SOLITUDE
LAKE MANAGEMENT

Mount Kemble Lake

2021 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.

Morristown, NJ

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YEAR END SUMMARY
2021 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

INTRODUCTION

The following report is the 2021 Year-End Summary of the Lake Management Water Quality Monitoring Program for Mount Kemble Lake located in Morristown, New Jersey. This report includes the details of lake surveys, water quality monitoring program, phytoplankton surveys, and observations logged during visits to the lake throughout the season. Recommendations for Mount Kemble Lake management efforts are also included for lake management strategies in the 2022 season. The Appendix of this report includes graphs and tables of field data, reference guides, along with supporting documents for this report.

Scientific Name	Common Name
Potamogeton foliosus	Leafy Pondweed
Potamogeton crispus	Curly-leaf Pondweed
Lemna minor	Small Duckweed
Najas guadalupensis	Southern Naiad

Table 1. 2021 Observed Aquatic Macrophytes.

The Lake Management Program for Mount Kemble Lake focused on control of nuisance and invasive aquatic plant growth, most specifically curly-leaf pondweed (*Potamogeton crispus)*, leafy pondweed (*Potamogeton foliosus*), and southern naiad (*Najas guadalupensis*) for the duration of the season. A total of four (4) different aquatic macrophytes were reported during surveys of the lake (Table 1), with invasive species highlighted in red. One (1) of these species duckweed (*Lemna minor*) is a floating aquatic plant. Also observed during portions of the season, was the growth of planktonic algae in the water column, which would often reduce water clarity.

Weather Discussion

The weather in 2021 created a unique challenge when it came to lake management. In terms of temperature, most months were above average with February and May being the only two months to report below average temperatures. Overall, the treatment season endured the 6th warmest summer on record, which generally will lead to increases in aquatic plant and algae growth. Although October is not yet included in the chart, also support warmer than average temperatures. (Figure 1 Rutgers Climate Lab). Precipitation throughout the year was above average; however, the heart of the treatment season featured many storms and tropical systems that contained heavy rainfall, the most notable being Tropical Storm Ida, which dropped record amounts of rainfall in many locations. Large rainfall events often introduce large quantities of nutrients, which allow aquatic growth to thrive, especially when coupled with the warm temperatures experienced throughout the treatment season (Figure 2 Rutgers Climate Lab).

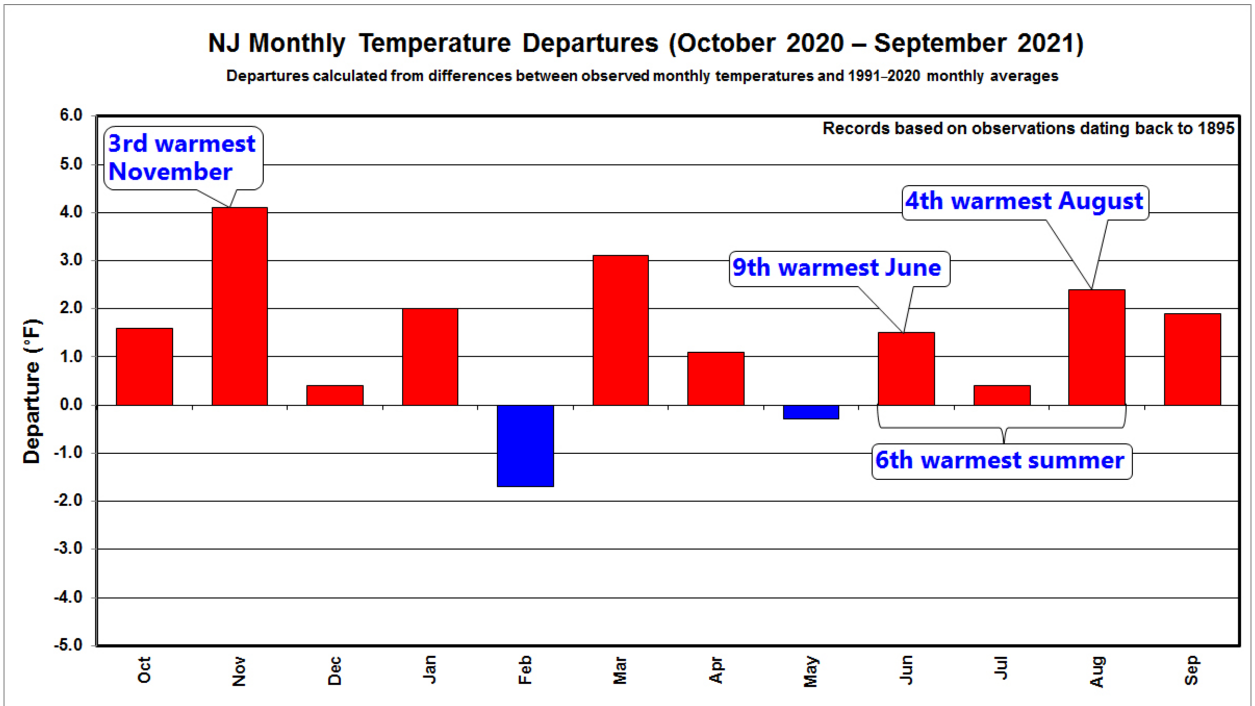


Figure 1: Temperature Departures.

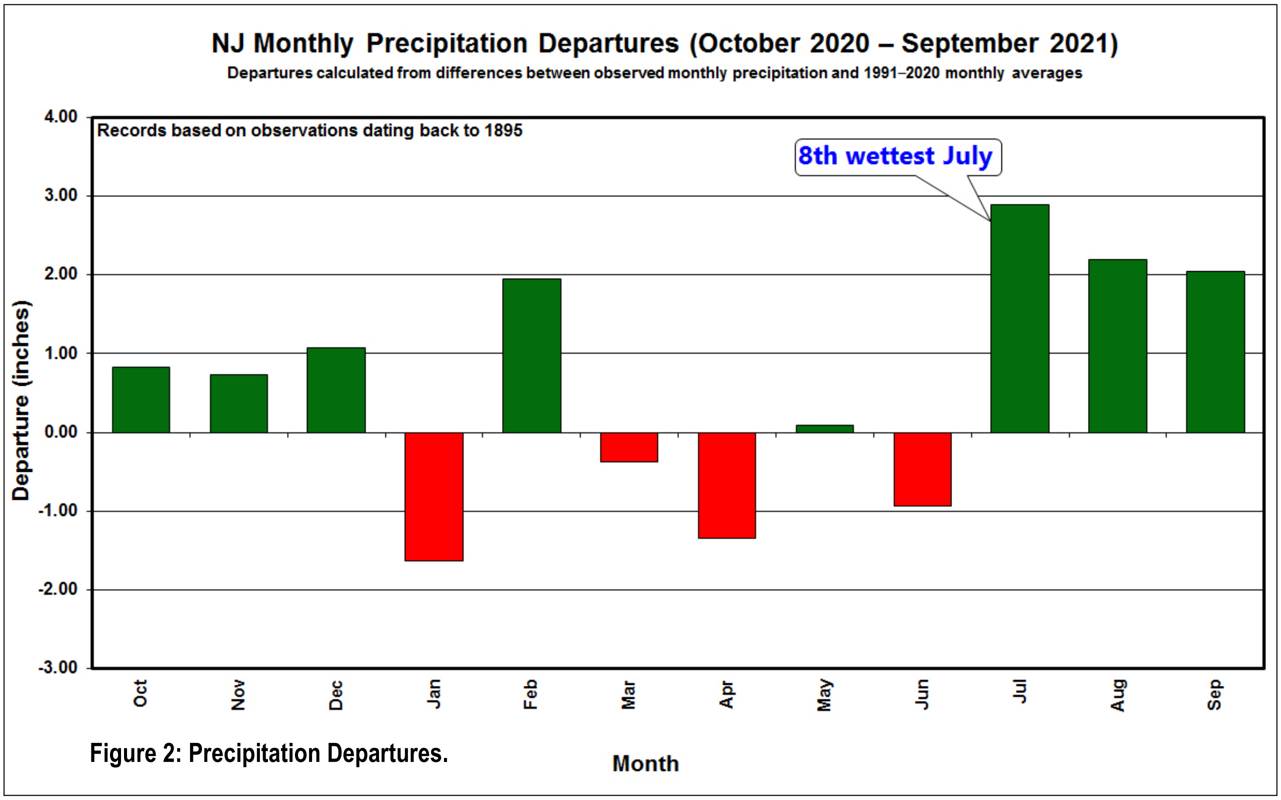


Figure 2: Precipitation Departures.

Lake Management

Aquatic biologists surveyed Mount Kemble Lake on nine (9) dates from April through September to conduct on-water assessments of aquatic vegetation and algae growth, and to perform *in situ* water quality analysis. On three (3) of the nine (9) visits, comprehensive water quality analysis was conducted including, sampling for planktonic algae and zooplankton, lab sample collection and lake profile analysis for temperature and dissolved oxygen. Upon completion of each survey, biologists would review lake conditions to if treatments were necessary. Throughout the season, SŌLitude Lake Management field staff conducted herbicide or algaecide applications for control of nuisance and invasive aquatic vegetation growth during four (4) of the total visits. One (1) treatment was conducted in the clubhouse pond for algae control. The table on the following page provides a reference to indicate dates of applications, what aquatic pesticides were applied, and the target acreage and aquatic plant species for each date (Table 2).

Date	Service Performed	Acres Treated	Target Species
5/20/2021	Tribune	4	Curly-leaf Pondweed
6/17/2021	Copper Sulfate	6.5	Unicellular algae
7/8/2021	Copper Sulfate	6.5	Unicellular algae
7/22/2021	Copper Sulfate	6.5	Unicellular algae

Table 2: Mount Kemble Lake 2021 Treatment Log

May 20th marked the second visit of the season; however the first treatment of the season was conducted at that time the lake supported dense growth of curly-leaf pond weed (*P. crispus*) primarily in the northern end of the lake. There was limited algae growth observed during this visit so an algae treatment was not necessary. **Tribune** was applied to reduce the reported plant growth. In June the first visit reported that the previous treatment was successful and no treatment was needed at that time as only a few stems were remaining and algae growth was not an issue. The second visit in June and both of the July visits reported excessive growth of unicellular algae, which was treated during each of those visits. **Copper Sulfate** was employed to reduce the overall growth of unicellular algae. Following the last July treatment, the lake clarity nearly doubled as the treatment was successful in controlling the growth of unicellular algae. The same favorable conditions continued for the remainder of the season as the observations of the lake reported minimal plant or algae growth.

Water Quality Monitoring Program

In 2021, the water quality monitoring program included *in-situ* field measured limnological analysis including temperature/dissolved oxygen profiles, pH, transparency, alkalinity, and total hardness. In addition, surface water chemistry samples were collected at the north inlet and lake station, as well as from the lake bottom at the lake station site, and transported to Alpha Laboratories (Mahwah, New Jersey) for analysis of the following parameters: ammonia, conductivity, nitrate, total phosphorus, and total suspended solids. Collection for phytoplankton and zooplankton identification and enumeration was also performed on three dates. Provided in the Appendix is a short description of each water quality parameter, and laboratory data results. Below is the water quality data tabulated to provide a seasonal reference.

