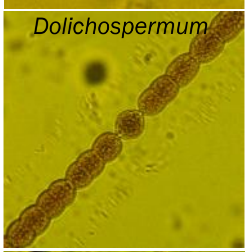
Note: Algae appear brown with a yellow background in photos because they are preserved with iodine.



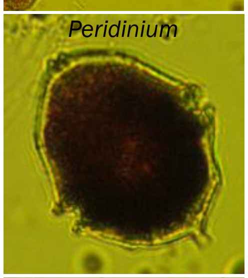
Green algae (Chlorophyta) are the most diverse group of algae present in freshwater habitats. They come in a variety of sizes and shapes: round or filamentous, single-celled or colonial, and flagellated or unflagellated. Green algae can be identified by their deep green grassy color and rigid cell walls.



Cryptomonads (Cryptophyta) are one-celled algae with two flagella (tails) that allow them to move through water. In this report, Haptophytes (of which only the genus *Chrysochromulina* was identified) and Euglenoids (rare in samples) are counted among the cryptomonads.

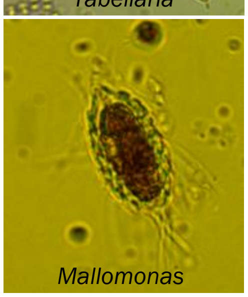


Cyanobacteria (Cyanophyta/blue-green algae) are not algae but prokaryotic bacteria that can photosynthesize. Most forms are colonial, and are usually either round or filamentous. While Cyanobacteria are present in all waters and many of them are harmless, there are several species that can produce toxins and will form blooms when nutrient levels are high.



Dinoflagellates (Dinophyta) are a group made up of large, motile algae. Large numbers of Dinoflagellates indicate high nitrate and phosphate levels. Most Dinoflagellates are covered in armor-like plates that serve as a protective shell.

Diatoms (Bacillariophyta) are easily identified by their hard silica-based outer shells. Diatoms are either centric (round) or pennate (long, thin rectangles or canoe-like shapes). Because their shells make them heavy, diatoms often settle out of the water column during the calm summer months. Most diatoms are single-celled, but a few of the common genera are colonial.



Golden algae (Chrysophyta) are common in lakes with low to moderate nutrient levels, low conductivity and alkalinity, moderate color and slightly acidic pH. Golden algae can be identified by their brown to yellow color and the delicate nature of their cells. They are often colonial and a few of the common genera are relatively large in size.

Moose Pond (Main Basin)

Moose Pond (Main Basin) Quick Statistics
2017 Average Versus the Long-term Average:

Clarity: Better at 7.5 meters
Chlorophyll: Worse at 2.9 ppb
Phosphorus: Similar at 5.8 ppb

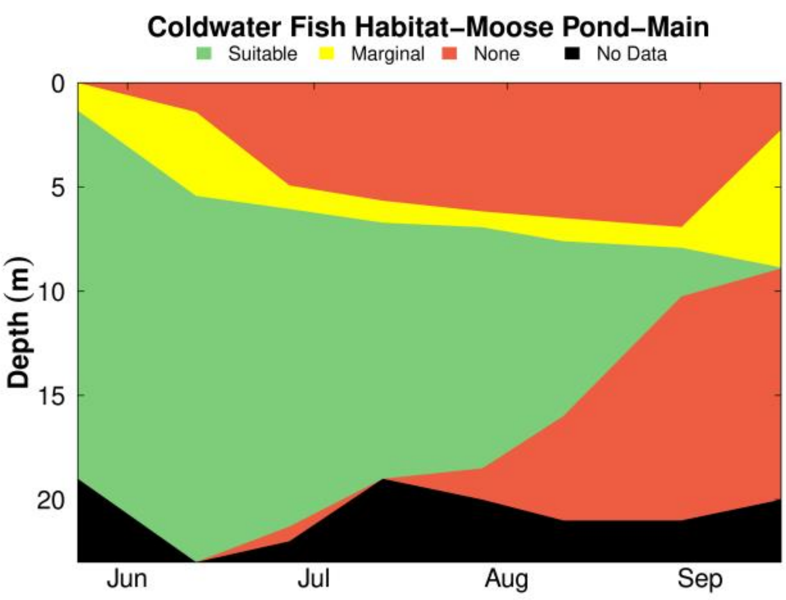
Surface Area:	941 acres
Maximum Depth:	77 feet
Mean Depth:	32.8 feet
Volume:	23,423 acre-feet
Watershed Area:	2,061 acres
Flushing Rate (whole pond):	3.69/year
Elevation:	418 feet

Water Quality Summary:

Trend analysis indicates clarity is stable on Moose Pond's main basin. Both phosphorus and chlorophyll levels are decreasing over time, which is good news. All three parameters' 2017 averages were very close to long-term averages. Moose Pond had the second highest average clarity, after Trickey Pond, of the 41 lakes and ponds LEA monitors. Clarity was in the good range, while chlorophyll and phosphorus were moderate.

