Mount Kemble Lake

2018 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.
Morristown, NJ

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YEAR END SUMMARY
2018 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

Introduction

The following report is the 2018 Year-End Summary of the Water Quality Monitoring and Lake Management Program for Mount Kemble Lake located in Morristown, Morris County, 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 2018 season. Recommendations for Mount Kemble Lake management efforts are also included for lake management strategies in the 2019 season. The Appendix of this report includes graphs and tables of the 2018 field data, reference guides, along with supporting documents for this report.

The 2018 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*). Through the season a total of four (4) different aquatic macrophytes were observed 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.

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

Table 1. 2018 Observed Aquatic Macrophytes.

Weather Discussion

The weather in 2018 at times, made for challenging lake management conditions. The winter was slightly below average overall with the exception of February, which included a day where temperatures were nearly 80 degrees. Early spring was quite a bit cooler than average until May which was the 4th warmest recorded. This led to a rapid increase in lake temperatures as well as plant and algae growth, which was continuously fueled by a warm summer that included a tie for the warmest August on record. (Figure 1 Rutgers Climate Lab). Precipitation was below average for the beginning of the year until February. From that point on precipitation was above average for the rest of the year with a dry period at the end of June. (Figure 2 Rutgers Climate Lab).

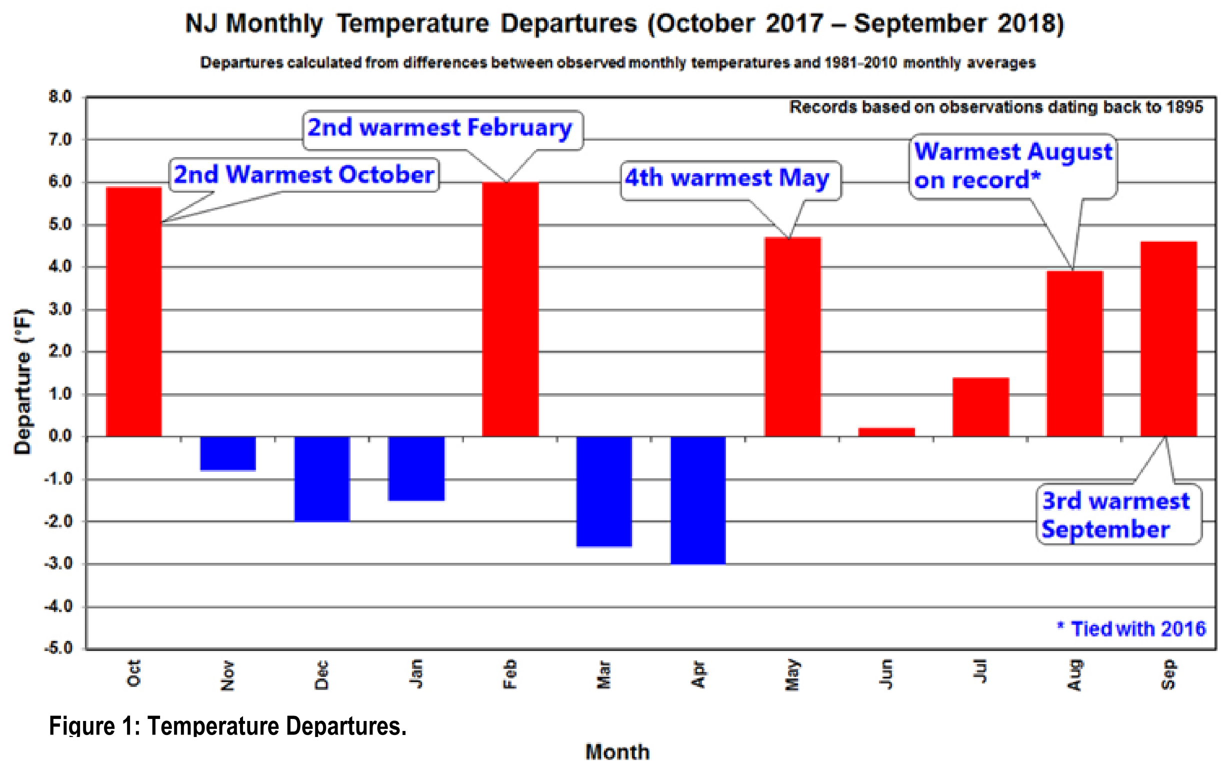


Figure 1: Temperature Departures.

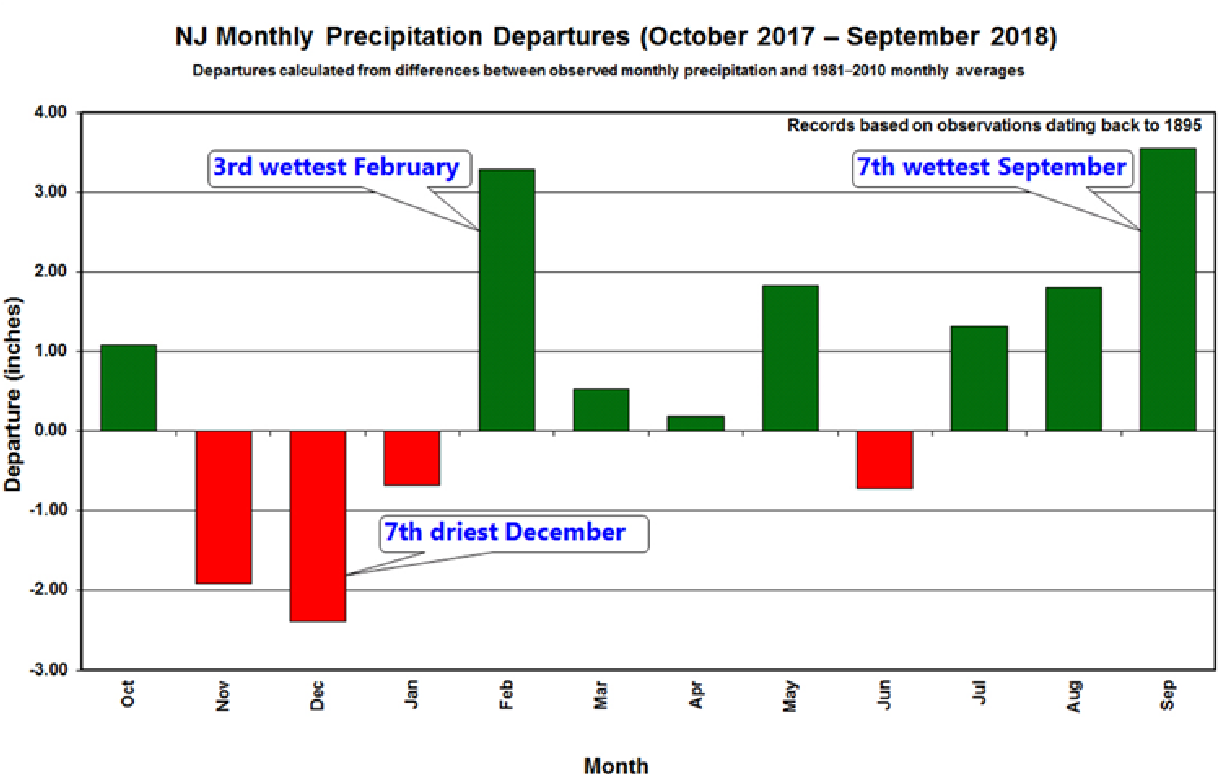


Figure 2. Precipation Departures.

Lake Management

Aquatic biologists were at Mount Kemble Lake on ten (10) 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) dates, 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. Following each survey, biologists would review lake conditions to determine if management activity was required or requested. In 2018, SŌLitude Lake Management field staff conducted herbicide or algaecide applications for control of nuisance and invasive aquatic vegetation growth during six (6) of the total ten (10). The table below 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
5/24/2018	Copper Sulfate	2	Filamentous algae
	Tribune	1.5	*P. crispus*
6/12/2018	Copper Sulfate	6.7	Unicellular algae
6/26/2018	Copper Sulfate	6.7	Unicellular algae
7/10/2018	Cutrine Plus	6.5	Unicellular algae
7/24/2018	Cutrine Plus	6.5	Unicellular algae
8/7/2018	Copper Sulfate	6.7	Unicellular algae

Table 2: Mount Kemble Lake 2018 Treatment Log

The early season survey conducted at Mount Kemble Lake during April showed that the lake supported small patches of southern naiad (*N. guadalupensis*) as well as limited curly-leaf pond weed (*P. crispus*). Overall, the lake looked good and only had minor amounts of filamentous algae that were observed floating on the surface. The second survey of the season was conducted and at this time aquatic plant life was observed in similar densities as the first visit of the season. Only trace amounts of filamentous algae were observed floating on the surface, but it was not found in densities that required treatment, however, during the next visit growth had increased. The next visit occurred on May 24th, and treatment was required for both curly-leaf pondweed as well as filamentous algae growth. **Schooner** was utilized in the control of the curly-leaf pondweed and **Copper Sulfate** was applied to control the growth of filamentous algae along the western shoreline.

The lake was visited on two (2) occasions during the month of June and reported that the lake was supporting limited amounts of plant growth, however, the water column was green with unicellular algae growth. Treatment was performed on both occasions with applications of **Copper Sulfate**. July saw similar lake conditions as June as plant growth remained at low, non-nuisance densities, while unicellular algae growth remained relatively dense. Both of the lake surveys in July reported a moderate to high observed density of unicellular algae in the water column. In order to improve water clarity, treatment was conducted employing **Cutrine Plus**, a chelated copper, which remains in the water column for a longer period of time. The early August survey was conducted on the 7th, and at that time the water clarity had once again diminished to below desirable standards. An application of **Copper Sulfate** was conducted to improve the clarity of the water. The second visit in August reported minor plant growth, but improved water clarity and algae control. No treatment was required for this visit to the lake. The final visit was performed in September and observations were similar to those of late August as plant growth was minimal and algae growth remained under control.