Water Quality Data Tables

Mount Kemble Lake Water Quality Results- Surface					
Parameter	**Units**	**4/20/21**	**6/3/21**	**8/25/21**	**Limits**
Temperature	ºC	13.7	19.1	25.6	NA
Dissolved Oxygen	mg/L	11.02	8.60	11.24	<4.0
pH	SU	8.0	8.0	8.5	9
Alkalinity	mg/L	72	88	80	NA
Total Hardness	mg/L	100	140	120	NA
Transparency	feet	12 +	7.0	6.0	<4'
Ammonia	mg/L	0.289	0.09	0.086	0.3
Conductivity	umhos/cm	320	330	280	1500
Nitrate	mg/L	0.959	0.325	ND	0.3
Total Phosphorous	mg/L	0.011	0.033	0.058	0.03
Total Suspended Solids	mg/L	ND	ND	ND	25

Table 3. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mount Kemble Lake Water Quality Results- Bottom					
Parameter	**Units**	**4/20/21**	**6/3/21**	**8/25/21**	**Limits**
Temperature	ºC	NA	9.0	8.8	NA
Dissolved Oxygen	mg/L	NA	0.31	0.17	<4.0
pH	SU	7.0	7.0	7.5	9
Alkalinity	mg/L	60	88	120	NA
Total Hardness	mg/L	220	140	220	NA
Ammonia	mg/L	0.309	0.396	1.74	0.3
Conductivity	umhos/cm	380	370	470	1500
Nitrate	mg/L	0.651	ND	ND	0.3
Total Phosphorous	mg/L	0.029	0.051	0.252	0.03
Total Suspended Solids	mg/L	ND	5.4	11	25

Table 4. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site A					
Parameter	**Units**	**4/20/21**	**6/3/21**	**8/25/21**	**Limits**
Total Phosphorous	mg/L	0.017	0.057	0.064	0.03

Table 5. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site B					
Parameter	**Units**	**4/20/21**	**6/3/21**	**8/25/21**	**Limits**
Total Phosphorous	mg/L	0.023	0.06	0.114	0.03

Table 6. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site C					
Parameter	**Units**	**4/20/21**	**6/3/21**	**8/25/21**	**Limits**
Total Phosphorous	mg/L	0.018	0.06	0.045	0.03

Table 7. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results–Upstream Site D					
Parameter	**Units**	**4/20/21**	**6/3/21**	**8/25/21**	**Limits**
Total Phosphorous	mg/L	0.028	0.045	0.045	0.03

Table 8. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results- Inlet Station			
Parameter	**Units**	**4/20/2021**	**Limits**
Total Phosphorous	mg/L	0.029	0.03

Table 9. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Mt. Kemble Lake Water Quality Results- Outlet Station			
Parameter	**Units**	**4/20/2021**	**Limits**
Total Phosphorous	mg/L	0.013	0.03

Table 11. 2021 Mount Kemble Lake Water Quality Results

Results highlighted in red identify those that are outside the acceptable lake management limit.

Water Quality Results Summary

During the 2021 season, the surface water temperature was 13.7° C in April, and by August the temperature had increased to 26.5 ˚C. Those numbers were consistent with numbers that were observed last season as they were nearly identical. The pH values collected throughout the year were consistent with a small range of 7.0 and 8.5 between both surface and bottom samples, which falls within the typical range for freshwater lake systems. The hardness levels were similar to last year, ranging from 140 mg/L to 220 mg/L. The typical range characteristics to freshwater lakes are those falling between 4 and 200mg/L, which falls in line with typical readings for the lake. The majority of the sampling stations fell within this range throughout the season.

The chemical composition of Mt. Kemble Lake's surface water is considered moderately hard water. The alkalinity values remained consistent throughout the year from 60 to 140 mg/L, and within a comparable level compared to similar NJ freshwater lakes' chemical composition. These numbers were lower than was observed in 2020 and falls within a more typical range. Conductivity was consistent throughout the season with values ranging from 280 to 470 µmhos/cm., with the highest observed value obtained in the August bottom lake station location sample. These conductivity readings would be considered relatively stable as there was not much fluctuation throughout the season.

Ammonia and nitrates are nutrients based on the chemical composition of nitrogen. These naturally occurring compounds when influenced by human activity can cause excessive plant and algae growth. Throughout the season, in most locations, ammonia levels were within the acceptable limits, but levels were increased in all sampling stations on the bottom as would be expected. The surface levels were all below the acceptable limits. Nitrates were found to be elevated in the early season sampling at both the bottom and surface locations. Elevated results were also reported in the June sampling at the surface as well. The rest of the season fell within the acceptable limits. This was a similar pattern to what was observed last season.

Total phosphorus is usually present in freshwater lakes at low concentrations. Total phosphorus concentrations in a freshwater lake system should be less than 0.03 mg/L to prevent higher productivity. In 2021, both the June and August samples were elevated, while only the June bottom sample was elevated.

During the 2021 season, 6 (six) additional phosphorus sampling locations were added to the water quality program continued to be sampled. Four (4) of them were taken up stream, one was taken at the lake inlet, and the final from the lake outlet. For the 2021 season there was at least one sample from each location that reported an elevated amount of phosphorus; however, in comparison to 2020 the levels were much more reasonable and this could have resulted in a less productive growth season and for the lake to have an overall favorable appearance.

Oligotrophic <0.012mg/L Very Good	Mesotrophic 0.012 - 0.024mg/L Good	Eutrophic 0.025 - 0.096mg/L Fair	Hypereutrophic >0.096mg/L Impoundments

Table 11: Trophic Status Based on Phosphorus Values

Transparency (water clarity) displayed a continuous decrease as the season with the observed secchi readings at over 12 feet in the beginning of the season. Mt. Kemble Lake typically supports lake conditions that favor relatively high water clarity readings and even though readings decreased throughout the year the lowest recording was 6 feet with is still considered good. Three (3) unicellular algae treatments were performed, which were likely helpful in maintaining high water clarity throughout the season. Total suspended solids were all below the thresholds throughout the season for Mt. Kemble Lake.

Lake Profile Description

Depth (ft)	4/20/2021 Temp. (°C)	4/20/2021 DO (mg/L)	6/3/2021 Temp. (°C)	6/3/2021 DO (mg/L)	8/25/2021 Temp. (°C)	8/25/2021 DO (mg/L)
Surface	13.70	11.02	19.10	8.60	25.60	11.24
2	13.10	10.92	18.90	8.13	25.60	11.01
4	13.00	11.20	17.60	8.95	25.40	10.25
6	12.30	11.98	16.60	6.38	24.00	8.56
8	11.20	13.30	16.30	5.41	23.20	3.20
10	9.40	13.80	15.50	3.79	21.90	1.31
12	8.30	15.40	14.30	8.75	18.30	0.30
14	7.10	13.40	13.40	8.75	13.00	0.21
16	6.70	8.47	12.50	12.60	11.50	0.19
18	6.50	6.83	9.00	0.31	9.50	0.18
20	6.10	5.03	NA	NA	8.80	0.17
22	5.90	2.80	NA	NA	NA	NA
24	5.80	1.20	NA	NA	NA	NA
26	5.70	0.34	NA	NA	NA	NA

Table 12. 2021 Mt. Kemble Lake Profiles

The April profile revealed a well mixed water column, with favorable dissolved oxygen to a depth of 20 feet, which is something that would be expected for that time of the year as water temperatures are colder and allow the water to hold a higher concentration of oxygen. During June, the lake profile was similar to what was observed in April as there was a favorable dissolved oxygen reading at a depth of sixteen (16) feet. At that time water temperatures were starting to rise, but were still relatively cool likely leading to the readings. In August, however, the results reported what is called a positive heterograde curve, which simply means that the water quality conditions of the lake depleted dissolved oxygen below a depth of approximately twelve feet (on this sampling location conditions were no longer favorable at a depth of eight (8) feet). This type of water quality condition is observed most frequently in lakes where the surface area is small relative to the maximum depth and protected from intense wind action by surrounding topography and vegetation, which is descriptive of Mt. Kemble Lake. Complete profile graphs are provided in the Appendix of this report.

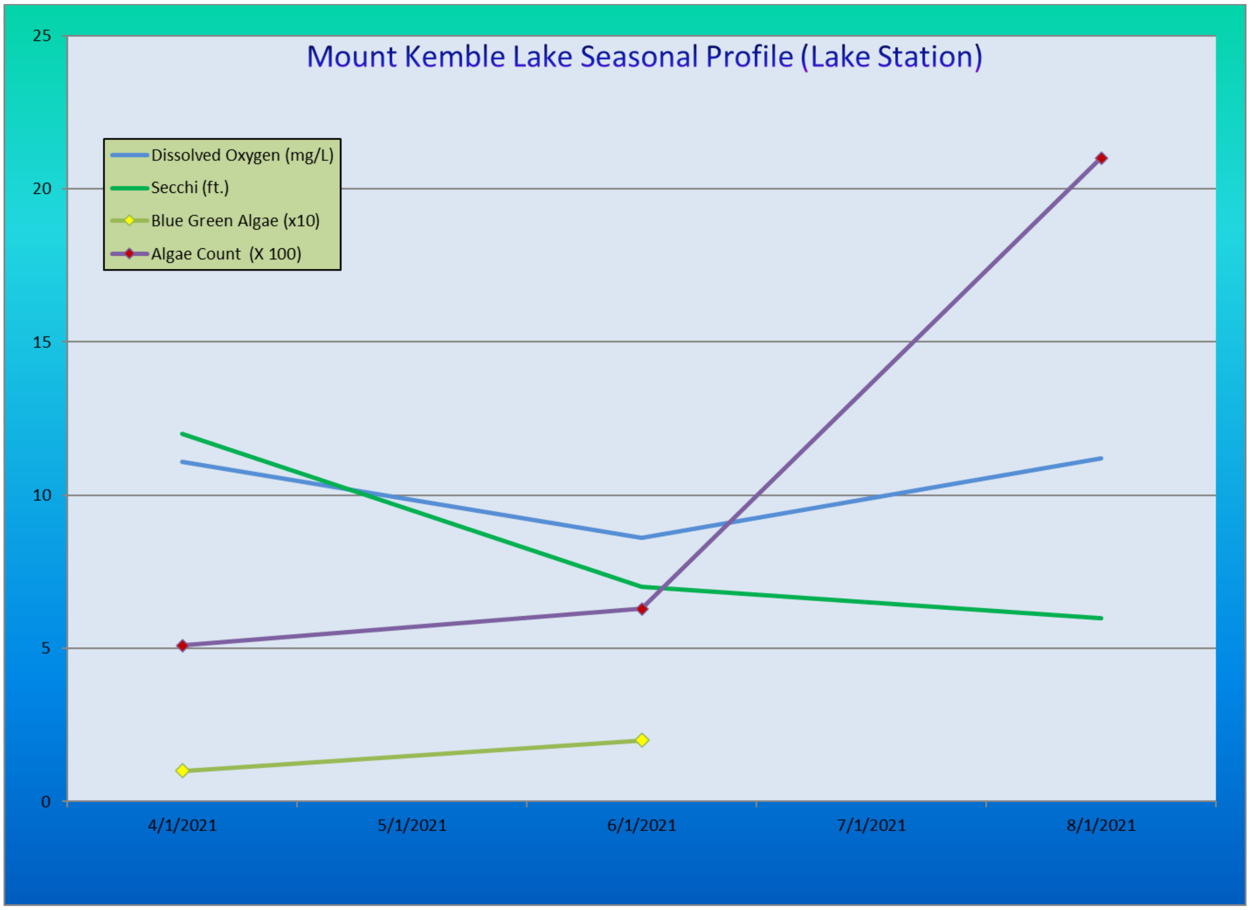


Figure 3. Mount Kemble Lake Seasonal Profile

Plankton Surveys

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2021, surface phytoplankton samples were collected at two established water quality monitoring sites in April, June, and August. Samples were collected in dedicated, pre-rinsed one-liter plastic bottles and placed in a cooler with ice for transport. The samples were identified and enumerated under a compound microscope immediately upon return to SŌLitude Lake Managements' laboratory. The microscopic examination data sheets and graphs are provided in the Appendix. A single vertical zooplankton tow was conducted at the lake station on each date. The collected sample was preserved in the field and returned to SŌLitude's lab for analysis.