Moose Pond's main basin suffers from dissolved oxygen depletion in the summer. This greatly reduces suitable habitat for coldwater fish and increases the potential for phosphorus release from sediments. Luckily, deep-water phosphorus levels remained moderate in 2017. However, previous sediment chemistry studies indicate that this basin of Moose Pond is susceptible to internal (sediment) phosphorus release due to low levels of aluminum in the sediments. Another issue that affects Moose Pond is the prevalence of *Gloeotrichia echinulata,* a colonial cyanobacteria that blooms in late summer and is capable of releasing toxins.

Oxygen depletion, lack of coldwater fish habitat, potential for phosphorus release, and Gloeotrichia blooms put Moose Pond's main basin is in LEA's HIGH degree of concern category.



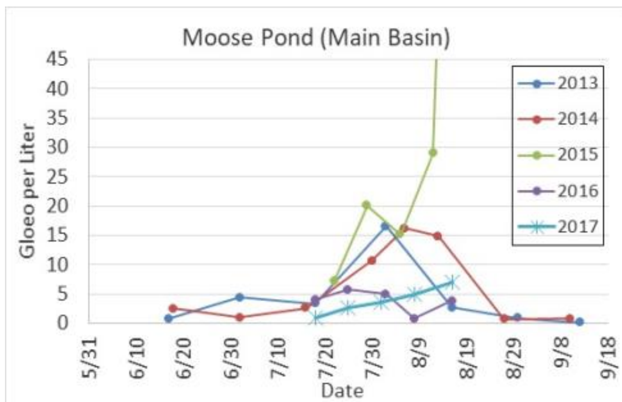
Coldwater fish habitat availability in the lake between late May and early September 2017. Colored areas indicate thickness of water column that is good habitat (green), marginal and stressful for some species (yellow), and inhospitable due to low oxygen and/or warm water temperatures (red).

Moose Pond (Main Basin)

The north, south, and main basins of Moose Pond were all sampled for Gloeo in 2017. The north and south basins have consistently had less than 5 col/L of Gloeo since they were first sampled. While the main basin did have relatively low levels in 2017, back in 2015 this site had the highest Gloeo level recorded anywhere by LEA at 192 col/L. Additionally, large concentrations of Gloeo are known to accumulate near shorelines, and these populations are not always captured by our testing method.

One sample was collected each week for five weeks from a site on the northwestern shore of the main basin between July 18th and August 16th, 2017. The highest level of Gloeo found in 2017 was 7 col/L on August 16th, however higher concentrations have been documented (see below).

The last two years' data show low Gloeo concentrations on Moose Pond. It is important to note that even if the site where samples were taken happened to have low levels of Gloeo at the time of sampling, concentrations elsewhere in the lake may still have been high. For instance, the picture on page two of this chapter shows an accumulation of Gloeo on the shore of Moose Pond seen during routine water testing (at a different location from the Gloeo sample site) on August 10th, two days after the pond was sampled for Gloeo. That sample had a concentration of only 4.9 col/L, much less than what was at the site in the picture. Gloeo concentrations across the pond fluctuate frequently, and the amount present at a site at any one time depends on a variety of factors, including time of day, wind speed and direction, and temperature.



Right (top): Graph of Gloeo data from 5 years of testing. Note that the vertical axis on the graph is cut off at 45 col/L to provide more detail of individual results.

Right (bottom): Graph showing full data, with the vertical axis range being 0-200 col/L. The red dashed line shows where the upper limit from the top graph is (45 col/L).