Water Quality Monitoring Program

In 2018, 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- North Station					
Parameter	**Units**	**4/23/2018**	**6/26/2018**	**8/21/2018**	**Limits**
Temperature	°C	13	25.6	24.3	NA
Dissolved Oxygen	mg/L	15.76	11.00	8.64	<4.0
ph	SU	8.00	8.50	8.0	9
Alkalinity	mg/L	52	72	76	NA
Total Hardness	mg/L	200	200	100	NA
Secchi	feet	3.0	2.50	3.0	<4'
Ammonia	mg/l	0.11	0.033	0.031	0.3
Nitrate	mg/L	1.180	0.422	0.344	0.3
Total Phosphorus	mg/L	0.105	0.065	0.056	0.03
Total Suspended Solids	mg/L	11.00	14.0	7.2	25
Conductivity	Umhos/cm	350	360	290	1500

Table 3. 2018 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- Lake Station Surface					
Parameter	**Units**	**4/23/2018**	**6/26/2018**	**8/21/2018**	**Limits**
Temperature	°C	14.5	23.9	24.4	NA
Dissolved Oxygen	mg/L	16.40	12.90	7.57	<4.0
ph	SU	9.00	8.50	7.5	9
Alkalinity	feet	60	64	60	NA
Total Hardness	mg/L	120	200	100	NA
Secchi	mg/L	4.5	2.00	4.0	<4'
Ammonia	mg/l	0.066	ND	0.075	0.3
Nitrate	mg/L	0.798	0.383	0.318	0.3
Total Phosphorus	mg/L	0.116	0.042	0.054	0.03
Total Suspended Solids	mg/L	7.10	13.0	5.9	25
Conductivity	Umhos/cm	340	360	280	1500

Table 4. 2018 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–Lake Station-Bottom					
Parameter	**Units**	**4/23/2018**	**6/26/2018**	**8/21/2018**	**Limits**
Dissolved Oxygen	mg/L	7.83	0.07	NA	<4.0
Ammonia	mg/L	0.447	1.390	2.46	0.3
Nitrate	mg/L	0.674	0.129	0.047	0.3
Total Phosphorus	mg/L	0.021	0.186	0.477	0.03
Total Suspended Solids	mg/L	ND	6.2	9,6	25
Conductivity	umhos/cm	380	380	390	1500

Table 5. 2018 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 2018, the surface water temperature was 14.5° C in April, and by August the temperature had increased to 24.4 ˚C. The pH values collected from the inlet and lake station sites throughout the year were consistent with a small range of 7.5 to 9, which falls within the typical range for freshwater lake systems, and is within historical readings of the past several years for Mt. Kemble Lake. The hardness levels were similar to last year, ranging from 100 mg/L to 200 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 chemical composition of Mount Kemble Lake's surface water is considered moderately hard water. The alkalinity values remained consistent throughout the year from 52 to 76 mg/L, and within a comparable level compared to similar NJ freshwater lakes' chemical composition. Conductivity was consistent throughout the season with values ranging from 280 to 390 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 in 3 samples at the lake station bottom sampling site they were above acceptable limits, which is generally not typical for the lake. Although levels were higher than normal it did not seem to have adverse effects on the lake. Nitrates were found to be elevated throughout the season with numbers well above the limit in during sampling. There were only 2 occasions of this in the other sites and the rest of the samplings all fell within the normal range and both of these samplings were taken from the bottom sampling station.

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 2018, the phosphorus levels were observed to be higher than the acceptable values in every sample taken throughout the year with the exception of the April sampling at the bottom station. The majority of these elevated samples were double the acceptable limit or higher. When levels were elevated they were marginally above the typical values expected in a eutrophic lake system. The elevated phosphorus levels could be an explanation for the amount of planktonic algae that was observed throughout the season, as many more applications were necessary to control growth in previous years.

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 6: Trophic Status Based on Phosphorus Values

Transparency (water clarity) displayed little variability in 2018, with observed secchi readings between 2 and 4.5 feet. Mt. Kemble Lake typically supports lake conditions that favor relatively high water clarity readings, however, in 2018 clarity readings were lower than usual as the highest clarity reading was 4.5 feet and the majority of the season was closer to a 3 foot reading. Lower water clarity readings were likely due to the higher than average amounts of planktonic algae that was observed in the water column for the majority of the season. Total suspended solids were all below the thresholds throughout the season for Mt. Kemble Lake.

Lake Profile Description

	4/23/2018		6/26/2018		8/21/2018	
Depth (m)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
Surface	14.5	16.40	23.9	12.90	24.4	7.57
1	12.5	17.45	23.9	12.00	24.2	6.64
2	11.8	16.70	22.7	6.50	23.4	1.35
3	9.5	15.60	19.2	2.40	22.2	0.11
4	9.0	13.05	11.3	0.85	15.4	0.08
5	8.7	12.43	8.6	1.01	11.6	0.08
6	8.2	10.70	7.9	0.98	9.4	0.07
7	8.0	9.30	7.6	0.86	8.4	0.08
8	7.8	8.92	7.1	0.77	7.9	0.08
9	7.5	8.88	7.0	0.72	NA	NA
10	7.0	7.83	NA	NA	NA	NA

Table 7. 2018 Mt. Kemble Lake Profiles

The 2018, the April profile revealed a well mixed water column, with favorable dissolved oxygen to a depth of 30 feet, which was similar to what was even better than in 2017 when favorable dissolved oxygen levels were observed to depths of 24 feet. During June, the lake profile revealed 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, however during this season, the dissolved oxygen levels were extremely low at depths of only 6 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. Overall, this pattern remained the same for the rest of the season as dissolved oxygen levels dropped significantly after 6 feet of depth. Complete profile graphs are provided in the Appendix of this report.

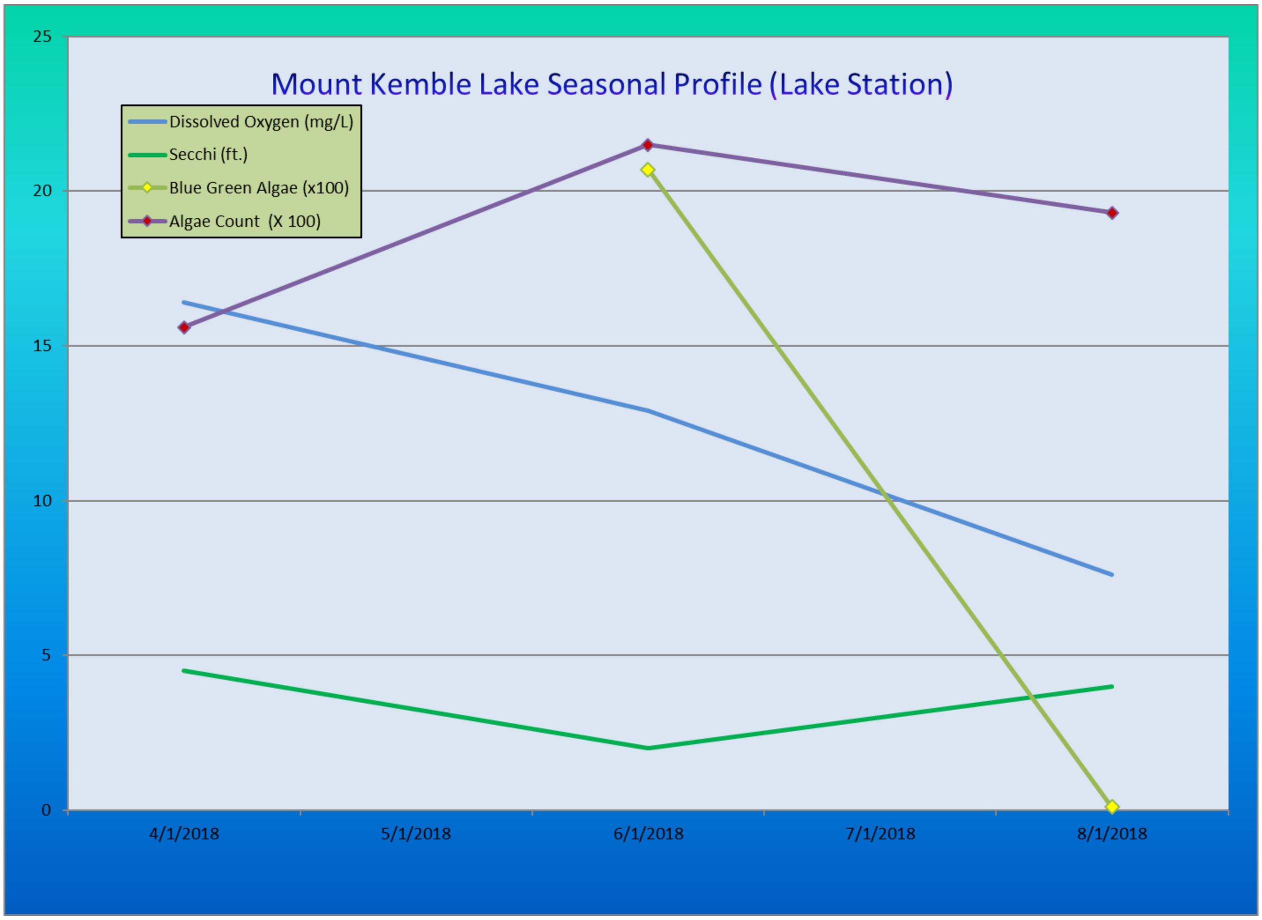


Figure 3. Mount Kemble Lake Seasonal Profile

PLANKTON SURVEYS

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2018, 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's laboratory. The 2018 microscopic examination data sheets and graphs are provided in the Appendix. In 2018, 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.

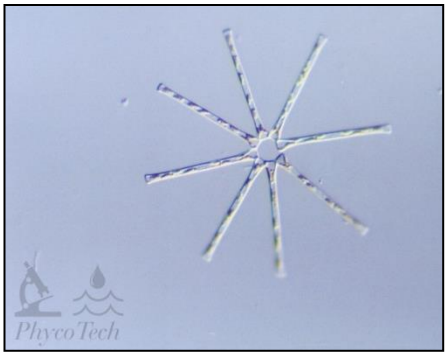
A Phytoplankton Primer

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 2017 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.