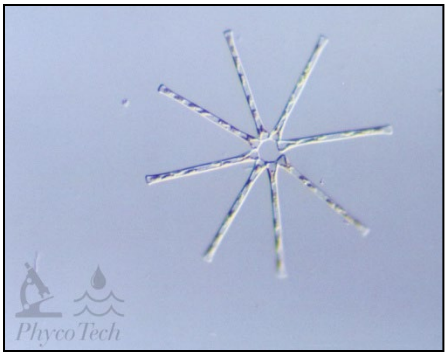
A Phytoplankton Primer

Lakes typically contain three broad categories of phytoplankton (also sometimes referred to as algae). These include filamentous phytoplankton, macroscopic multi-branched phytoplankton (which appear similar to submersed plants), and unicellular phytoplankton. Each category shall be discussed in turn, although the results of the season's sampling will focus on the unicellular phytoplankton population.

Filamentous phytoplankton are typically macroscopic (that is, visible with the naked eye), composed of long chains of cells that are attached to a substrate, typically the lake bottom, submersed or emergent vegetation, or rocks. This is called benthic filamentous algae (BFA), and rampant growth can become visible at the surface. As pieces of benthic filamentous algae break apart, it often floats on the surface as dense unsightly mats called floating filamentous algae (FFA). Typically, genera of green algae or blue-green algae develop into nuisance filamentous mats. Abundant nuisance growth of filamentous phytoplankton creates numerous negative impacts to a lake. These can include a decrease in aesthetics, a decrease in recreational uses, increased fishing frustration, and water quality degradation.

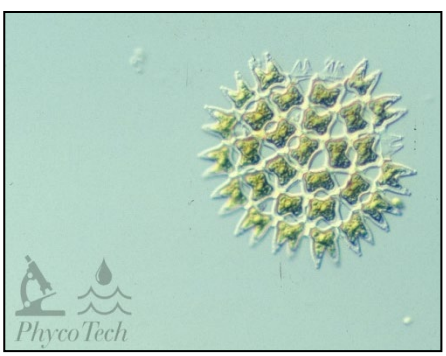
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches, under ideal conditions, this type of phytoplankton can reach lengths of several feet, and create a dense carpet on the bottom of a lake. Therefore, it typically does not reach nuisance levels in a lake, save for high use areas such as beaches and other popular swim areas. Since this phytoplankton occupies a similar ecological niche as submersed plants, it's often included in detailed and visual aquatic plant surveys. It provides numerous benefits to a lake system, including sediment stabilization, acting as a nutrient sink, providing invertebrate and fish shelter and habitat, and is one of the first to re-colonize a disturbed area. In the Northeast, muskgrass (*Chara* sp.) and stonewort (*Nitella* sp.) are two of the most common macroscopic multi-branched phytoplankton.

Unicellular phytoplankton are typically microscopic, and consist of individual cells or colonies of cells suspended in the water column. At high enough densities (often called a bloom), they can impart a green or brown (and sometimes, even red) tint to the water column. Unicellular phytoplankton belongs to several taxonomic groups with density and diversity of these groups often varying due to seasonality. When unicellular phytoplankton density becomes elevated it can reduce water clarity (giving the water a "pea soup" appearance), and impart undesirable odors. Usually blue-green algae are responsible for these odors, but other groups or extremely elevated densities can impart them as well. In addition to decreased aesthetics, unicellular phytoplankton blooms can cause degradation of water quality, increase the water temperature (turbid water warms faster than clear water), and can possibly produce a variety of toxins (in the case of blue-green algae), depending on the type of genera present and environmental conditions. Numerous groups of unicellular phytoplankton are common in the Northeast, including diatoms, golden algae, green algae, blue-green algae, euglenoids and dinoflagellates. Each group shall be discussed in turn.



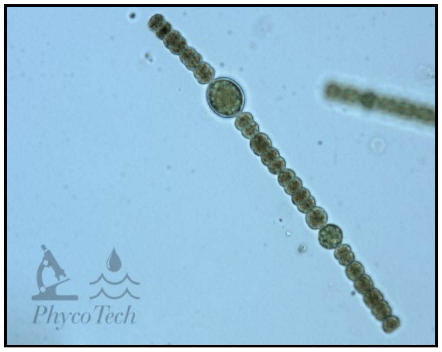
Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population characteristics of diatoms. Some are round and cylindrical (centric) in shape, while others are long and wing-shaped (pennales). They are usually brown in color, and reach maximum abundance in colder or acidic water. Therefore, they tend to dominate in winter and early spring. Common diatoms in the Northeast include *Fragilaria, Cyclotella, Navicula*, and *Asterionella* (pictured).

Golden Algae are typically yellow or light brown in color. Cell size is usually small oval shaped with a partially empty area, but several genera create colonies of smaller cells. Most have two flagella, and some type of scales or a rigid coating that grants it a fuzzy appearance. However, a few filamentous forms are possible as well. They typically prefer cooler water, so they dominate in the late fall, winter, or early spring. They also tend to bloom at deeper (cooler) depths. They are common in low nutrient water, and numerous forms produce taste and odor compounds. Common golden algae in the Northeast include *Dinobryon* (pictured), *Mallomonas*, and *Synura*.

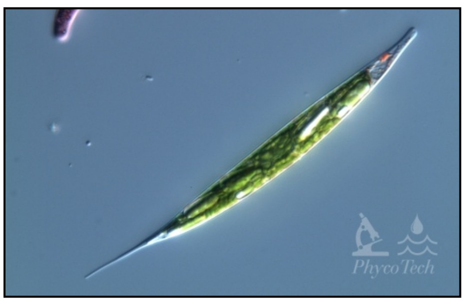


Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically with distinct cell shapes light green in color. Some prefer acidic waters, and others highly eutrophic (sewage) conditions. A green algae bloom usually occurs in water with high nitrogen levels. Green algae typically dominate in mid to late summer in the Northeast. Common genera include *Chlorella*, *Scenedesmus*, *Spirogyra* and *Pediastrum* (pictured).

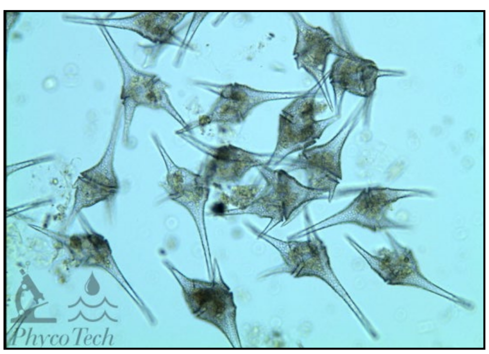
Blue-green algae are actually photosynthetic bacteria. Therefore, they tend to be small, simple in structure and lacking interior cell details. Blue-green algae are typically encased in a mucilaginous



outer layer. Some genera are adorned with heterocysts, swollen structures capable of fixing nitrogen, a competitive advantage. These types tend to bloom in nitrogen-poor or eutrophic systems. Yet, blue-green algae are tolerant of a wide variety of water chemistries, and boast many oligotrophic forms as well. Blue-green algae often have gas vesicles which provide increased buoyancy another competitive advantage over other groups of phytoplankton, due to their propensity to shade out others by blooming at the surface. Numerous blue-green algae are documented taste and odor (T&O) producers, and under certain environmental conditions and high enough densities, can produce toxins dangerous to fish, livestock, and possibly humans. Blue-green algae typically dominate a lake system in late summer to early fall. Common blue-green algae that occur in the Northeast include *Anabaena* (pictured), *Aphanizomenon, Microcystis* and *Coelosphaerium.*



Euglenoids are typically motile with 0 to 3 (typically 2) flagella, one of which is longer. Euglenoids has plasticity of shape, and usually are grass green in color (although sometime they are clear or even red). Most forms have a distinct red “eyespot. They are often associated with high organic content water, and eutrophic conditions. Common euglenoids that occur in the Northeast include *Euglena* (pictured), *Phacus,* and *Trachelomonas*.



Dinoflagellates are very common in marine environments, in which they often cause toxic blooms. However, toxin production in freshwater genera is very rare. Dinoflagellates are typically single ovoid to spherical cells, but large compared to phytoplankton from other groups. They usually possess two flagella (one wrapped around the middle of the cell) which grant them rotation while they move through the water column. Cellulose plates (armored dinoflagellates) are more common, but genera without cellulose plates (naked dinoflagellates) also occur. They generally prefer organic-rich or acidic waters, and can impart a coffee-like brown tint to the water at high enough densities. Common dinoflagellates in the Northeast include *Ceratium* (pictured) and *Peridinium*.

PHYTOPLANKTON RESULTS

In April, the phytoplankton density was considered light and favorable at the inlet station and moderate at the lake station. Diversity would also be considered moderate at both locations with six (6) genera observed at the inlet station, while the lake station reported nine (9) different genera. Diatoms accounted for the majority of both samples with the most dominant being, *Fragilaria*. The second sampling occurred in early June and at the time the inlet station was supporting a low density of algal growth with the lake station being slightly higher, supporting moderate density growth. Diversity had increased slightly to nine (9) genera at the inlet station and to (10) genera at the lake station, which would be considered high. The most commonly observed genera was the golden algae, *Mallamonas*, which was the most common at both sampling station despite the fact the diatoms were most common in the inlet station sampling.

Algal Group			
% Abundance	**4/20/21**	**6/3/21**	**8/25/21**
Diatoms	**80.5%**	**38.2%**	27.8%
Golden Algae	17.1%	35.3%	8.9%
Protozoa			
Green Algae	2.4%	26.5%	**57.8%**
Blue-green Algae			
Dinoflagellates			4.4%
Euglenoids			1.1%
Total Orgs / mL	**410**	**340**	**900**

Table 13. Mt. Kemble Phytoplankton Assemblage Inlet

Algal Group			
% Abundance	**4/20/21`**	**6/3/21**	**8/25/21**
Diatoms	**68.6%**	6.3%	8.6%
Golden Algae	19.6%	**74.6%**	
Protozoa			
Green Algae	9.8%	7.9%	11.4%
Blue-green Algae	2.0%	3.2%	
Dinoflagellates		4.0%	**80.0%**
Euglenoids			
Total Orgs. / mL	**510**	**630**	**2100**

Table 14. Mt. Kemble Phytoplankton Assemblage Lake Station

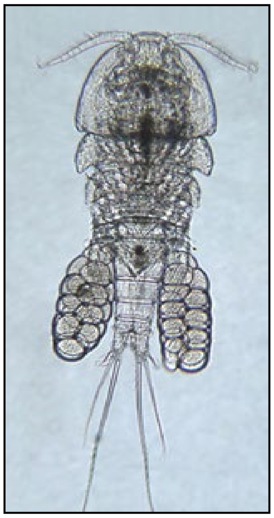
For the August sampling event, the phytoplankton density increased at both locations to be considered moderate at the inlet station and high at the lake station. The inlet station saw diversity decrease to eight (8) genera, while the diversity remained the same at the lake station sampling location with ten (10) observed genera. The late season sampling reported that the most common group of algae observed at the inlet station was green algae with the most dominant genera being, *Eudorina*. The lake station had an abundance of dinoflagellate growth as it accounted for over three quarters of the sample with *Peridinium* being most commonly observed. Overall, planktonic algae was relatively low and manageable throughout the season with a slight increase towards the end.