Moose Pond (Main Basin)

The temperature sensor buoy on Moose Pond's main basin was not placed at the deepest point within the basin in 2017, which meant that the line on which the sensors were attached had a lot of slack. Because of this, the sensors moved around in the water much more than they would have been able to if the line was tight, and caused very large temperature swings that made the graph hard to read. For this reason, a graph of daily average values is presented below. The high temperature of 32.0 °C (89.6 °F) is much higher than on other ponds monitored in 2017 because the one-meter sensor was able to float close to the surface; however this spike in temperature cannot be seen in the average data graphed below. The thermocline was located between 6-7 meters for much of the season until mixing in early September deepened stratification. Note that data was unavailable for the 3 meter and 21 meter sensors.

The following events can be seen in the graph below:

1) The pond was still well mixed when sensors were deployed April 27th

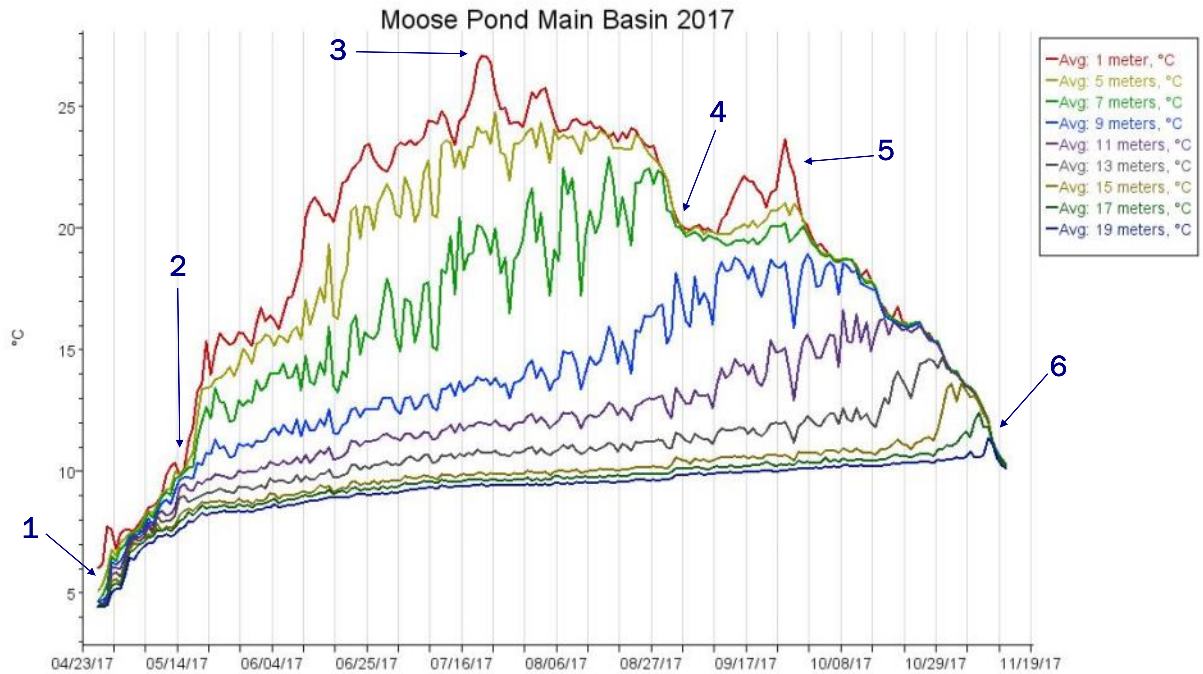
2) Cooler spring temperatures meant the basin stayed well mixed until mid-May

3) The peak in temperature occurred on July 26th (full data) or July 21st (average data)

4) High winds on September 1st caused mixing and slight warming of deeper waters

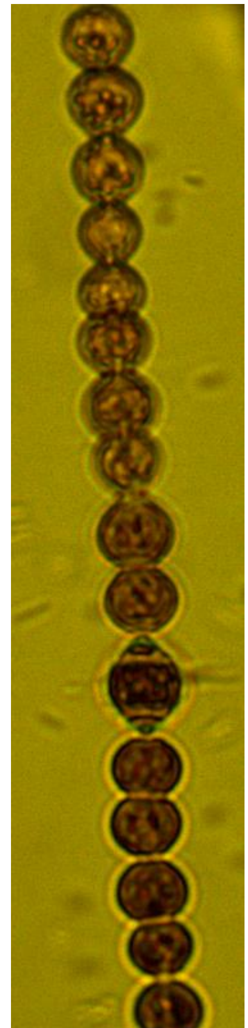
5) Warm temperatures in the fall kept the basin stratified and raised surface water temperatures