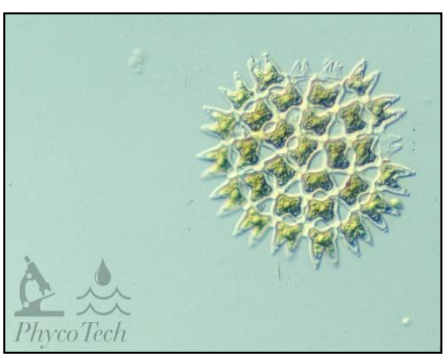
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches, 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.

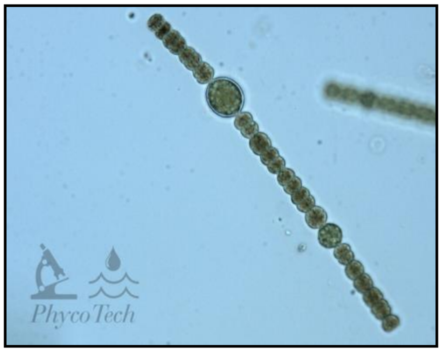


Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population 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*.

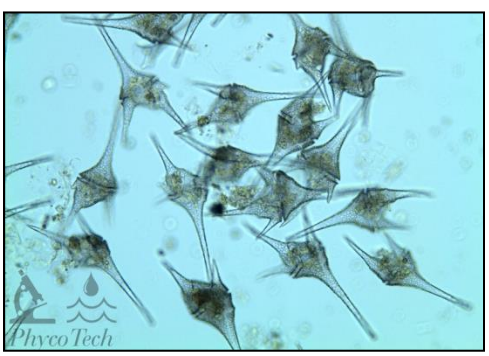


Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically 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 of 2018, the phytoplankton density was considered moderate at the inlet station and high at the lake station. Although density was moderate to high, diversity at the inlet station was only six (6) genera, while the lake station only supported four (4). Diatoms accounted for nearly 100% of both samples with the most commonly observed genera being *Synedra*, a diatom. The second sampling occurred in June and at the time both stations saw the highest observed algal totals of the entire season as the inlet stations supported 3240 Orgs/mL. Diversity remained similar as seven (7) genera were observed the inlet sampling station and once again four (4) genera were observed at the lake station. Each sampling station contained the highest number of blue-green algae, which accounted for at least 92% of each sample. The dominant genera was *Anabaena*.

Algal Group			
% Abundance	4/23/18	6/26/18	8/21/18
Diatoms	**98.8%**	6.2%	7.2%
Golden Algae	1.2%		12.5%
Protozoa			
Green Algae		0.3%	**75.9%**
Blue-green Algae		**92.9%**	
Dinoflagellates		0.6%	2.6%
Euglenoids			1.8%
Total Orgs / mL	**840**	**3240**	**1120**

Table 8. Mt. Kemble Phytoplankton Assemblage Inlet Station

For the August sampling event, the phytoplankton density remained high at both locations, however, the densities were slightly slower than the June observations. At each sampling location the diversity increased a great deal from the previous sampling events as they contained eleven (11) and twelve (12) genera, respectively. The dominant algal group shifted from blue-green algae to green algae as both stations contained at least 75% of that algal family. Each location contained the highest density of *Phytoconis*, a green algae.

Algal Group			
% Abundance	4/23/18	6/26/18	8/21/18
Diatoms	**99.4%**	2.3%	1.5%
Golden Algae			9.4%
Protozoa			
Green Algae	0.6%		**81.9%**
Blue-green Algae		**96.3%**	0.7%
Dinoflagellates			6.5%
Euglenoids		1.4%	
Total Orgs. / mL	**1560**	**2150**	**1930**

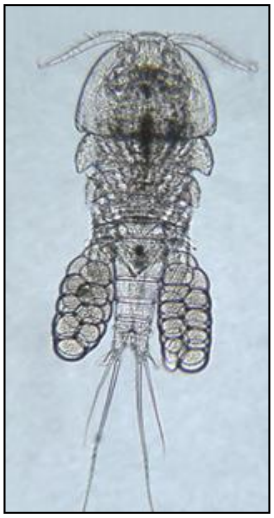
Table 9. Mt. Kemble Phytoplankton Assemblage Lake Station

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.

2018 Zooplankton Results

Zooplankton Group	4/23/2018	6/26/2018	8/21/2018
Rotifers	**72.9%**	41.5%	**74.9%**
Cladocera	2.1%	**56.6%**	23.2%
Copepoda	25.0%	2.0%	1.9%
Total Zooplankton (Orgs. / mL)	1032	1730	8886

Table 10. Mount Kemble Lake 2018 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 1032 organisms per mililiter, which is considered high, but sample diversity was moderate to high with seven (7) different genera observed. At this time Rotifers accounted for nearly all off the total sample at 72.9 percent of the total zooplankton community with *Conochilus* being the most abundant genera. Additionally, a very low density of Cladocerans were observed, while a moderate density of Copepoda were observed as they accounted for a quarter of the total sample.

The June sampling once again revealed a high density of zooplankton as there were 1730 organisms per mililiter. The Cladocera genera were the most commonly found, but only accounted for at little more than half of the total sample at 53.2 percent of the total with the genera *Bosmina* being the most commonly found within the group. At this time zooplankton diversity is considered high as only a total of twelve (12) different genera were found in the sample. *Keratella* was the most commonly observed Rotifer, as Rotifers accounted for 41.5% of the total sample. The *Copepoda,* was found in this sample and was the most dominant copepod, but the copepods only accounted for a total of 2.0 percent of the zooplankton observed.

The final sampling of the season showed that the zooplankton composition was still considered high as twelve (12) different genera were observed once again, however the density of zooplankton observed increased dramatically as a total of 8886 orgs/mL were observed. Rotifers made of 74.9 percent of the zooplankton composition with *Conochilus* being the most abundant in the sample. The Cladoceran, *Bosmina* made up nearly a quarter of the total sample at just under 23%. A small density of Copepoda were observed at the time of the sampling.

Discussion

The 2019 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 2018, southern naiad (*N. guadalupensis*) as well as curly-leaf pondweed (*P. crispus*). Although growth was limited in 2018, it is still recommended that localized applications of the contact aquatic herbicide **Reward/Tribune** continue to be utilized through the season for its ability to selectively control nuisance submerged vegetation by rapid absorption into the target plant. **Schooner** (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, such as the northern inlet, where they are not interrupting recreational activities or reducing the aesthetic appeal of the lake.

Copper sulfate will continue to provide the most cost effective and cost-efficient management method for controlling nuisance density filamentous and planktonic algae growth. It should be reminded that **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. 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. On two occasions in 2018, **Cutrine Plus** was applied for planktonic algae management as it is a chelated, liquid copper product that will stay in the water column longer than **Copper Sulfate**. If planktonic algal densities are similar in 2019, this may be an effective alternative for treatment.

The management program for 2019 is anticipated to be similar to the 2018 monitoring program, 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. In 2018, an alum treatment was not performed and water clarity readings were lower than 2017 and many more planktonic algae treatment were required in order to maintain a relatively clear water column. Alum is strongly recommended in 2019 based on observed phosphorus levels throughout the season. A more intensive management effort for the inlet pond will also be evaluated for 2019, including a possible nutrient mitigation application to reduce phosphorous introduction into Mt. Kemble Lake. During the season one herbicide/algicide application was made in an effort to reduce that amount of plant and algae growth that was being introduced into the lake. A more elaborate program can be discussed at the request of MKLA.

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 2019 lake management season.

Sincerely,

Carl Cummins

Carl Cummins
Environmental Scientist

SŌLITUDE
LAKE MANAGEMENT

APPENDIX

APPENDIX A: WATER QUALITY PARAMETER DESCRIPTION
APPENDIX B: AQUATIC MACROPHYTE GUIDE
APPENDIX C: WATER QUALITY SAMPLING MAP
APPENDIX D: PHYTOPLANKTON ENUMERATION CHARTS
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS
APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES
APPENDIX G: LAB DATA REPORTS