A Zooplankton Primer

Zooplankton provides an important link in a typical lake's food web between phytoplankton and developing/juvenile stages of fish. In general, zooplankton feed on phytoplankton, while fish in turn feed on zooplankton. The rate of phytoplankton feeding efficiency is primarily based on body size, but zooplankton group, and to some effect specific genera, also plays an important role. There are three main groups of zooplankton found in freshwater systems: rotifers, cladocera, and copepods.

Rotifers are a diverse group of zooplankton, very common in lakes and marine environments alike. Rotifers are generally the smallest zooplankton of the three groups, and thus typically the least efficient phytoplankton grazers. Feeding preferences are determined primarily by mouth structures, and include generalist feeders (omnivores), which eat any small organic detritus encountered, and predators, which eat other smaller rotifers and small phytoplankton. Generalist feeders include *Filinia, Keratella, Lecane, Euchlanis*, and *Brachionus*. Predator genera include *Polyarthra* (larger species)*, Asplanchna, Synchaeta*, and *Trichocerca*.

Cladocera are less diverse, but also very common in freshwater lakes. They are sometimes called "water fleas". They spend most of their lifecycle reproducing via parthenogenesis (asexual reproduction with an all female population) only switching to less efficient sexual reproduction when environmental conditions decline. Some genera (such as *Daphnia*) can be quite large (up to 5.0 mm long, visible without magnification), and thus can be classified as highly efficient phytoplankton grazers. Most cladocera are phytoplankton grazers, although their diet includes most organic matter ingested, including bacteria and protozoa. Body size (and thus mouth size) determines feeding efficiency, but ironically the larger-bodied genera are easier to see by predaceous fish, and thus typically have reduced numbers in populations of zooplanktivorous fish. *Daphnia* are the most efficient phytoplankton feeders, while *Ceriodaphnia, Bosmina* and *Eubosmina* are less efficient. There are a few predator genera as well, including *Polyphemus* and *Leptodora*.



Copepods are almost excusive to freshwater lake systems (not streams or rivers) and estuarine and marine systems. Of the six suborders native to the United States, three are parasitic, and three are free living. One of the free living, *Harpacticoida* are exclusively benthic and thus often not collected in traditional plankton tows (unless the bottom sediments are disturbed). The remaining two suborders, the Calanoida and the Cyclopoida are of primary concern during lake studies. All copepods have several naupilar stages, followed by several immature stages, before reaching an adult stage. Both suborder adults are considered large bodied zooplankton, but have distinct feeding preferences. Calanoids are almost exclusively phytoplankton feeders and have even demonstrated selective feeding strategies. Cyclopoids have mouth parts suitable for biting and seizing prey. Their diet is primarily other crustacean zooplankton (including cannibalism on younger life stages), as well as phytoplankton and organic detritus ingestion, but less efficiently.

Zooplankton samples were collected with an 80 um Nitex plankton net. At the Lake Station, a single vertical tow was performed to a depth of 18 feet. Using as little site water as possible, the sides of the net were rinsed of any trapped zooplankton, concentrating the organisms into the net bottom. This concentrate was then emptied into a clean 1000 mL HDPE sample bottle. Immediately after collection, the sample was preserved with an equal amount of 10% sucrose formalin, to achieve a 5% solution. Sucrose was added to the preservative to help maintain carapace integrity. The samples were then placed in a cooler stocked with blue ice. On arrival at SŌLitude's laboratory, the samples were stored in a dark refrigerator until the samples were identified and enumerated.

In the laboratory, each sample was manually mixed for about one minute, before a one mL subsample was removed using a calibrated syringe. The subsample was placed on a Sedgewick-Rafter counting cell, and examined under a compound microscope at 100X magnification. By using calibrated guides on the microscope stage, the entire one mL sample was examined, and any zooplankton were identified and enumerated to the lowest practical taxa using regionally appropriate taxonomic keys. This procedure was repeated two more times to generate three replicate counts. The counts were then averaged, and back-calculated to achieve an organism per liter density. The zooplankton count data sheets in the Appendix describe the step by step procedures for all three replicates, and the final averaged densities. Also, included in the Appendix are pie charts depicting the sample date zooplankton group distribution.

2021 Zooplankton Results

Zooplankton Group	4/20/2021	6/3/2021	8/25/2021
Rotifers	**43.8%**	**65.3%**	**74.6%**
Cladocera	25.9%	26.3%	1.5%
Copepoda	30.3%	8.3%	29.3%
Total Zooplankton (Orgs. / mL)	896	349	668

Table 16. Mount Kemble Lake 2021 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 896 organisms per milliliter, which is considered moderate, but sample diversity was high with twelve (12) different genera observed. At this time Rotifers accounted for approximately half of the total sample at 43.8% of the total zooplankton community with *Notholca* being the most abundant genera. Additionally, a moderate density of Cladocerans and Copepoda were observed as they accounted for just under half of the sample.

The June sampling reported a low density of zooplankton as there were 349 organisms per milliliter. The Rotifer genera were the most commonly found accounting for nearly three quarters of the total sample at 65.3% of the total with the genera *Notholca* being the most commonly found within the group. At this time zooplankton diversity is considered moderate as a total of eight (8) different genera were found in the sample. Copepoda accounted for the lowest percentage of the sample with only 8.3%. The Cladocera genera only accounted for approximately a quarter of the total sample.

The final sampling of the season showed that the zooplankton composition was considered high as twelve (12) different genera were observed. The density of zooplankton observed was moderate with a total of 668 orgs/mL. Rotifers made up 76.4% of the zooplankton composition with *Notholca* once again being the most abundant in the sample. The Cladocerans made up a very small portion of the of the total sample at 1.5%. About a quarter of the total sample Copepoda as it accounted for 23.9% of the sample. Overall, rotifers dominate the zooplankton community in Mt. Kemble Lake.

Discussion

The 2022 management program of Mount Kemble Lake will continue to focus on the control of nuisance densities of plant and algae growth. The target aquatic macrophyte species observed at Mount Kemble Lake in 2020, curly-leaf pondweed (*P. crispus*) and occasionally southern naiad (*N. guadalupensis*) depending on the conditions during that season. Throughout the season plant growth was similar to what was observed the previous year as only one (1) treatment was necessary to provide season long control.

This year; however, required a treatment twice the size of the treated area in the previous year. **Reward/Tribune** should continue to be utilized through the season for its ability to selectively control nuisance submerged vegetation by rapid absorption into the target plant. **Red Eagle/Clipper** (flumioxazin) can also be utilized a method of control, especially for smaller target areas as it can provide control in areas that are heavily disturbed. In addition, it is beneficial to allow certain amounts of plants to persist in the lake to provide dissolved oxygen, fish habitat, and compete for nutrients required for nuisance plant and algae development. The growth of leafy pondweed and southern naiad should be encouraged in areas of the lake where they are not interrupting recreational activities or reducing the aesthetic appeal of the lake.

Copper sulfate will continue to provide the most a cost-effective management method for controlling nuisance density filamentous and planktonic algae growth. **Copper Sulfate** has acknowledged negative impacts on zooplankton populations, with localized targeted applications recommended for only nuisance growth of filamentous algae, and limited use on planktonic algae blooms only at times when water clarity is significantly impaired. In 2021, three (3) **Copper Sulfate** treatments were conducted as growth of unicellular algae was reducing the water clarity. Numerous other copper and non-copper based algaecides are available and at the request of the Association, SŌLitude Lake Management would be happy to discuss these alternatives. **Cutrine Plus** is an effective way to control these planktonic blooms as it remains suspended in the water column longer than **Copper Sulfate** and is something to be considered.

The management program for 2022 is anticipated to be similar to the monitoring program that was utilized this year, which included at least twice per month lake surveys during the height of the growing season, including lake-wide assessment of the submersed aquatic plant community. An aluminum sulfate treatment was performed during the 2019 season and there was a noticeable difference in planktonic algae growth and overall water clarity. The water clarity was at considered good throughout the season, however, algae counts were elevated on one (1) of the three (3) sampling events and treatments were conducted in between those samplings for algae . Alum was not applied in either of the past two seasons. Both of those years saw in increase in total phosphorus as well as a decrease in water clarity, which is likely a combination of additional nutrients combined with weather conditions. The reduction in overall phosphorus will lead to less plant and algae growth as it is the limiting resource in all aquatic habitats. Continued monitoring of the inlet pond will help to understand the amount of phosphorus that is entering Mt. Kemble Lake and management strategies can be designed using that information. It is also recommended to continue to perform phosphorus mitigation in the upstream pond to manage phosphorous concentrations closer to the source of the phosphorous introduction which will help reduce the concentration that is entering the lake.

The current Mount Kemble Lake Water Quality Monitoring Program is well-designed, and provides suitable water quality data allowing for proactive management of the lakes' environment and reduces the opportunity for the development of problematic situations. It is important to continue water quality monitoring on a regular yearly basis over the long-term to build a baseline data record which will assist biologists in developing more quantitative analysis for greatest possible management procedures.

SŌLitude Lake Management appreciates the opportunity to be of service to the Mount Kemble Lake Association and looks forward to assisting the Association on the stewardship of Mount Kemble Lake in the 2022 lake management season.

Sincerely,

Carl Cummins

Carl Cummins
Environmental Scientist

SŌLITUDE
LAKE MANAGEMENT

APPENDIX

Appendix A: Water Quality Parameter Descriptions

Temperature

Temperature is measured in degrees Celsius, and is very important to aquatic biota. Several factors affect temperature in a lake system, including air temperature, season, wind, water flow through the system, and shade trees. Turbidity can also increase water temperature as suspended particles absorb sun rays more efficiently. Water depth also affects temperature. In general, deeper water remains cooler during the summer months.

Temperature preferences vary among aquatic biota. Since water temperature typically varies between 5 ºC and 30 ºC during the season, most aquatic biota can flourish under this wide range of temperatures. Of more concern is thermal shock, which occurs when temperature rapidly changes in a short amount of time. Some aquatic biota can become stressed when temperature changes as little as 1-2 ºC in a 24 hour period.

Dissolved Oxygen

Dissolved Oxygen is the measurement of the amount of oxygen freely available to aquatic biota in water. Several factors play a role in affecting the amount of dissolved oxygen in the water. These factors include temperature (warmer water holds less dissolved oxygen), low atmospheric pressure (such as higher altitude) decreases the solubility of oxygen, mineral content of the water can reduce the water's dissolved oxygen capacity, and water mixing (via wind, flow over rocks, or thermal upwelling) increases dissolved oxygen in the water. In addition, an over abundance of organic matter, such as dead algae or plants causes rapid aerobic bacteria growth. During this growth, bacteria consume oxygen during respiration, which can cause the water's dissolved oxygen to decrease.

Dissolved oxygen has a wide range, from 0 mg/L to 20 mg/L. To support diverse aquatic biota, 5-6 mg/L is minimally required, but 9-10 mg/L is an indicator of better overall water quality. Dissolved oxygen reading of below 4 mg/L is stressful to most aquatic organisms, especially fish.

Water Clarity

Transparency (or visibility) is measured with a Secchi disc, and can provide an experienced biologist with a quick determination of a lake's water quality. In short, higher visibility indicates a cleaner (and healthier) aquatic system. Cloudy conditions could indicate nutrient rich sediments entering the lake or excessive algal blooms due to nutrient availability, leading to a degradation of water quality.
Clear conditions allow greater light penetration and the establishment of a deeper photic zone. The photic zone is the depth of active photosynthesis carried out by plants and algae. A byproduct of photosynthesis is dissolved oxygen, required for use by higher aquatic organisms, such as zooplankton and fish.