6) Full mixing occurred on or around November 10th *The bottom-most sensor at 21 meters failed, so the turnover date listed is based on data from a sensor 3 meters from the bottom and is probably underestimated



Peak Temperature	Full Mixing
7/21 or 7/26	11/10*

Moose Pond (Main Basin)

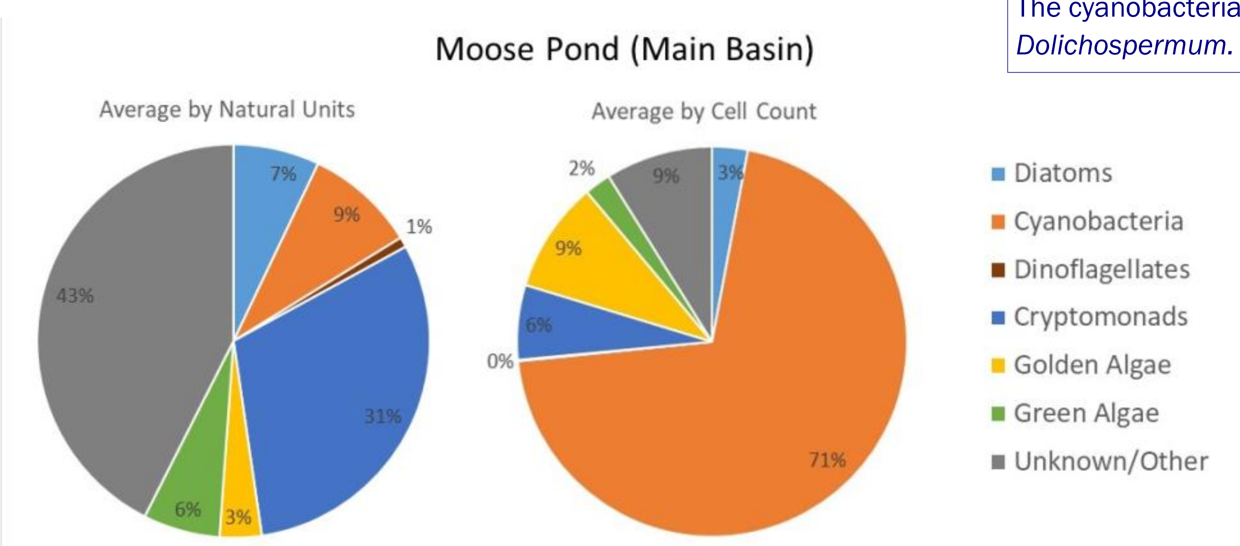


The cyanobacteria *Dolichospermum.*

Five algae samples from the main basin of Moose Pond were collected between May and September, 2017. Cell counts were lowest in May and highest in July, with the overall average for the season being high compared to the other lakes sampled.

The most common algae based on natural units were in the "unknown/other" category. Most of the algae in the "unknown/other" category are flagellates (single celled algae with flagella or "tails" that allow them to swim) of different algae types. The second most common algae were Cryptomonads, flagellated algae that include *Cryptomonas, Rhodomonas,* and *Chrysochromulina*. Between these two categories, flagellates made up the majority of algae based on natural units. Flagellates are good quality food for zooplankton, the tiny crustaceans that are in turn eaten by small fish and insects.

Although cyanobacteria made up a majority of the algae assemblage based on cell counts, many of the common genera were not the kinds that cause blooms or produce toxins. The most common cyanobacteria in the pond were *Aphanocapsa, Aphanothece, Chroococcus* and *Merismopedia*. Colonies of cyanobacteria made up only 9% of the algae present in Moose Pond's main basin, but because these colonies can contain hundreds of cells each, they made up 71% of the total cells counted. The cyanobacteria of concern present in Moose Pond's main basin were *Gloeotrichia* and *Dolichospermum* (pictured to the right), which was present in all samples at low concentrations.