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

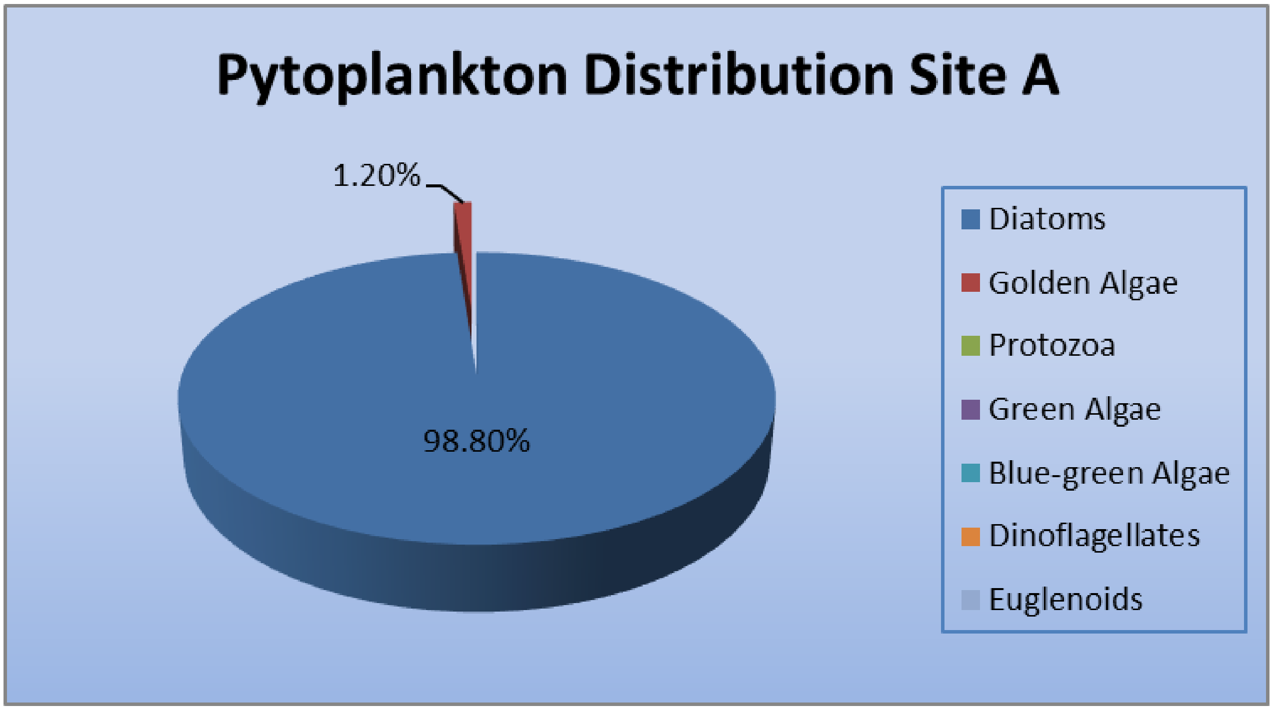
Sample from: Mt. Kemble Lake

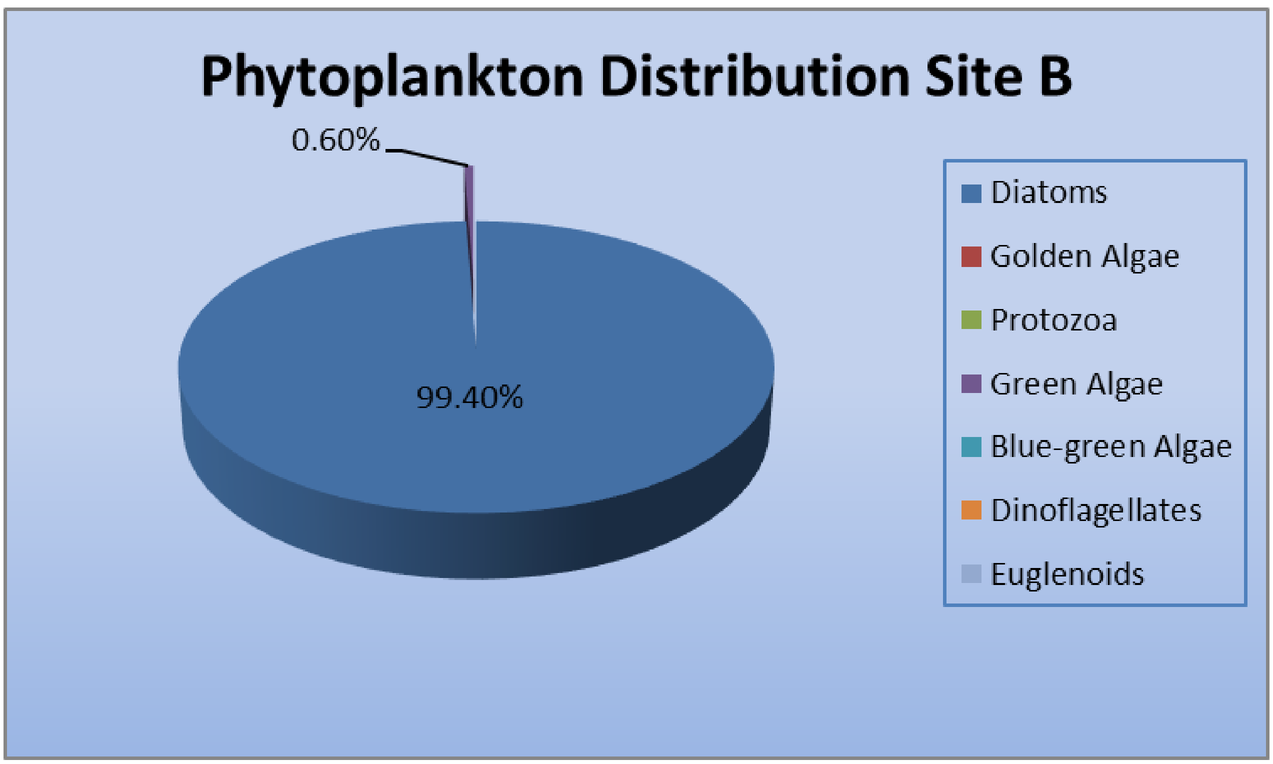
Collection Date: 04/23/18	Examination Date: 04/24/18	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**	**CHLOROPHYTA (Green Algae)**	**A**	**B**	**C**	**CYANOPHYTA (Blue-green Algae)**	**A**	**B**	**C**
Asterionella	130	530		*Ankistrodesmus*				*Anabaena*			
Cyclotella	90	90		*Chlamydomonas*				*Anacystis*			
Cymbella				*Chlorella*				*Aphanizomenon*			
Diatoma				*Chlorococcum*				*Coelosphaerium*			
Fragilaria				*Closterium*				*Gomphosphseria*			
Melosira				*Coelastrum*				*Lyngbya*			
Navicula	30			*Eudorina*				*Microcystis*			
Nitzschia				*Mougeotia*				*Oscillatoria*			
Pinnularia	10			*Oedogonium*		10		*Pseudoanabaena*			
Urosolenia				*Oocystis*				*Synechocystis*			
Stephanodiscus				*Pandorina*				*Agmenellum*			
Stauroneis				*Pediastrum*							
Synedra	570	930		*Phytoconis*				**PROTOZOA**			
Tabellaria				*Rhizoclonium*				*Actinophyrs*			
Cocconeis				*Scenedesmus*							
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**	*Spirogyra*				**EUGLENOPHYTA (Euglenoids)**	**A**	**B**	**C**
				Staurastrum							
Dinobryon				*Sphaerocystis*				*Euglena*			
Mallomonas	10			*Ulothrix*				*Phacus*			
Synura				*Volvox*				*Trachelomonas*			
Tribonema				*Zygnema*							
Uroglenopsis				*Aulacoseira*							
				Microtinium				**PYRRHOPHYTA (Dinoflagellates)**	**A**	**B**	**C**
				Cosmerium							
								Ceratium			
								Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	6	4	
TRANSPARENCY:	3.0’	4.5’	
ORGANISMS PER MILLILITER:	**840**	**1,560**	

NOTES: This is the first sampling event of 2018. Algal diversity is considered to be moderate at site A while site B is low. Algal density is considered to be moderate at site A while site B is high. The assemblage is dominated by various diatoms. Trace amounts of golden algae were observed at site A only and green algae was observed at site B only. Water clarity is considered to be poor at site A and fair at site B.


Pytoplankton Distribution Site A
1.20%
98.80%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
0.60%
99.40%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 6/26/2018	Examination Date: 6/27/2018	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**
Asterionella			
Cyclotella		30	
Cymbella			
Diatoma			
Fragilaria	150	20	
Melosira			
Navicula	20		
Nitzschia			
Pinnularia			
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra	20		
Tabellaria	10		
Cocconeis			

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

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

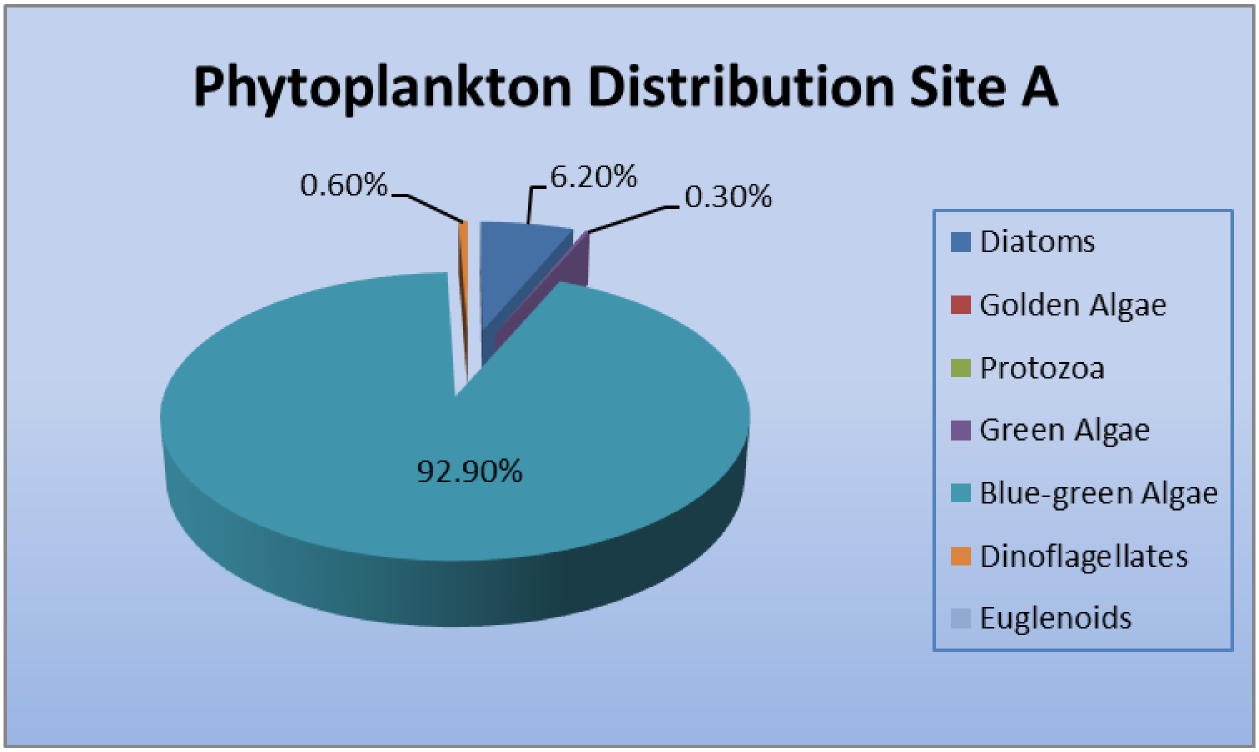
CYANOPHYTA (Blue-green Algae)	**A**	**B**	**C**
Anabaena	2290	2070	
Anacystis			
Aphanizomenon			
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			
Agmenellum			
PROTOZOA			
Actinophyrs			