Total Hardness

Hardness is a measure of dissolved salts in the water, usually calcium, but also magnesium and iron. Hardness is usually influenced by the rock and soil types of the watershed, and the amount of runoff over these surfaces. Hardness can be measured for only calcium content (Hardness (Ca)), or for all three salts, called Total Hardness. Water with Hardness (Ca) less than 10 mg/L can only support sparse aquatic biota. Freshwater typically has a Hardness (Ca) level from 4 to 100 mg/L. In general, the degree of total hardness can be classified according to the table to the right.

Alkalinity

Alkalinity is the measure of the water's capacity to neutralize acids. A higher alkalinity can buffer the water against rapid pH changes, which in turn prevents undue stress on aquatic biota due to fluctuating pH levels. The alkalinity of a lake is primarily a function of the watersheds soil and rock composition. Limestone, dolomite and calcite are all a source of alkalinity. High levels of precipitation in a short amount of time can decrease the waters alkalinity. A typical freshwater lake has an alkalinity of 20-200 mg/L. A lake with a low alkalinity typically also has a low pH, which can limit the diversity of aquatic biota.

pH

The measurement of acidity or alkalinity of the water is called pH (the "potential for hydrogen"). Several factors can impact the pH of a lake, including precipitation in a short amount of time, rock and soil composition of the watershed, algal blooms (increase the pH), and aquatic plant decomposition (decreases the pH). A pH level of 6.5 to 7.5 is considered excellent, but most lake systems fall in the range of 6.0 to 8.5. Aquatic biota can become stressed if the pH drops below 6.0, or increases above 8.5 for an extended amount of time.

Most aquatic biota are adapted to specific pH ranges. When the pH fluctuates rapidly, it can cause changes in aquatic biota diversity. Immature stages of aquatic insects and juvenile fish are more sensitive to low pH values than their adult counterparts. Therefore, a low pH can actually inhibit the hatch rate and early development of these organisms.

Conductivity

Conductivity is the measure of water's ability to conduct an electrical current, and is measured in umhos/cm, the higher the number of charged particles(ions) in the water, the easier for electricity to pass through it. Conductivity is useful in lake management by estimating the dissolved ionic matter in the water, the lower the conductivity, the higher the quality of water (oligotrophic). A higher conductivity usually indicates an abundance of plant nutrients (total phosphorous and nitrate), or eutrophic conditions. Industrial discharge, road salt runoff, and septic tank leaching can increase conductivity. Distilled water has a conductivity of 0.5 to 2.0 umhos/cm, while drinking water conductivity typically ranges from 50to 1,500 umhos/cm. Conductivity below 500 umhos/cm is considered ideal in a lake system.

Nitrate

Nitrates are chemical compounds derived from nitrogen and oxygen. Nitrogen is needed by all plants and animals to make proteins needed for growth and reproduction. Nitrates are generated during plant and animal decomposition, from man-made sources, and from livestock and waterfowl sources. Man-made sources of nitrates include septic system leaching, fertilizer runoff, and improperly treated wastewater. Freshwater lake systems can potentially receive large nitrate inputs from waterfowl, specifically large flocks of Canada geese. An increase in nitrate levels can in turn cause an increase in total phosphorous levels. A nitrate level greater than 0.3 mg/L can promote excessive growth of aquatic plants and algae.

Total Phosphorous

Total phosphorous is a chemical compound derived from phosphorous and oxygen. Total phosphorous is usually present in freshwater in low concentrations, and is often the limiting nutrient to aquatic plant growth. However, man-made sources of phosphorous include septic system leaching, fertilizer runoff, and improperly treated wastewater. These phosphorous inputs usually enter a freshwater lake system during rain events, and bank erosion.

A total phosphorous level greater than 0.03 mg/L can promote excessive aquatic plant growth and decomposition, either in the form of algal blooms, or nuisance quantities of aquatic plants. This process is called eutrophication, and when induced or sped up by man-made nutrient inputs, it is called cultural eutrophication. As a result of this excessive growth, recreational activities, such as swimming, boating, and fishing in the lake can be negatively impacted. In addition, aerobic bacteria will thrive under these conditions, causing a decrease in dissolved oxygen levels which can negatively impact aquatic biota such as fish.

Total Suspended Solids

Total suspended solids refer to all of the particulate matter suspended in the water column. When these solids settle to the bottom of a water body (a process called siltation), they become sediments. There are two components that make up total suspended solids: inorganic and organic. The inorganic portion is usually considerably higher than the organic portion and includes silts, clays, and soils. Organic solids include algae, zooplankton, bacteria and organic debris. All these solids create turbid (or “muddy”) conditions. The geology and vegetation of a watershed affect the amount of suspended solids that enter a lake system. Most suspended solids originate from accelerated soil erosion from agricultural operations, logging activities, and construction activities. Another source is the disturbance of bottom sediments from dredging activities, grazing of bottom feeding fish, and recreational activities such as boating.

Ammonia

Ammonia is a type of nitrogen compound used by plants and algae to support growth. Ammonia content in a body of water is influenced by decaying plants and animals, animal waste, industrial waste effluent, agricultural runoff, and atmospheric nitrogen gas transfer. A concentration exceeding 0.30 mg/L can promote excessive plant and algae growth. Elevated ammonia levels can increase nitrification, which in turn depletes the oxygen content of water. Extremely high ammonia levels can be toxic to aquatic biota (such as fish).

Appendix B: Aquatic Macrophyte Guide

Small Duckweed (*Lemna minor.* Common Names: Small duckweed, water lentil, lesser duckweed. **Native.**). Small duckweed is a free floating plant, with round to oval-shaped leaf bodies typically referred to as fronds. The fronds are small (typically less than 0.5 cm in diameter), and it can occur in large densities that can create a dense mat on the water's surface. Each frond contains three faint nerves, a single root (a characteristic used to distinguish it from other duckweeds), and no stem. Although it can produce flowers, it usually reproduces via budding at at a tremendous rate. Its population can double in three to five days. Since it is free floating, it drifts with the wind or water current, and is often found intermixed with other duckweeds. Since it's not attached to the sediment, it derives nutrients directly from the water, and is often associated with eutrophic conditions. It over winters by producing turions late in the season. Small duckweed is extremely nutritious and can provide up to 90% of the dietary needs for waterfowl. It's also consumed by muskrat, beaver and fish, and dense mats of duckweed can actually inhibit mosquito breeding.

Curly-leaf Pondweed (*Potamogeton crispus*. Common Name: curly-leaf pondweed. **Invasive.**): Curly-leaf pondweed has spaghetti-like stems that often reach the surface by mid-June. Its submersed leaves are oblong, and attached directly to the stem in an alternate pattern. The margins of the leaves are wavy and finely serrated, hence its name. No floating leaves are produced. Curly-leaf pondweed can tolerate turbid water conditions better than most other macrophytes. In late summer, Curly-leaf pondweed enters its summer dormancy stage. It naturally dies off (often creating a sudden loss of habitat and releasing nutrients into the water to fuel algae growth) and produces vegetative buds called turions. These turions germinate when the water gets cooler in the autumn and give way to a winter growth form that allows it to thrive under ice and snow cover, providing habitat for fish and invertebrates.

Leafy Pondweed (*Potamogeton foliosus*: Common Name: leafy pondweed. **Native**.): Leafy pondweed has freely branched stems that hold slender submersed leaves that become slightly more narrow as they approach the stem. The leaf contains 3-5 veins and often tapers to a point. No floating leaves are produced. It produces early season fruits in tight clusters on short stalks in the leaf axils. These early season fruits are often the first grazed upon by waterfowl during the season. Muskrat, beaver, deer and even moose also graze on the fruit. It inhabits a wide range of habitats, but usually prefers shallow water. It has a high tolerance for eutrophic conditions, allowing it to even colonize secondary water treatment ponds.

Southern Naiad (*Najas guadalupensis*. Common Names: Southern water nymph, bushy pondweed. **Native**.): Southern naiad is an annual aquatic plant that can form dense stands of rooted vegetation. Its ribbon-like leaves are dark-green to greenish-purple, and are wider and less pointed than slender naiad. Flowers occur at the base of the leaves, but are so small, they usually require magnification to detect. Southern naiad is widely distributed, but is less common than slender naiad in northern zones. Southern naiad reproduces by seeds and fragmentation.

APPENDIX D: PHYTOPLANKTON ENUMERATION CHARTS

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 4/20/21	Examination Date: 4/21/21	Amount Examined: 200 ml.
Site A: Inlet Station	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**
Asterionella	90	70	
Cocconeis			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria	170	190	
Melosira			
Navicula			
Nitzschia			
Pinnularia			
Urosolenia			
Stephanodiscus		40	
Stauroneis			
Synedra	70	50	
Tabellaria			

CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**
Dinobryon	30	40	
Mallomonas			
Synura	40	60	
Tribonema			
Uroglenopsis			

CHLOROPHYTA (Green Algae)	**A**	**B**	**C**
Ankistrodesmus			
Aulacoseira			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium		10	
Coelastrum			
Cosmerium			
Eudorina			
Gloeocystis	10	40	
Golenkinia			
Microtinium			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus			
Spirogyra			
Staurastrum			
Sphaerocystis			
Ulothrix			
Volvox			
Zygnema			

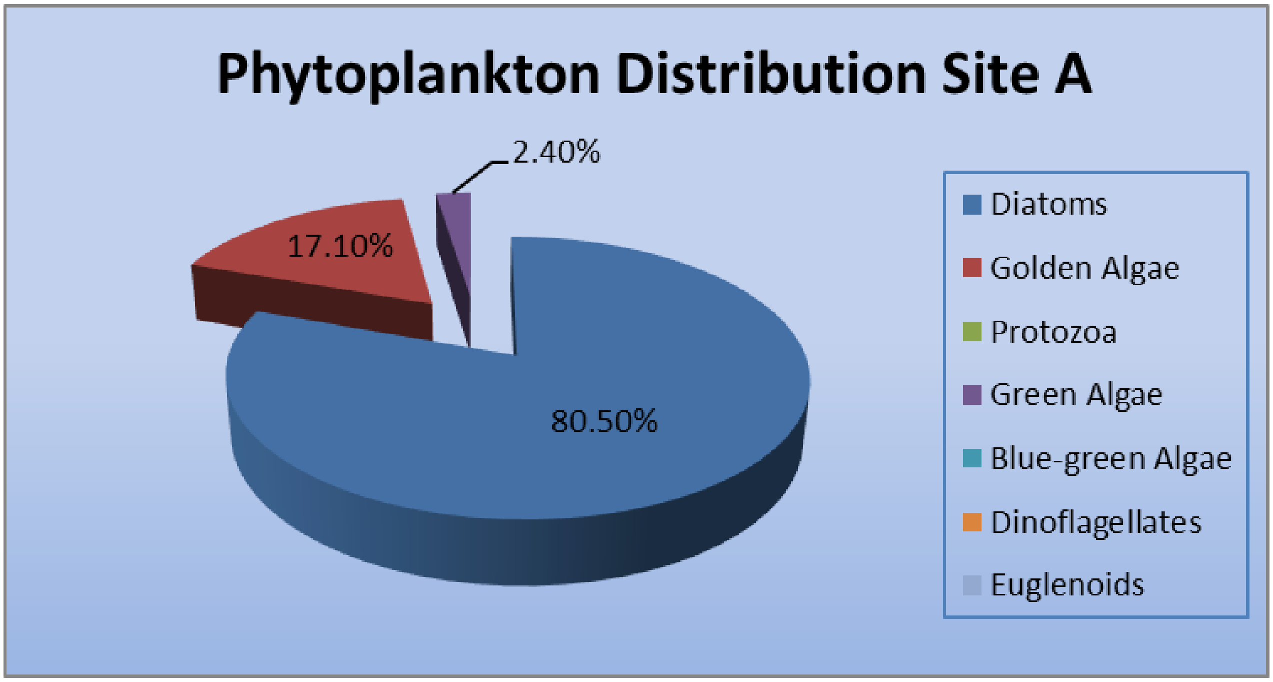
CYANOPHYTA (Blue-green Algae)	**A**	**B**	**C**
Agmenellum			
Anabaena			
Anacystis			
Aphanizomenon		10	
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
PROTOZOA			
Actinophyrs			