Moose Pond (North Basin)

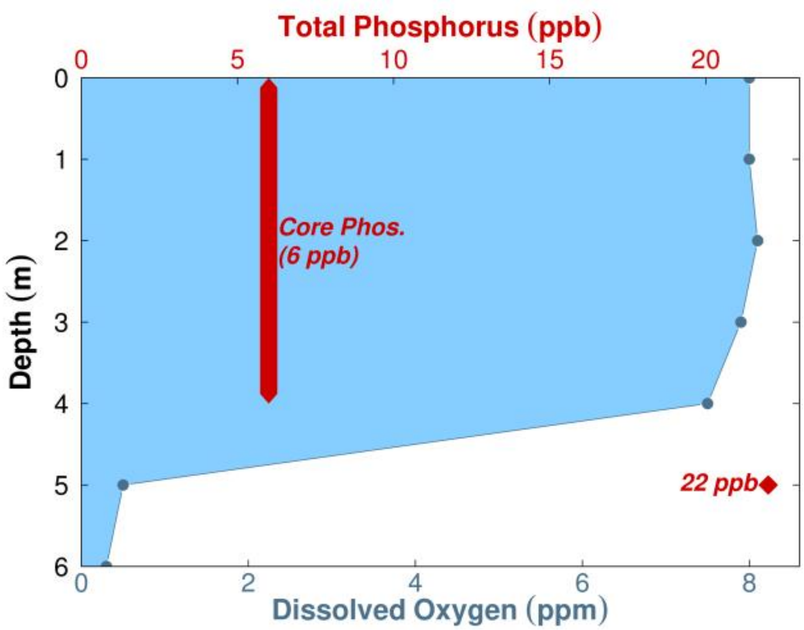
Moose Pond (North Basin) Quick Statistics 2017 Average Versus the Long-term Average:
Clarity: Worse at 4.5 meters
Chlorophyll: Worse at 4.8 ppb
Phosphorus: Worse at 10.1 ppb

Surface Area:	365 acres
Maximum Depth:	20 feet
Mean Depth:	8.5 feet
Volume:	3,151 acre-feet
Watershed Area:	1,182 acres
Flushing Rate (whole pond):	3.69/year
Elevation:	418 feet

Water Quality Summary:

Trend analysis indicates that clarity, phosphorus, and chlorophyll have all remained stable over time. All three parameters were worse, on average, in 2017 compared to long-term averages. Consistently worse than average results over time will lead to declining clarity and increasing phosphorus and chlorophyll trends. In 2017, clarity, upper layer phosphorus, and chlorophyll averages were in the moderate range.

A deep-water grab sample taken in August on the north basin of Moose Pond contained a high level of phosphorus. This basin also experiences mild oxygen depletion at times during the summer. However, a lack of other water quality issues means that Moose Pond's north basin remains in LEA's AVERAGE degree of concern category.



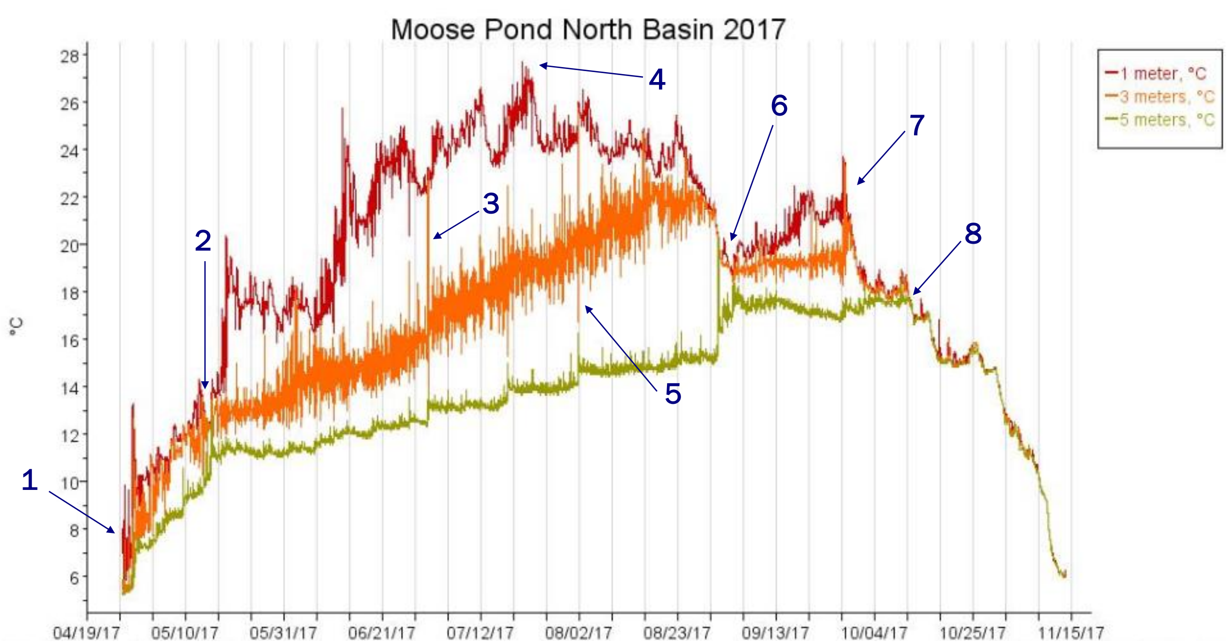
Moose Pond North Basin water column phosphorus (red) and dissolved oxygen (blue) data on 8/29/2017. Upper layer phosphorus (bar) from 0 to 4 m composite water sample. Deep water phosphorus (diamonds) from depth-specific grab samples.