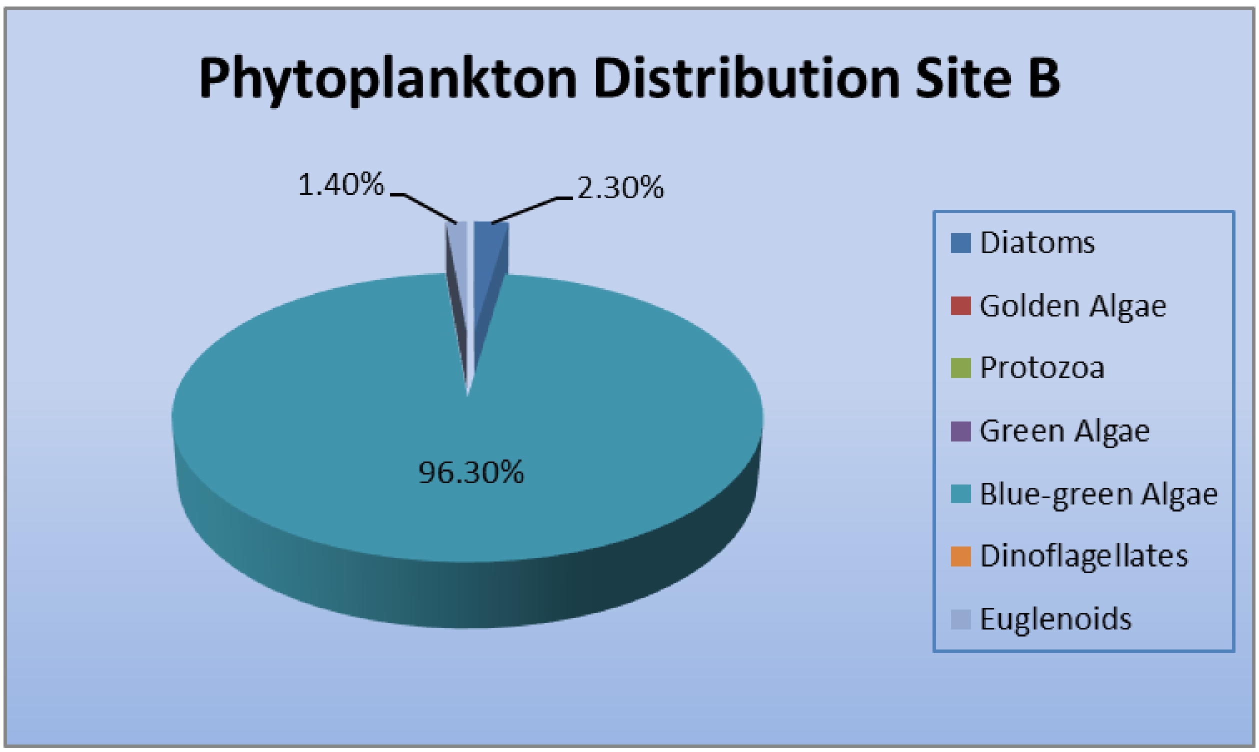
EUGLENOPHYTA (Euglenoids)	**A**	**B**	**C**
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	**A**	**B**	**C**
Ceratium	20	30	
Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	7	4	
TRANSPARENCY:	2.5’	2.0’	
ORGANISMS PER MILLILITER:	**3,240**	**2,150**	

NOTES: Since the last sampling event, algal density increased dramatically, especially with blue-green algae. The density is now considered high at both sites. Algal diversity increased slightly at site A and remained the same at site B. Site A has moderate diversity and site B continues to be low. The assemblage is dominated by blue-green algae, specifically *Anabaena*. Diatoms and dinoflagellates were also observed. Trace amounts of green algae were observed at site A only. Clarity decreased at both sites and is now considered poor.


Phytoplankton Distribution Site A
0.60%
6.20%
0.30%
92.90%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
1.40%
2.30%
96.30%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

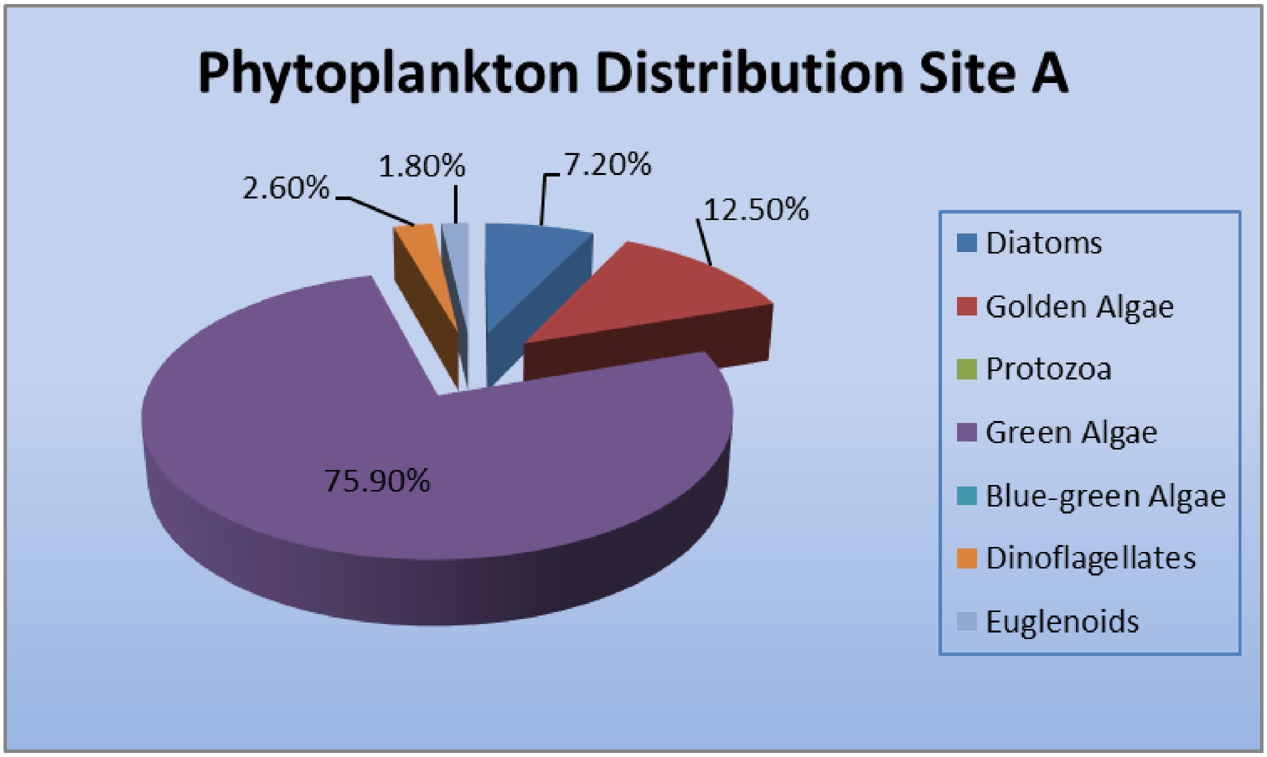
MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 8/21/2018	Examination Date: 8/23/2018	Amount Examined: 200 ml.
Site A: North Station (inlet)	Site B: Lake Station	Site C:

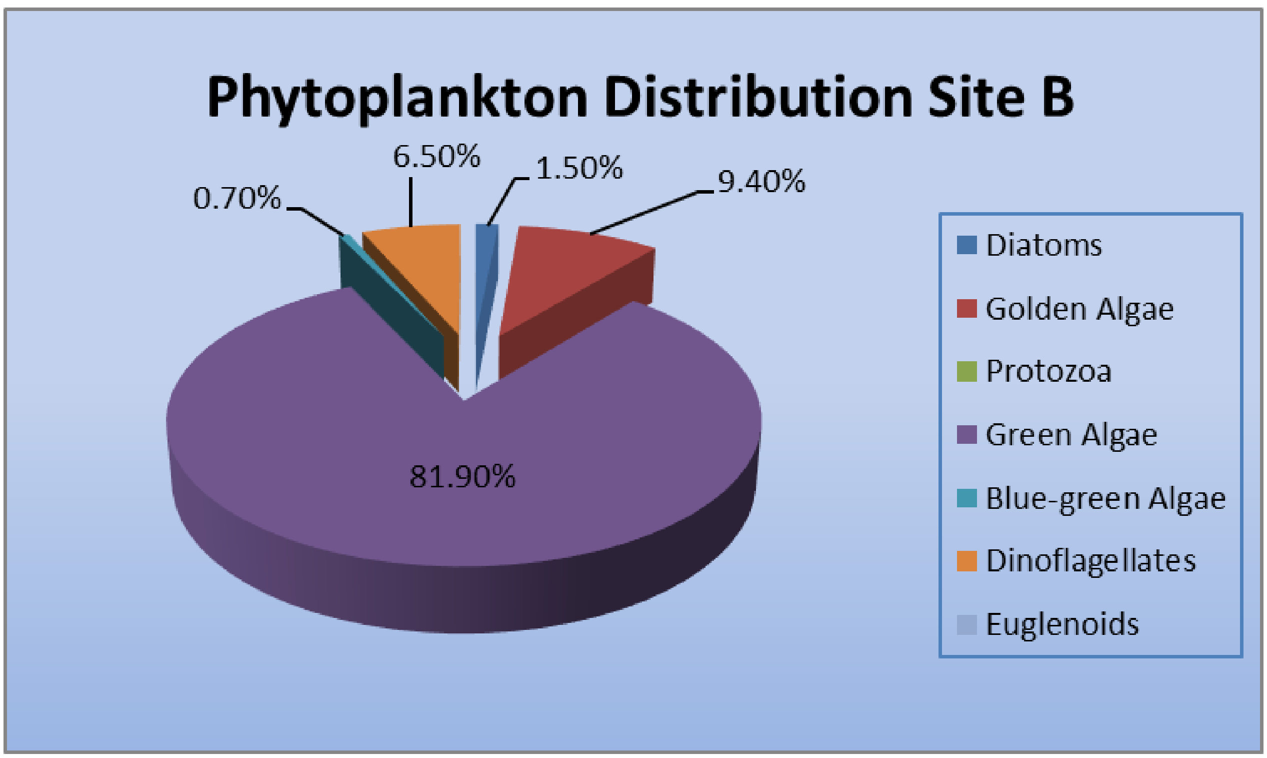
BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**	**CHLOROPHYTA (Green Algae)**	**A**	**B**	**C**	**CYANOPHYTA (Blue-green Algae)**	**A**	**B**	**C**
Asterionella				*Ankistrodesmus*				*Anabaena*			
Cyclotella		10		*Chlamydomonas*				*Anacystis*			
Cymbella				*Chlorella*				*Aphanizomenon*			
Diatoma				*Chlorococcum*				*Coelosphaerium*		10	
Fragilaria	80	10		*Closterium*				*Gomphosphseria*			
Melosira				*Coelastrum*	60	120		*Lyngbya*			
Navicula				*Eudorina*	360	520		*Microcystis*			
Nitzschia				*Mougeotia*				*Oscillatoria*			
Pinnularia		10		*Oedogonium*				*Pseudoanabaena*			
Urosolenia				*Oocystis*	10	10		*Synechocystis*			
Stephanodiscus				*Pandorina*				*Agmenellum*			
Stauroneis				*Pediastrum*							
Synedra				*Phytoconis*	380	810		**PROTOZOA**			
Tabellaria				*Rhizoclonium*				*Actinophyrs*			
Cocconeis				*Scenedesmus*	40	60					
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**	*Spirogyra*				**EUGLENOPHYTA (Euglenoids)**	**A**	**B**	**C**
				Staurastrum							
Dinobryon				*Sphaerocystis*		100		*Euglena*			
Mallomonas	130	180		*Ulothrix*				*Phacus*	10		
Synura	10			*Volvox*				*Trachelomonas*	10		
Tribonema				*Zygnema*							
Uroglenopsis				*Aulacoseira*							
				Microtinium				**PYRRHOPHYTA (Dinoflagellates)**	**A**	**B**	**C**
				Cosmerium							
								Ceratium			
								Peridinium	30	90	

SITE	**A**	**B**	**C**
TOTAL GENERA:	11	12	
TRANSPARENCY:	3.0’	4.0’	
ORGANISMS PER MILLILITER:	**1,120**	**1,930**	

NOTES: Since the last sampling event, algal density decreased at both sites, but is still considered high. Algal diversity increased at both sites and is now high. The assemblage consists mainly of green algae with some lower amounts of diatoms, golden algae, euglenoids, and dinoflagellates. Trace amounts of blue-green algae was found at site B. Water clarity increased and is now fair at both sites.



Phytoplankton Distribution Site A
2.60%
1.80%
7.20%
12.50%
75.90%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids



Phytoplankton Distribution Site B
0.70%
6.50%
1.50%
9.40%
81.90%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

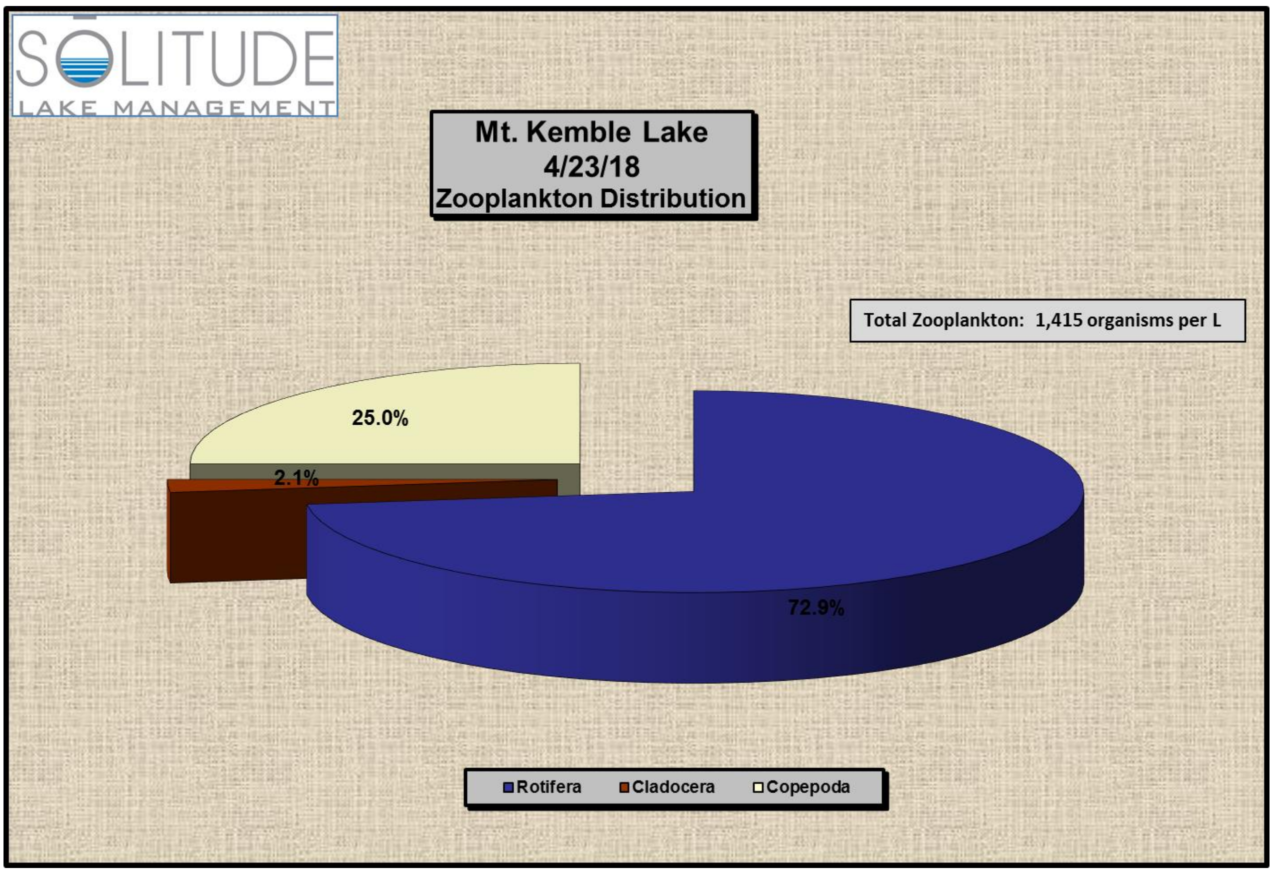
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS

Zooplankton Count Results

Site: Mt. Kemble Lake **Date: 4/23/18**

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	*Keratella*	1		7	2.67	2667	68.8	39
		Synchaetidae	*Polyarthra*	12	5	9	8.67	8667	68.8	126
		Trichocercidae	*Trichocerca*	1			0.33	333	68.8	5
	Flosculariacea	Conochilidae	*Conochilus*	55	61	62	59.33	59333	68.8	862
									Total:	**1032**
Cladocera	**Cladocera**	Bodminidae	*Bosmina*	6			2.00	2000	68.8	29
									Total:	**29**
Copepoda	**Cyclopoida**	Cyclopoidae	*Microcyclops*	3			1.00	1000	68.8	15
			Cyclopoid	21	20	29	23.33	23333	68.8	339
									Total:	**354**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1415	1032	72.9%	29	2.1%	354	25.0%

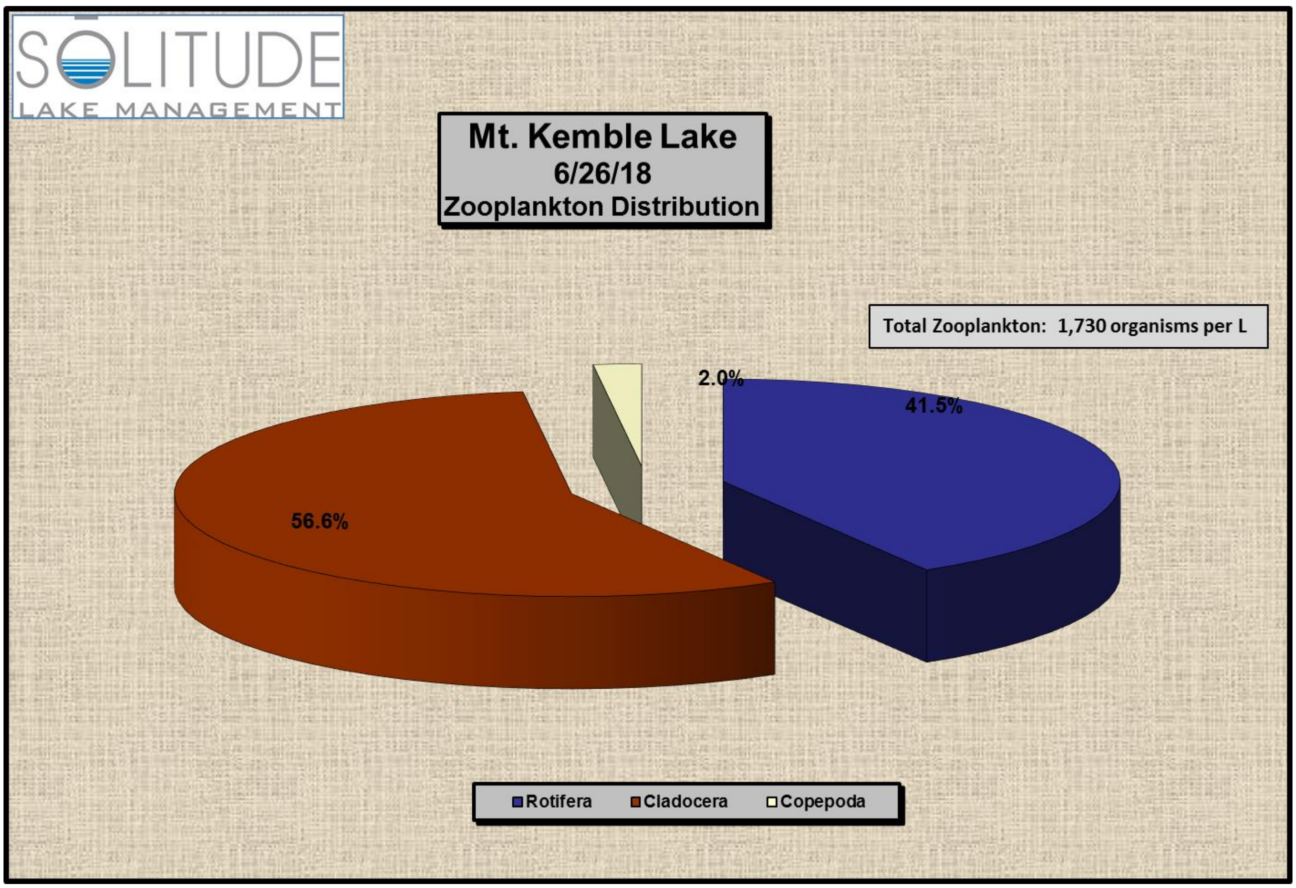


Zooplankton Count Results

Site: Mt. Kemble Lake **Date: 6/26/18**

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	*Keratella*	13	17	21	17.00	17000	68.8	247
			Kellicottia	1			0.33	333	68.8	5
		Synchaetidae	*Polyarthra*	4	9	10	7.67	7667	68.8	111
			Synchaeta	5			1.67	1667	68.8	24
		Asplanchnidae	*Asplanchna*	1	1	1	1.00	1000	68.8	15
		Trichocercidae	*Trichocerca*	7	9	11	9.00	9000	68.8	131
	Flosculariacea	Conochilidae	*Conochilus*	1	1	2	1.33	1333	68.8	19
		Testudinellidae	*Filinia*	4	14	16	11.33	11333	68.8	165
									Total:	**717**
Cladocera	**Cladocera**	Bodminidae	*Bosmina*	57	65	74	65.33	65333	68.8	950
		Daphniidae	*Ceriodaphnia*	3	3		2.00	2000	68.8	29
									Total:	**979**
Copepoda	**Cyclopoida**	Cyclopoidae	*Microcyclops*		2	2	1.33	1333	68.8	19
			Cyclopoid	1	2		1.00	1000	68.8	15
									Total:	**34**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1730	717	41.5%	979	56.6%	34	2.0%

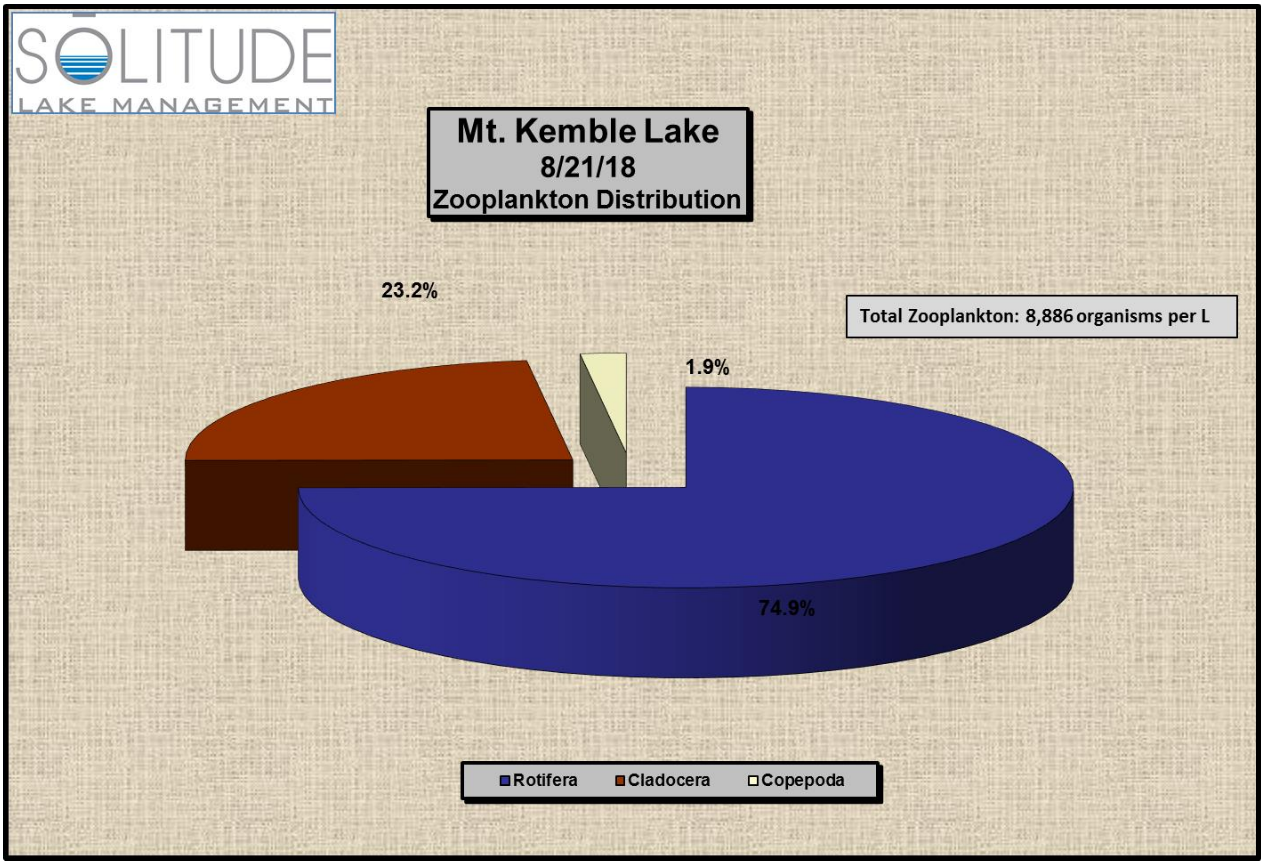


Zooplankton Count Results

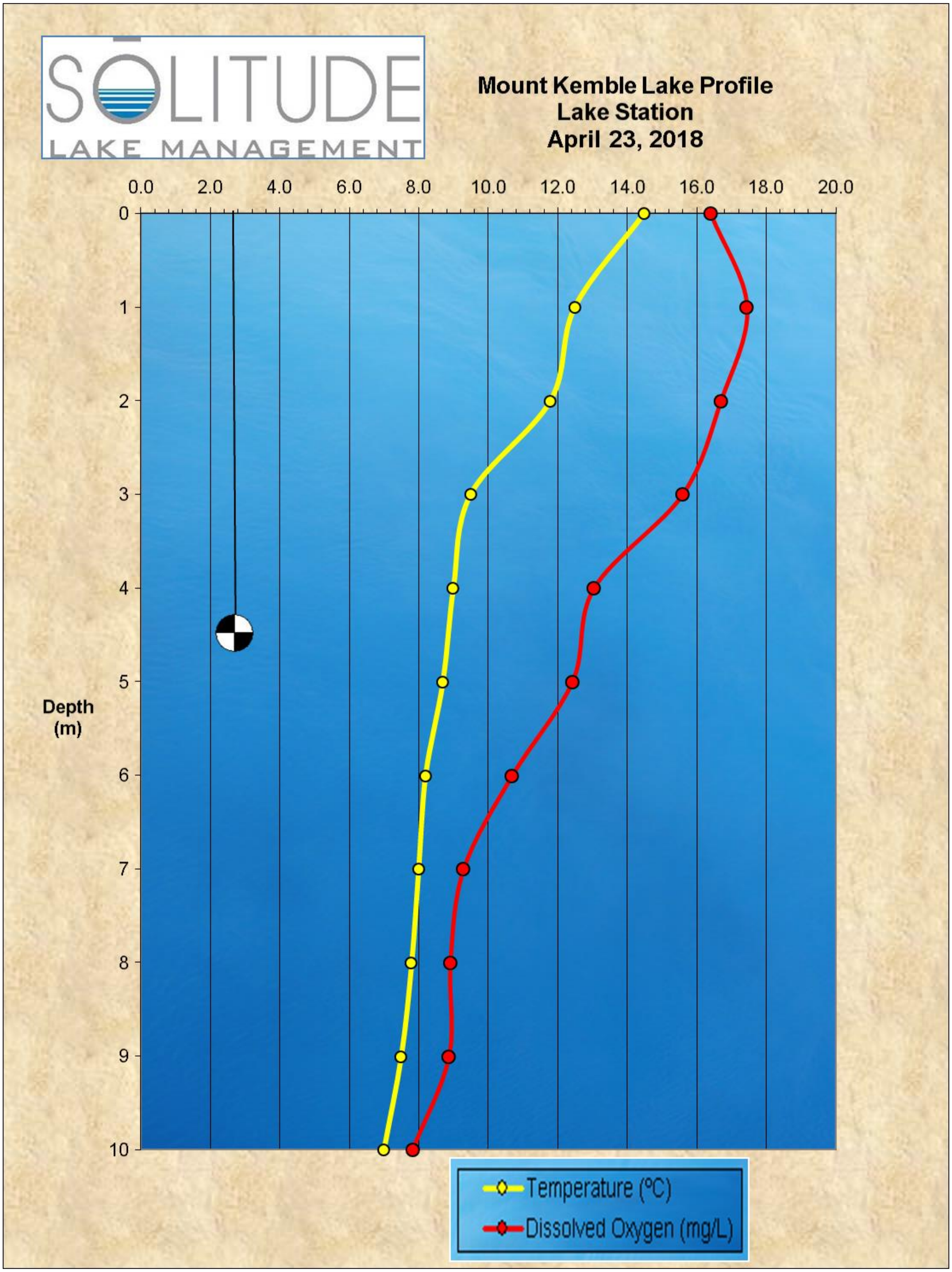
Site: Mt. Kemble Lake **Date: 8/21/18**

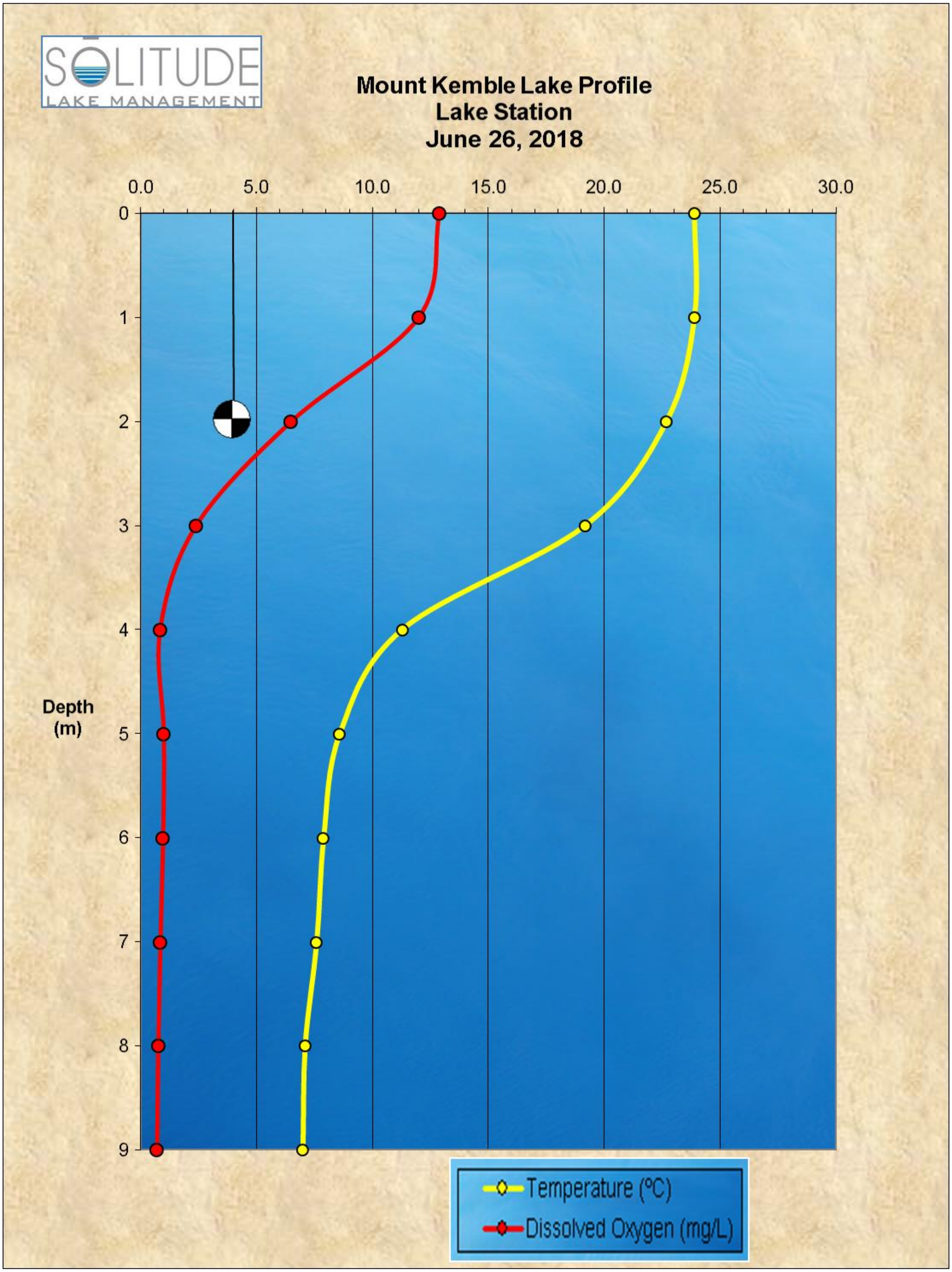
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Brachionidae	*Keratella*	134	135	124	131.00	131000	68.8	1904
			Brachionus	47	31	43	40.33	40333	68.8	586
		Synchaetidae	*Polyarthra*	60	57	60	59.00	59000	68.8	858
			Synchaeta	1	9	8	6.00	6000	68.8	87
		Asplanchnidae	*Asplanchna*	3	2	4	3.00	3000	68.8	44
		Trichocercidae	*Trichocerca*	2	2	1	1.67	1667	68.8	24
	Flosculariacea	Conochilidae	*Conochilus*	169	248	232	216.33	216333	68.8	3144
		Hexarthridae	*Hexarthra*	1		1	0.67	667	68.8	10
									Total:	**6657**
Cladocera	**Cladocera**	Bodminidae	*Bosmina*	156	114	145	138.33	138333	68.8	2011
		Daphniidae	*Ceriodaphnia*	5	1	4	3.33	3333	68.8	48
									Total:	**2059**
Copepoda	**Cyclopoida**	Cyclopoidae	*Microcyclops*	2	5	2	3.00	3000	68.8	44
			Cyclopoid	12	10	4	8.67	8667	68.8	126
									Total:	**170**

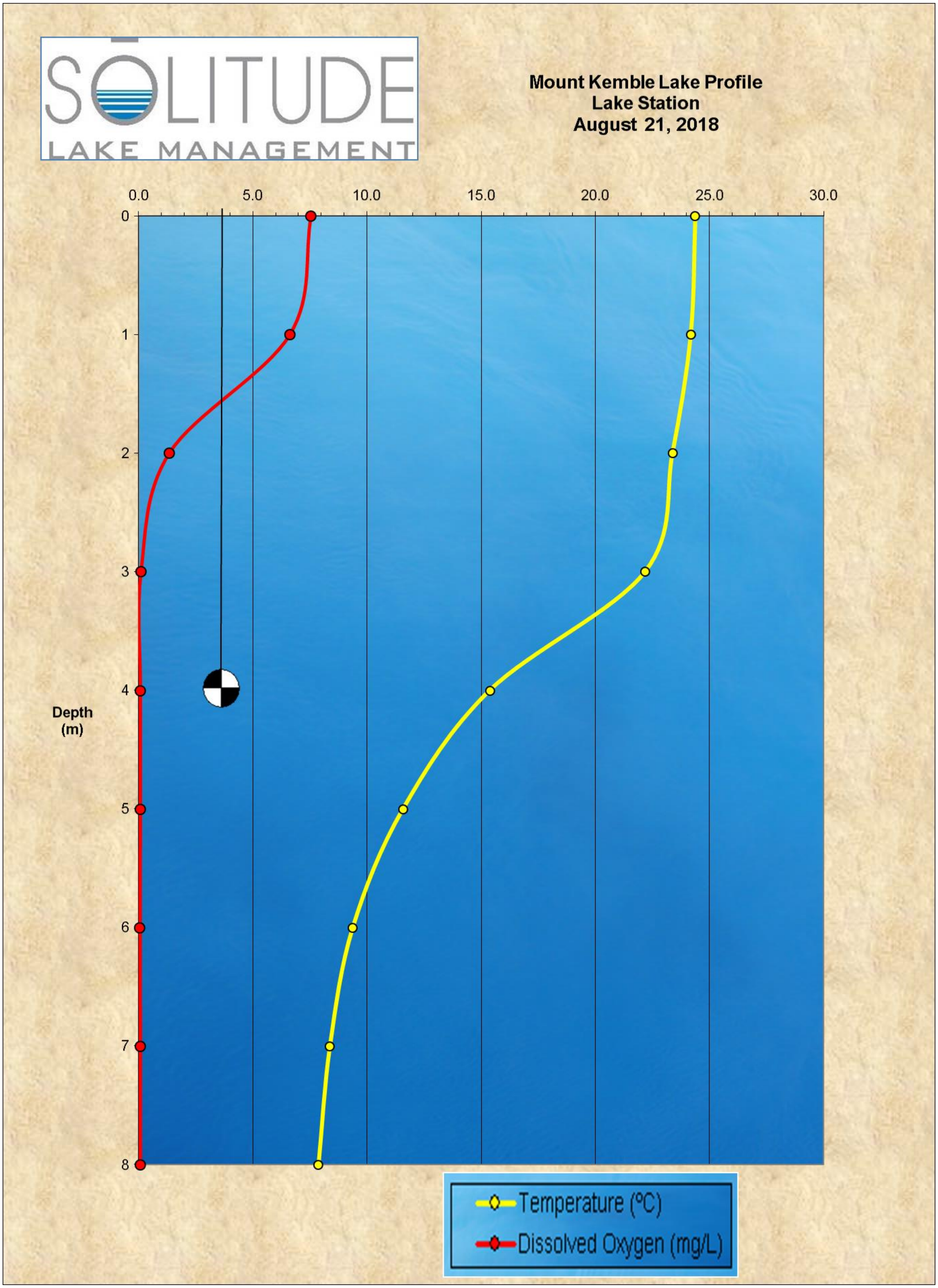
Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
8886	6657	74.9%	2059	23.2%	170	1.9%



APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES




SOLITUDE
LAKE MANAGEMENT
Mount Kemble Lake Profile
Lake Station
June 26, 2018
0.0
5.0
10.0
15.0
20.0
25.0
30.0
0
1
2
3
4
5
6
7
8
9
Depth (m)
Temperature (ºC)
Dissolved Oxygen (mg/L)


SOLITUDE
LAKE MANAGEMENT
Mount Kemble Lake Profile
Lake Station
August 21, 2018
0.0
5.0
10.0
15.0
20.0
25.0
30.0
0
1
2
3
4
5
6
7
8
Depth
(m)
Temperature (ºC)
Dissolved Oxygen (mg/L)