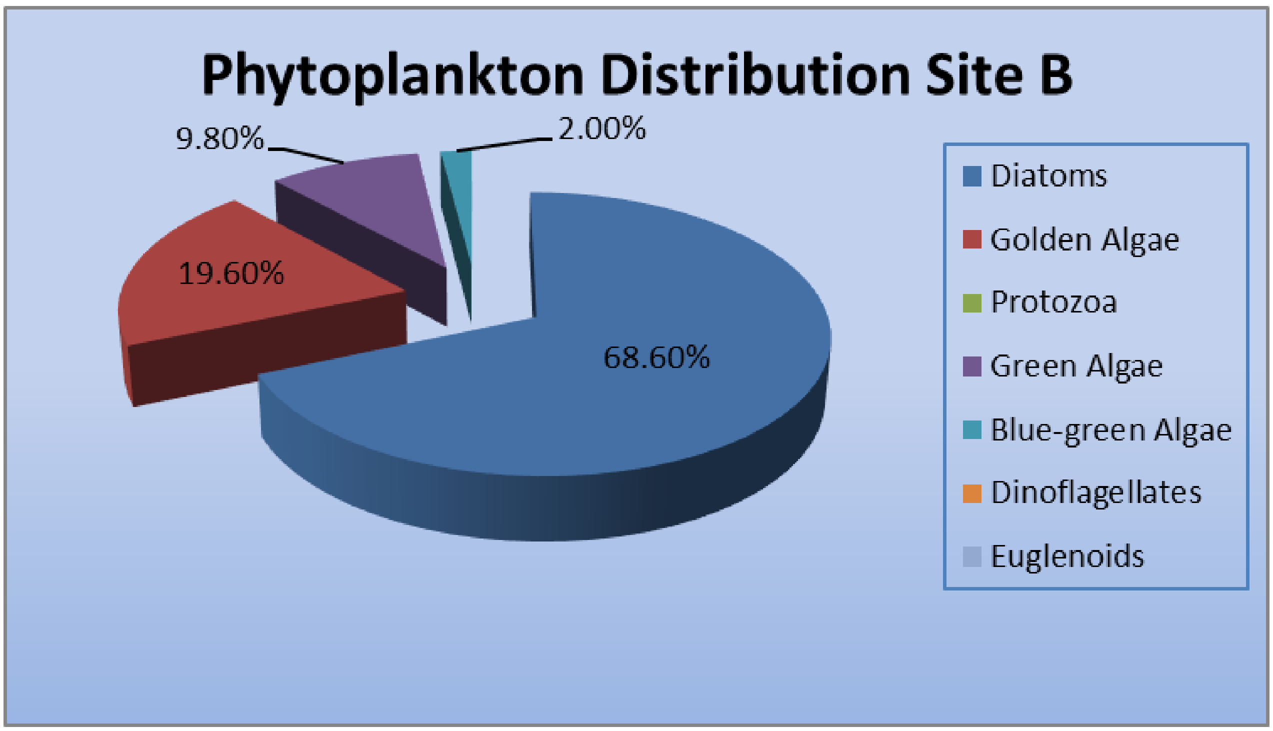
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium			
Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	6	9	
TRANSPARENCY:	12' est	12'	
ORGANISMS PER MILLILITER:	**410**	**510**	

NOTES: This is the first sampling event of 2021. Algal diversity is considered moderate at both sites. Algal density is considered low at site A while site B is considered moderate. Typical of early spring, the assemblage is dominated by diatoms. A mix of golden algae, green algae and blue-green algae (site B only) were also observed. Water clarity is considered excellent at both sites.


Phytoplankton Distribution Site A
2.40%
17.10%
80.50%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
9.80%
2.00%
19.60%
68.60%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

MICROSCOPIC EXAMINATION OF WATER

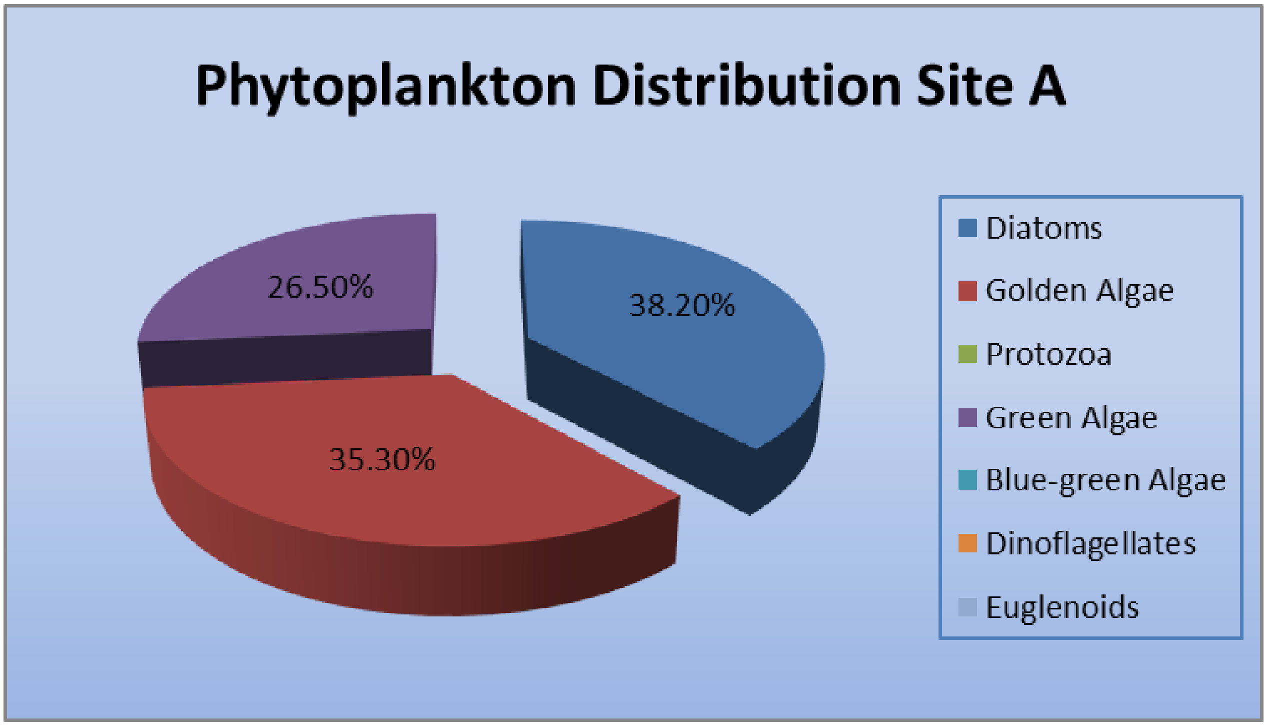
Sample from: Mt. Kemble Lake

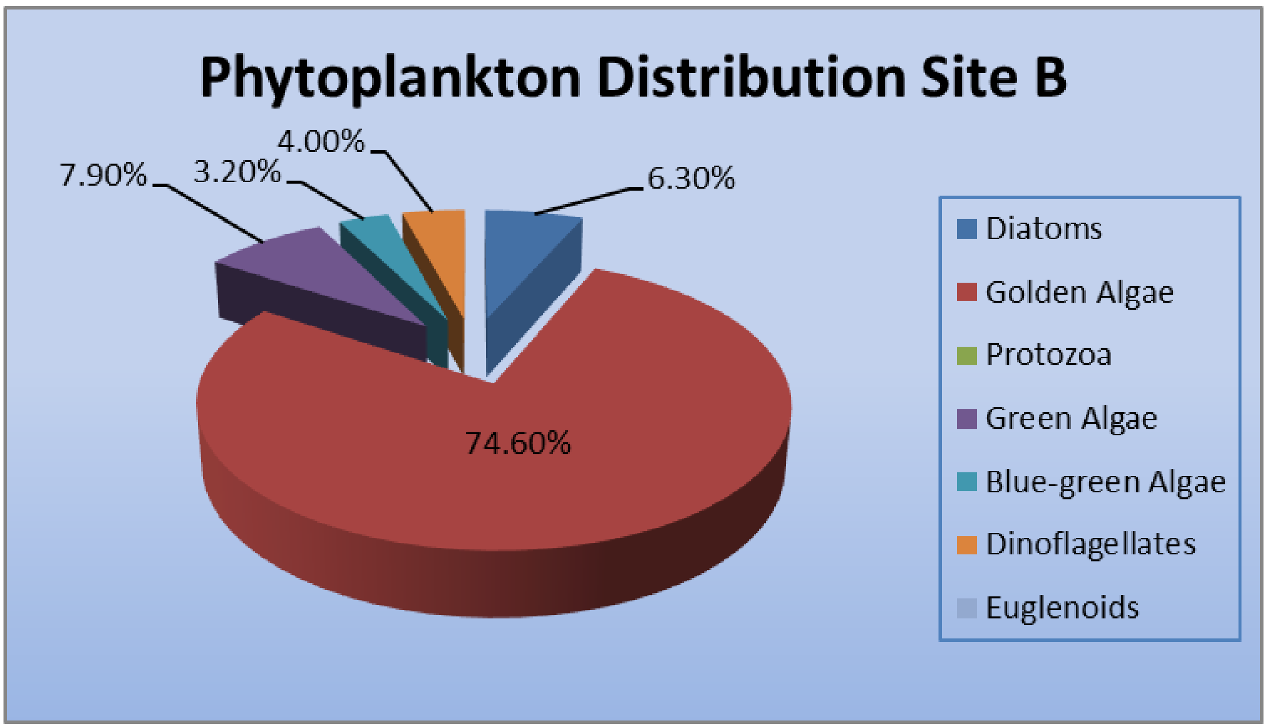
Collection Date: 6/23/20	Examination Date: 6/23/20	Amount Examined: 200 ml.
Site A: Inlet Station	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**	**CHLOROPHYTA (Green Algae)**	**A**	**B**	**C**	**CYANOPHYTA (Blue-green Algae)**	**A**	**B**	**C**
Asterionella				*Ankistrodesmus*	3480	4470		*Anabaena*			
Cyclotella				*Chlamydomonas*				*Anacystis*			
Cymbella				*Chlorella*				*Aphanizomenon*		10	
Diatoma				*Chlorococcum*				*Coelosphaerium*			
Fragilaria				*Closterium*				*Gomphosphseria*			
Melosira				*Coelastrum*		10		*Lyngbya*			
Navicula				*Eudorina*				*Microcystis*			
Nitzschia				*Mougeotia*				*Oscillatoria*			
Pinnularia	10			*Oedogonium*				*Pseudoanabaena*			
Urosolenia				*Oocystis*				*Synechocystis*			
Stephanodiscus				*Pandorina*	10			*Agmenellum*			
Stauroneis				*Pediastrum*							
Synedra	20			*Phytoconis*				**PROTOZOA**			
Tabellaria				*Rhizoclonium*				*Actinophyrs*	10	10	
Cocconeis				*Scenedesmus*	10						
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**	*Spirogyra*				**EUGLENOPHYTA (Euglenoids)**	**A**	**B**	**C**
				Staurastrum							
Dinobryon	20	30		*Sphaerocystis*				*Euglena*			
Mallomonas				*Ulothrix*				*Phacus*			
Synura				*Volvox*				*Trachelomonas*			
Tribonema				*Zygnema*							
Uroglenopsis				*Aulacoseira*							
				Microtinium				**PYRRHOPHYTA (Dinoflagellates)**	**A**	**B**	**C**
				Cosmerium							
				Gloeocystis	10			*Ceratium*			
				Golenkinia		20		*Peridinium*	130	190	

SITE	**A**	**B**	**C**
TOTAL GENERA:	9	7	
TRANSPARENCY:	4.0’	4.0’	
ORGANISMS PER MILLILITER:	**3,700**	**4,740**	

NOTES: Overall algal diversity increased since last sampling event on 4/16/20. Diversity continues to be moderate. Overall algal density increased and is now considered high. The assemblage is dominated by green algae. Golden algae, blue-green algae, dinoflagellates, and diatoms (site A only) were observed. Overall water clarity decreased and continues to be fair.