Moose Pond (North Basin)

Moose Pond's north basin is only about 6 meters deep. At this relatively shallow depth, the basin does not stratify strongly. The bottom temperature is influenced by air temperature as well as mixing, which causes it to warm incrementally throughout the summer. Storm events, such as around July 1st, August 2nd, and September 1st, impacted temperatures throughout the water column. However, the basin did remain stratified for several months in 2017. At the height of the stratified period, the temperature at one meter deep reached 27.7 °C (81.9 °F) and the thermocline was located at around 3 meters deep.

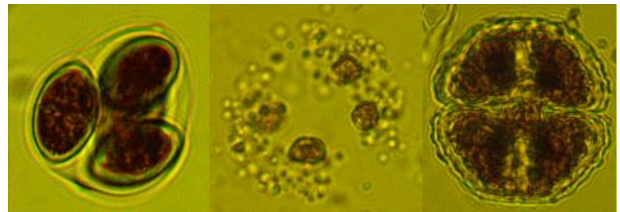
The following events can be seen in the graph below:

1) The pond had just begun to stratify when sensors were deployed April 27th
2) Cooler spring temperatures meant the basin stayed well mixed until mid-May
3) Heavy rains and wind around July 1st can be seen causing temperature fluctuations
4) The peak in temperature occurred on July 21st
5) Rain and thunderstorms August 2nd affected temperatures throughout the water column
6) High winds on September 1st caused almost complete mixing
7) Warm temperatures in the fall kept the basin weakly stratified and raised surface temperatures
8) Full mixing occurred on October 12th



Peak Temperature	Full Mixing
7/21	10/12

Moose Pond (North Basin)



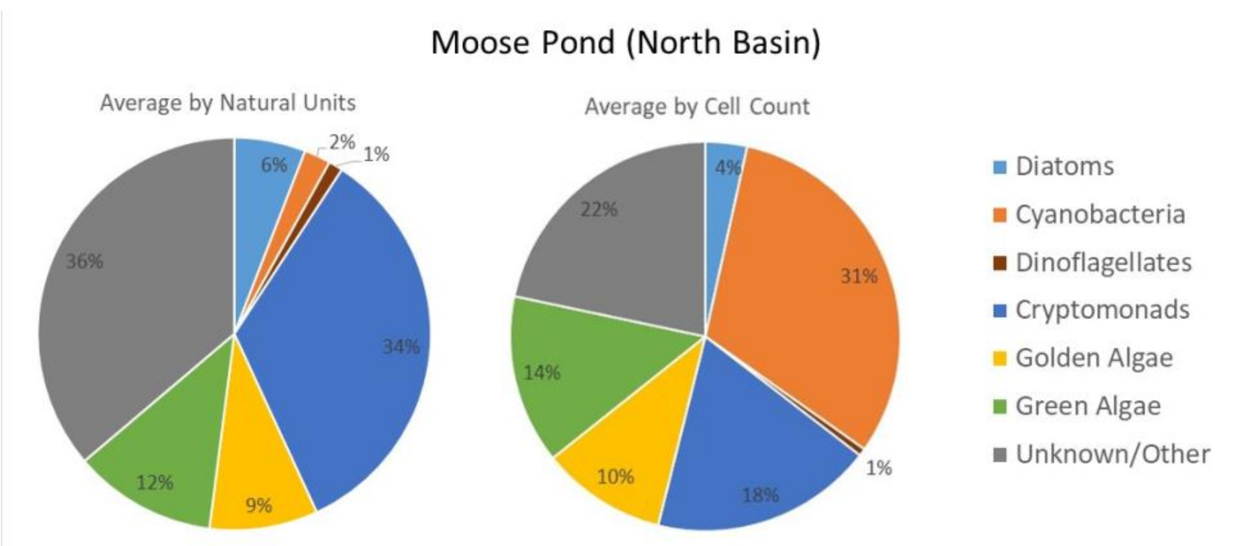
From left to right: *Oocystis* (green algae), *Chrysostephanosphaeria* (golden algae), and *Cosmarium* (green algae).

Algae samples were collected from the north basin of Moose Pond once per month between May and September, 2017. The average cell count for the north basin was the lowest of all the lakes sampled. The cell count peaked in August, but was still very low compared to other sample sites.

Moose Pond's north basin had the highest average percentage of both green and golden algae of all the lakes sampled based on natural units (and cell counts, in the case of green algae). *Crucigenia, Monomastix, Oocystis,* and *Pediastrum* were common green algae seen in samples and *Chrysosphaerella, Dinobryon, Mallomonas, Paraphysomonas,* and *Synura* were common golden algae.

The north basin also had the smallest percentage of cyanobacteria based on natural units. Most of the cyanobacteria noted were *Aphanocapsa* and *Merismopedia*. A very small amount of *Dolichospermum*, a cyanobacterium that can cause harmful blooms in high nutrient systems, was noted.

The most common algae based on natural units were in the "unknown/other" category, at 36%. Most of the algae in this category are flagellates (single celled algae with "tails" called flagella that help them swim) of different algae types. An almost equal percentage, 34%, were cryptomonads, flagellated algae that include *Cryptomonas* and *Rhodomonas*. Between these two categories, flagellates made up the majority of the algae present based on natural units. Flagellates are good quality food for zooplankton, the tiny crustaceans that are in turn eaten by small fish and insects.



Moose Pond (South Basin)

Moose Pond (South Basin) Quick Statistics
2017 Average Versus the Long-term Average:

Clarity: Worse at 6.5 meters
Chlorophyll: Better at 2.9 ppb
Phosphorus: Better at 6.3 ppb

Surface Area:	388 acres
Maximum Depth:	39 feet
Mean Depth:	15.7 feet
Volume:	6,105 acre-feet
Watershed Area:	1,964 acres
Flushing Rate (whole pond):	3.69/year
Elevation:	418 feet

Water Quality Summary:

The south basin of Moose Pond has only been sampled regularly since 2015, so there is not enough data available to conduct a trend analysis. Similarly, average values for 2017 are only being compared with two other years of data, not a true long-term average. The 2017 average clarity, upper layer phosphorus, and chlorophyll levels were very similar to the overall average. All three parameters were within the moderate range.

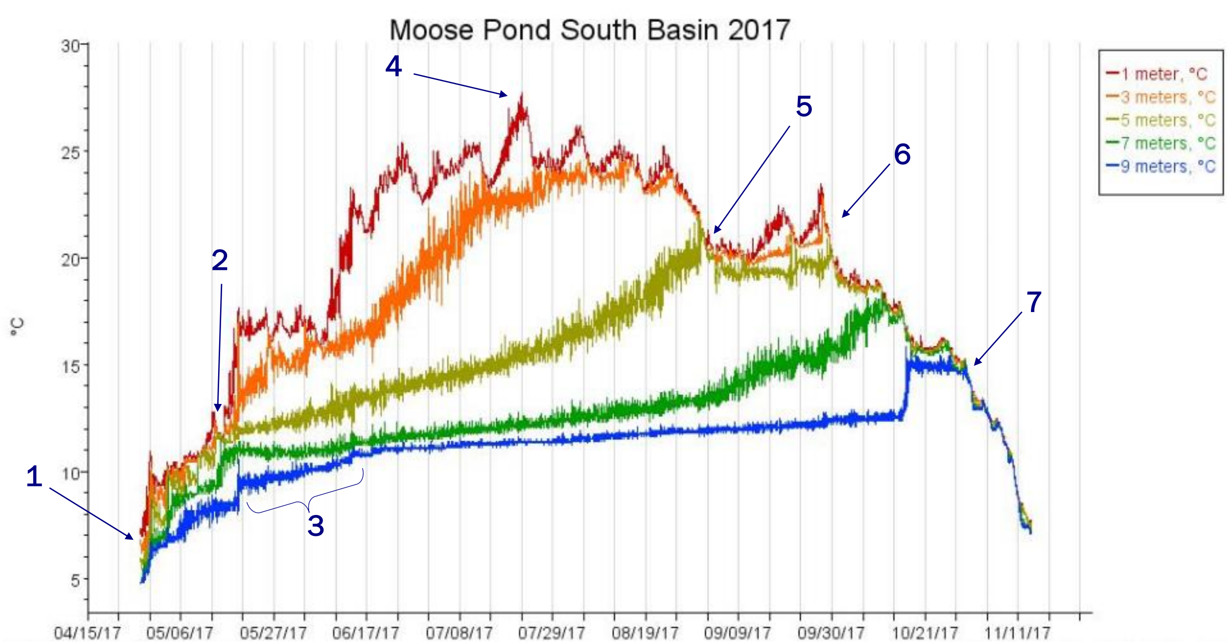
The south basin of Moose Pond suffers from dissolved oxygen depletion and high deep-water phosphorus concentrations in late summer, which puts it in LEA's MODERATE degree of concern category.

Moose Pond (South Basin)

The temperature record from Moose Pond's south basin indicates relatively shallow stratification throughout the 2017 season. As seen in the graph below, the 1 meter (red line) sensor data show greater day-to-day variability than the other depths, indicating that it is affected by air temperatures. The three meter (orange line) data shows a steadier pattern but tracks well with the 1 meter data about halfway through the season. Over the course of the stratified period, the depth of the thermocline was anywhere from 3 to 7 meters in depth. At the height of stratification, the temperature at one meter deep reached 27.8 °C (82.0 °F) and the thermocline was located at approximately 5-6 meters.

The following events can be seen in the graph below:

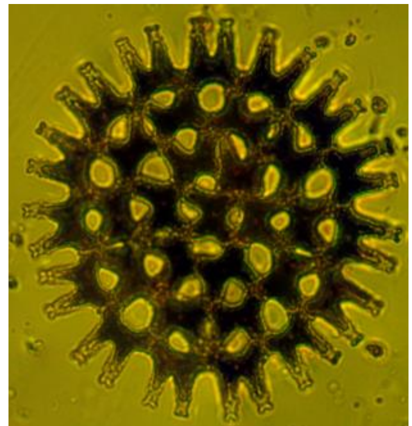
1) The pond had just begun to stratify when sensors were deployed April 27th
2) Cooler spring temperatures meant surface water temperatures stayed cold until mid-May
3) Weak stratification allowed temperature to creep up at the bottom of the basin throughout May and early June
4) The peak in temperature occurred on July 22nd
5) High winds on September 1st caused mixing down to about 5 meters deep, weakening stratification and allowing for the gradual warming of deeper waters
6) Warm temperatures in the fall kept the basin stratified and raised surface water temperatures
7) Full mixing occurred on October 31st



Peak Temperature	Full Mixing
7/22	10/31

Moose Pond (South Basin)

Algae samples were collected once per month between May and September, 2017. Cell counts increased month after month, peaking in September. The average cell count was moderate compared to other sampling sites.



A *Pediastrum* (green algae) colony seen in a sample from Moose Pond's south basin.

The pie charts below show the most common types of algae seen on average in the five samples, both by natural units and by number of cells. In natural units, "unknown/other" and "cryptomonads" were the most common categories. The "unknown/other" category mainly consists of small flagellated algae of various algae types. Crytomonads are, by definition, flagellates, so the majority of algae present in the samples were various types of flagellated algae. This kind of algae are good quality food for the larger organisms that eat algae.

By cell count, cyanobacteria were the most abundant algae in the samples from Moose Pond's south basin, despite making up only 9% of the algae by natural units. This is because the pond had a lot of small colonial cyanobacteria such as *Aphanocapsa* and *Merismopedia.* These cyanobacteria do not add much to the biomass of lakes because their individual cells are small; however, they can add a lot to cell counts because they are often made up of hundreds of cells. There were a few nuisance cyanobacteria noted in some samples, including *Dolichospermum* and *Aphanizomenon*, however, they were at very low concentrations and are not currently a concern. There is also a relatively small amount of *Gloeotrichia* present in the south basin each summer.