Phytoplankton Distribution Site A
26.50%
38.20%
35.30%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
4.00%
7.90%
3.20%
6.30%
74.60%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

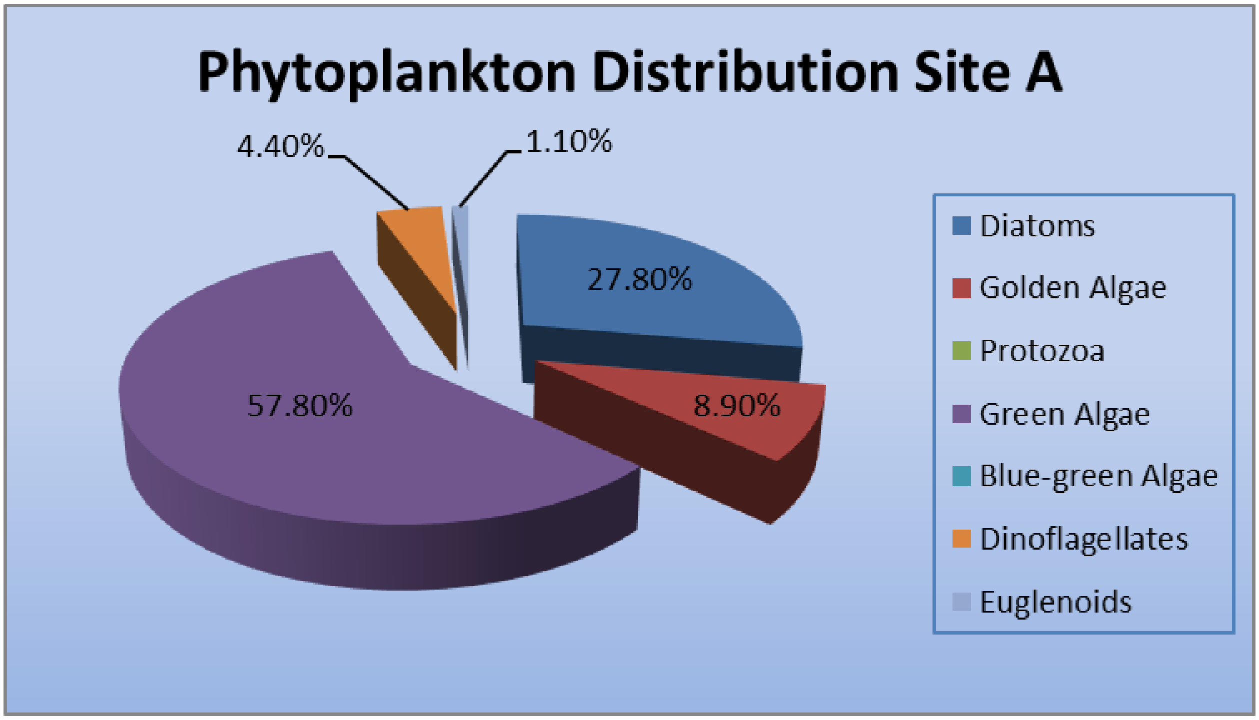
MICROSCOPIC EXAMINATION OF WATER

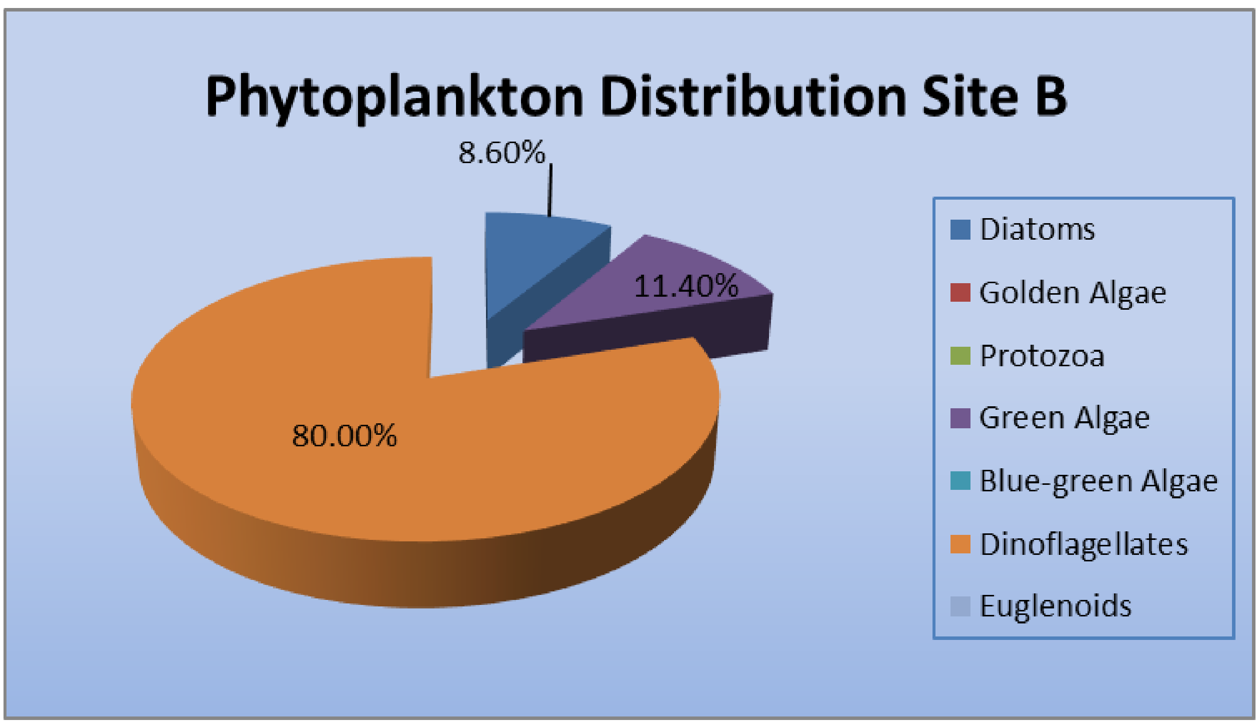
Sample from: Mt. Kemble Lake		
Collection Date: 8/25/21	Examination Date: 8/25/21	Amount Examined: 200 ml.
Site A: Inlet Station	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**	**CHLOROPHYTA (Green Algae)**	**A**	**B**	**C**	**CYANOPHYTA (Blue-green Algae)**	**A**	**B**	**C**
Asterionella				*Ankistrodesmus*				*Agmenellum*			
Cocconeis				*Aulacoseira*				*Anabaena*			
Cyclotella				*Chlamydomonas*				*Anacystis*			
Cymbella				*Chlorella*				*Aphanizomenon*			
Diatoma				*Chlorococcum*				*Coelosphaerium*			
Fragilaria				*Closterium*		20		*Gomphosphseria*			
Melosira				*Coelastrum*	70	20		*Lyngbya*			
Navicula				*Cosmerium*				*Microcystis*			
Nitzschia				*Eudorina*	400	100		*Oscillatoria*			
Pinnularia				*Gloeocystis*	30	30		*Pseudoanabaena*			
Urosolenia				*Golenkinia*				*Synechocystis*			
Stephanodiscus				*Microtinium*							
Stauroneis				*Mougeotia*		10		**PROTOZOA**			
Synedra	250	180		*Oedogonium*				*Actinophyrs*			
Tabellaria				*Oocystis*							
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**	*Pandorina*				**EUGLENOPHYTA (Euglenoids)**	**A**	**B**	**C**
				Pediastrum		10					
Dinobryon				*Phytoconis*				*Euglena*	10		
Mallomonas	80			*Rhizoclonium*				*Phacus*			
Synura				*Scenedesmus*	20	10		*Trachelomonas*			
Tribonema				*Spirogyra*							
Uroglenopsis				*Staurastrum*							
				Sphaerocystis				**PYRRHOPHYTA (Dinoflagellates)**	**A**	**B**	**C**
				Ulothrix							
				Volvox		40		*Ceratium*			
				Zygnema				*Peridinium*	40	1,68	

SITE	**A**	**B**	**C**
TOTAL GENERA:	8	10	
TRANSPARENCY:	6.0’	6.0’	
ORGANISMS PER MILLILITER:	**900**	**2,100**	

NOTES: Algal diversity at site A has decreased slightly since the last sampling event while site B remains the same. Diversity at both sites is still considered moderate. Algal density has increased significantly at each site. Density at site A is now considered moderate while site B is now high. Site A is now dominated by green algae, such as *Eudorina*. Site B is now dominated by dinoflagellates, specifically *Peridinium*. Diatoms, golden algae (site A only), and euglenoids (site A only) were also observed. Water clarity decreased at both sites and is now


Phytoplankton Distribution Site A
4.40%
1.10%
27.80%
57.80%
8.90%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
8.60%
11.40%
80.00%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

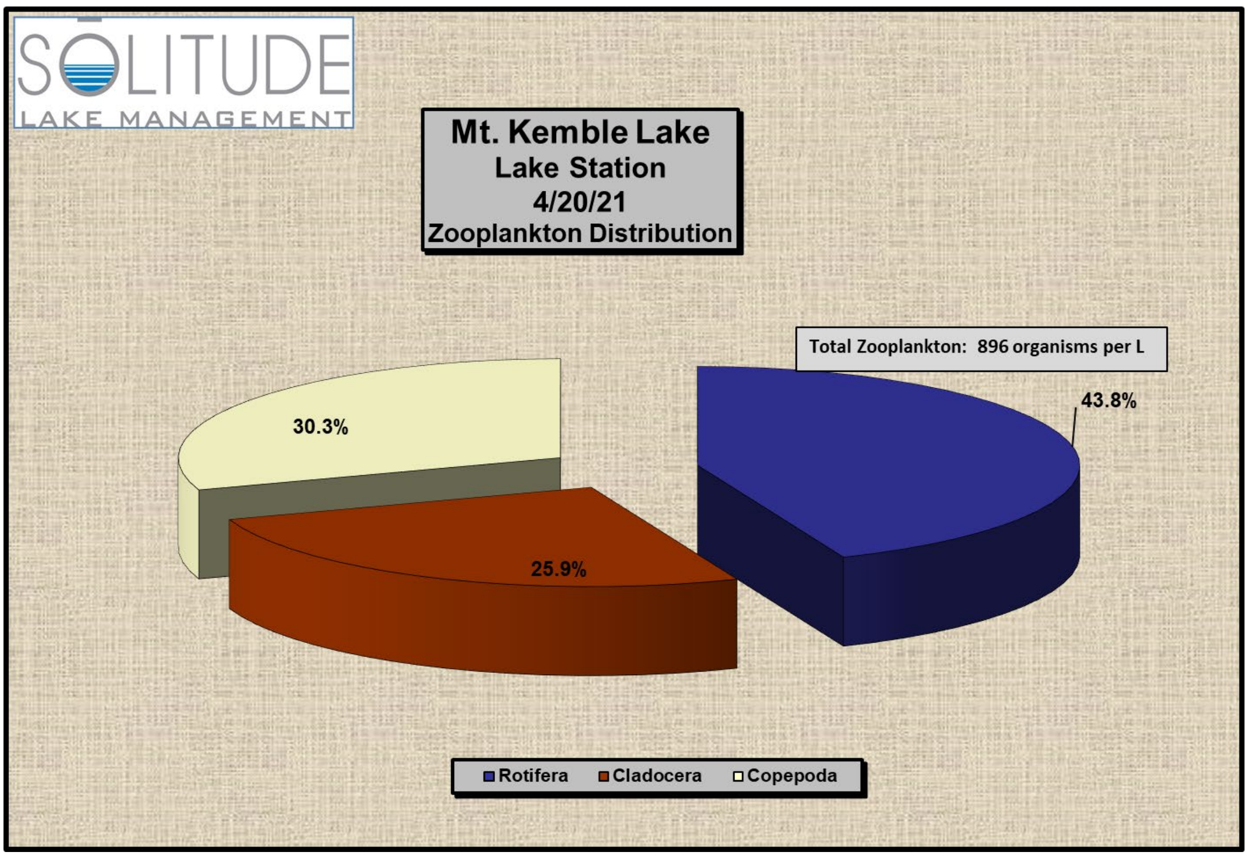
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS

Zooplankton Count Results

Site: Date:

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Branchionidae	*Notholca*	22	21	25	22.67	22667	68.8	329
			Keratella	5	1	2	2.67	2667	68.8	39
			Euchlanis	1			0.33	333	68.8	5
		Gastropidae	*Gastropus*	1		1	0.67	667	68.8	10
		Asplanchnidae	*Asplanchna*		1	1	0.67	667	68.8	10
							0.00	0	68.8	0
							0.00	0	68.8	0
							0.00	0	68.8	0
									Total:	**392**
Cladocera	**Cladocera**	Bosminidae	*Bosmina*	4	7	2	4.33	4333	68.8	63
		Daphniidae	*Daphnia*	11	12	12	11.67	11667	68.8	170
									Total:	**233**
Copepoda	**Cyclopoida**	Cyclopidae	*Nauplius*	18	14	18	16.67	16667	68.8	242
			Microcyclops		4	1	1.67	1667	68.8	24
			Diacyclops			1	0.33	333	**68.8**	5
									Total:	**271**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
896	392	43.8%	233	25.9%	271	30.3%

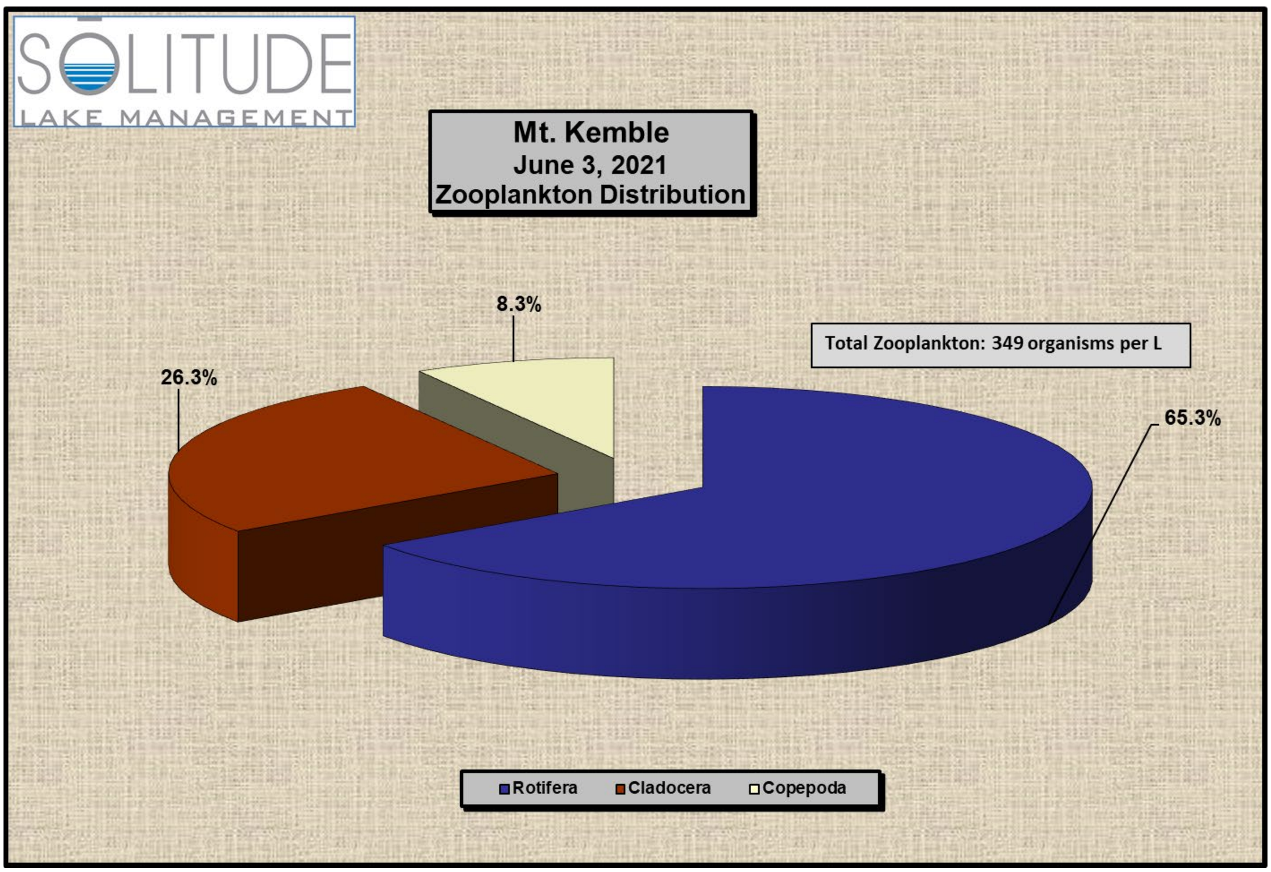


Zooplankton Count Results

Site: **Date:**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Notholca*	8	12	10	10.00	10000	68.8	145
			Keratella	2	7	4	4.33	4333	68.8	63
		Synchaetidae	*Ploesoma*		1	3	1.33	1333	68.8	19
							0.00	0	68.8	0
							0.00	0	68.8	0
							0.00	0	68.8	0
							0.00	0	68.8	0
							0.00	0	68.8	0
									Total:	**228**
Cladocera		Bosminidae	*Bosmina*	4	2	4	3.33	3333	68.8	48
			Eubosmina	2		1	1.00	1000	69.8	14
		Daphniidae	*Daphnia*	2		4	2.00	2000	68.8	29
									Total:	**92**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops*	1			0.33	333	68.8	5
			Cyclopoid nauplius	1	2	2	1.67	1667	68.8	24
							0.00	0	**68.8**	0
									Total:	**29**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
349	228	65.3%	92	26.3%	29	8.3%

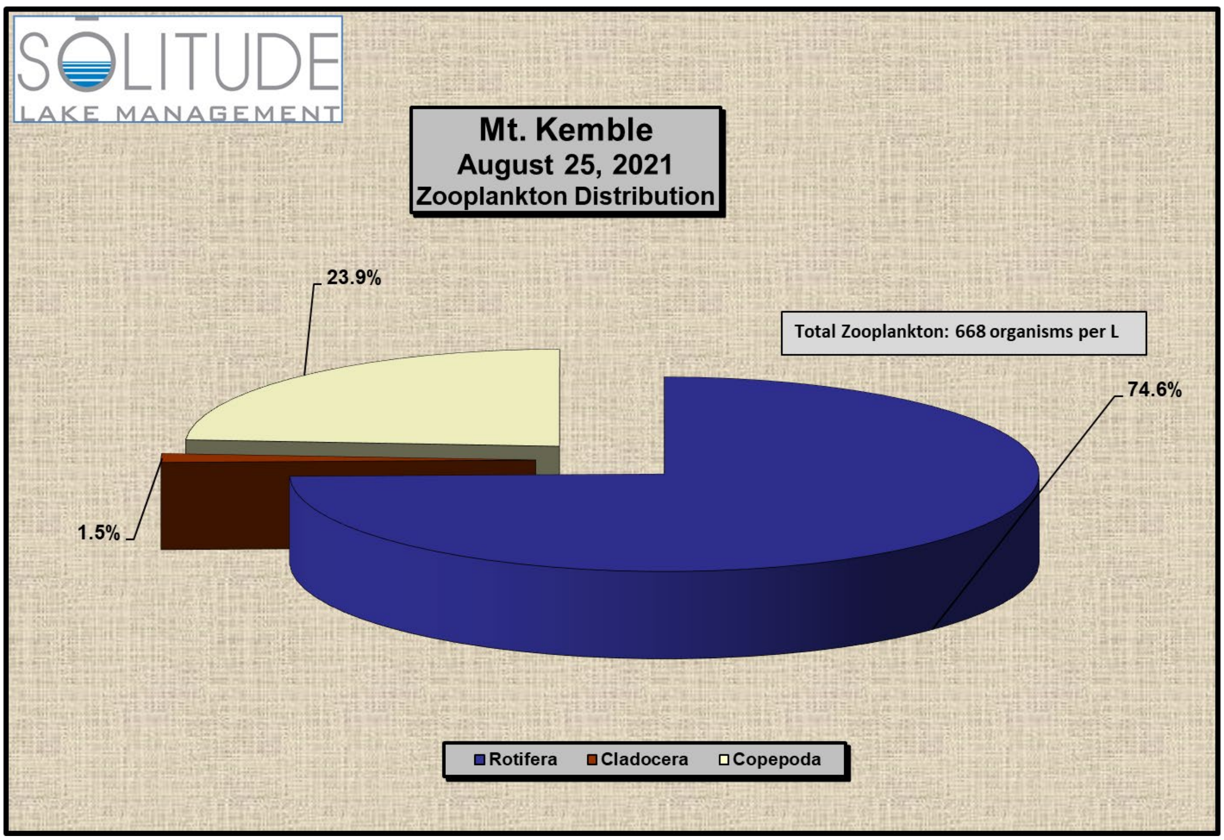


Zooplankton Count Results

Site: Mt. Kemble **Date: 8/25/21**

Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Notholca*	15	35	30	26.67	26667	68.8	388
			Keratella			2	0.67	667	69.8	10
			Anuraeopsis			8	2.67	2667	69.8	38
		Synchaetidae	*Bipalpus*		2	3	1.67	1667	68.8	24
			Ploesoma		1		0.33	333	68.8	5
			Synchaeta		4	3	2.33	2333	68.8	34
							0.00	0	68.8	0
							0.00	0	68.8	0
							0.00	0	68.8	0
							0.00	0	68.8	0
									Total:	**498**
Cladocera		Bosminidae	*Bosmina*			1	0.33	333	68.8	5
		Daphniidae	*Daphnia*			1	0.33	333	68.8	5
									Total:	**10**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops*		8	7	5.00	5000	68.8	73
			Diacyclops	2	1	1	1.33	1333	68.8	19
			Cyclopoid nauplius	1	4	9	4.67	4667	68.8	68
	Calanoida	Diaptomidae	*Leptodiaptomus*			1	0.33	333	69.8	5
									Total:	**160**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
668	498	74.6%	10	1.5%	160	23.9%



APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES