Mount Kemble Lake

2020 Year End Water Quality Summary

Mount Kemble Lake Association, Inc.

Morristown, NJ

November 24, 2020

Fred Luberto
Mount Kemble Lake Association
10 Lake Trail West
Morristown, NJ 07960

YEAR END SUMMARY
2020 WATER QUALITY PROGRAM
MOUNT KEMBLE LAKE

INTRODUCTION

The following is the 2020 Year-End Summary of the Water Quality Monitoring and Lake Management 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 2021 season. The Appendix of this report includes graphs and tables of field data, reference guides, along with supporting documents for this report.

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*) during the 2020 season. 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. 2020 Observed Aquatic Macrophytes.

Weather Discussion

In 2020, the weather was largely unpredictable in terms of rainfall, but one trend that was consistent was warm temperatures. 2020 was the 2nd warmest summer since 1895 and some of the warmest weather occurred in July, which was the warmest month ever recorded. The early months of the year were part of one of the warmer winters as well, which led to in increase in holdover plant growth from the previous season and led to more overall growth in the early season (Figure 1 Rutgers Climate Lab). Precipitation for the year was unpredictable as rainfall totals overall were on par with an average season, however, rainfall often occurred in large quantities followed by a long stretch of no rainfall. For the most part, it was a dry summer as many waterbodies were very low especially towards the end of the season. Levels were so low that the early August tropical storm still did not refill some waterbodies. (Figure 2 Rutgers Climate Lab).

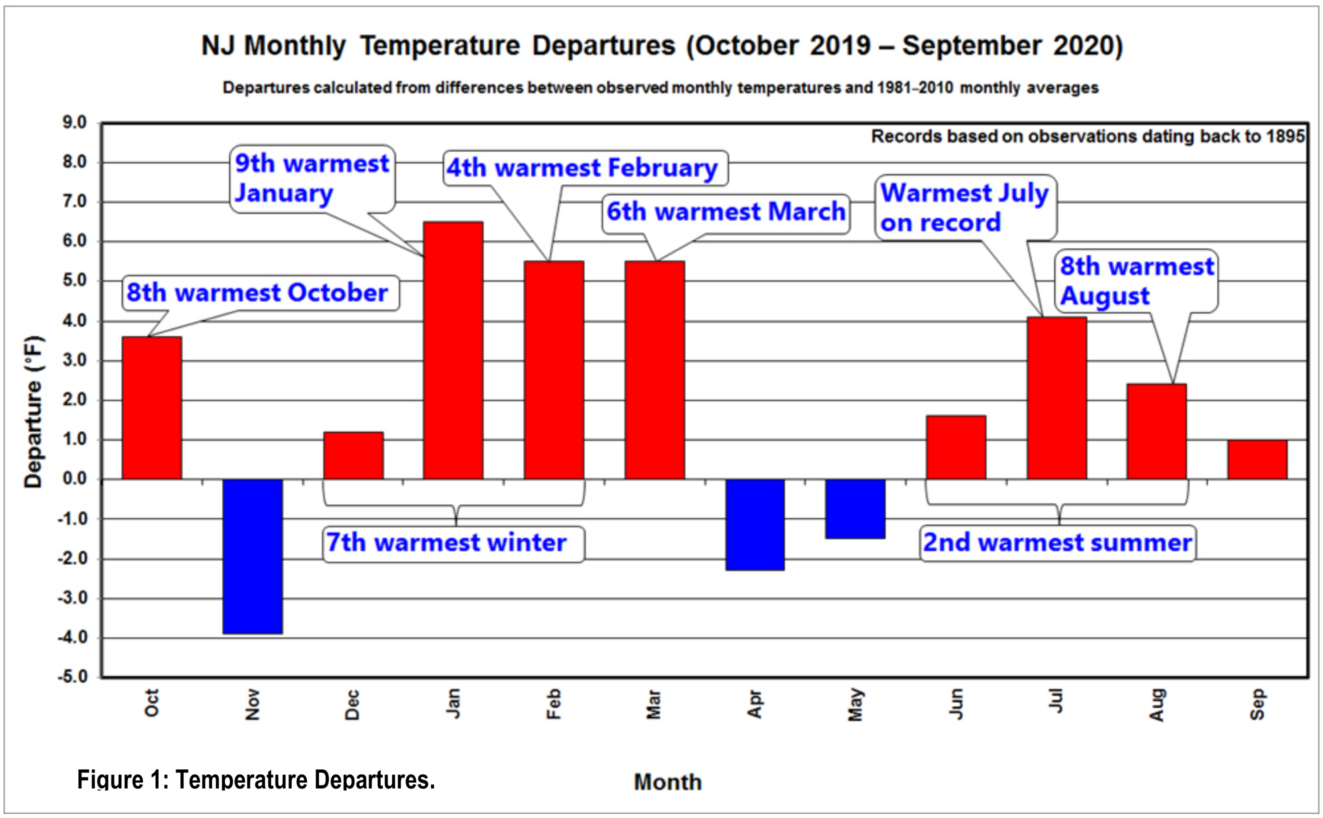


Figure 1: Temperature Departures.

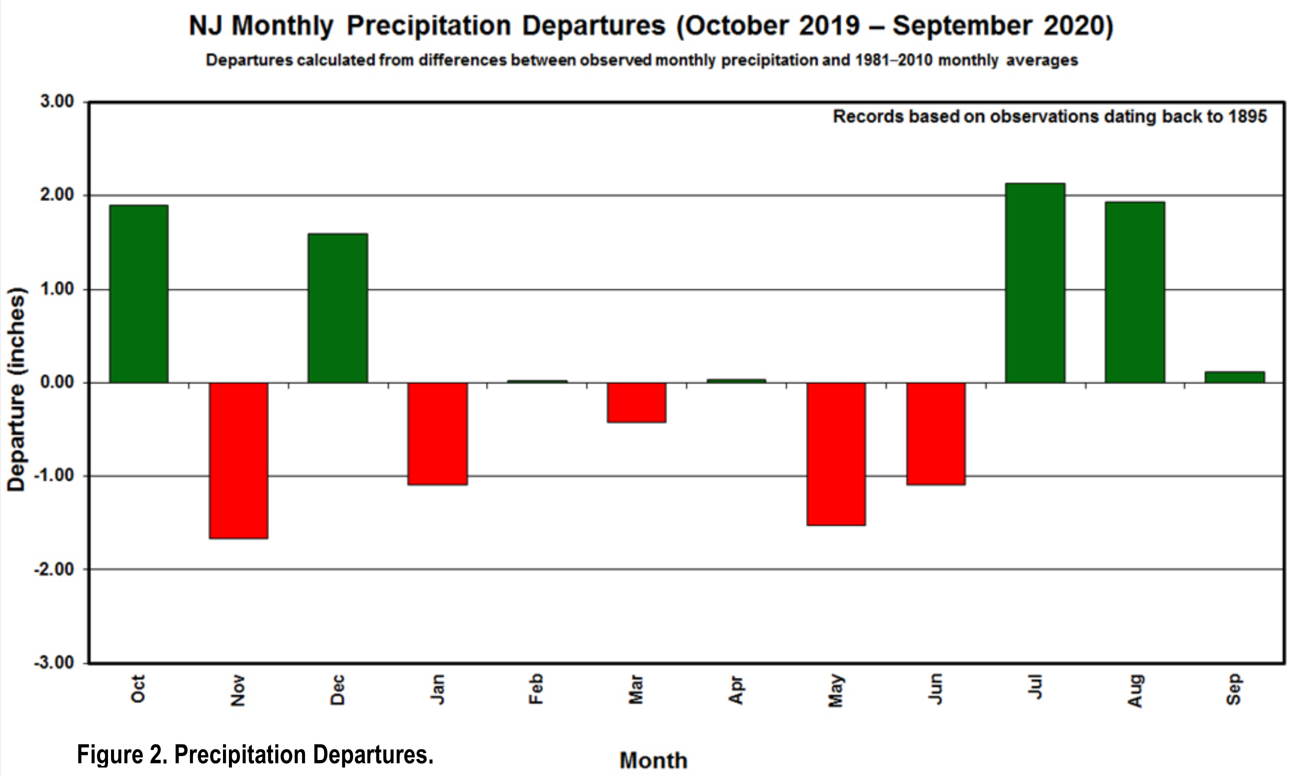


Figure 2. Precipitation Departures.

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) of the ten (10) 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. Following each survey, biologists would review lake conditions to determine if management activity was required or requested. In 2020, SŌLitude Lake Management field staff conducted herbicide or algaecide applications for control of nuisance and invasive aquatic vegetation growth during three (3) of the total visits throughout the season. 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
5/8/2020	Tribune	2	Curly-leaf Pondweed
7/21/2020	Copper Sulfate	6.5	Unicellular algae
9/1/2020	Copper Sulfate	6.5	Unicellular algae

Table 2: Mount Kemble Lake 2020 Treatment Log

In early May marked the first treatment of the season and at that time the lake supported small patches of curly-leaf pond weed (*P. crispus*) primarily along portions of both the east and west shorelines. The growth was limited along those shorelines to include the northern third of the lake. There was limited algae growth observed during this visit so an algae treatment was not necessary. **Tribune** was utilized to reduce the shoreline plant growth. The next lake treatment was performed on July 21st , which reported the previous treatment of curly-leaf pondweed was successful as only a few stems were remaining. During this particular visit the lake was supporting growth of unicellular algae within the water column reducing the overall clarity of the lake. Treatment for algae was performed using **Copper Sulfate**. The lake remained in good condition until the beginning of September in which the lake survey reported moderate growth of unicellular algae once again. An application was conducted with **Copper Sulfate** as a means to control the unicellular algae growth. There limited observable plant growth at the time of the survey. Surveys conducted for the remainder of the year reported minimal plant or algae growth that did not warrant any treatments.

Water Quality Monitoring Program

In 2020, 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**	**4/16/2020**	**6/23/2020**	**8/24/2020**	**Limits**
Temperature	ºC	12.1	27.0	26.6	NA
Dissolved Oxygen	mg/L	10.94	11.31	8.79	<4.0
pH	SU	7.50	8.50	8.50	9
Alkalinity	mg/L	76	76	80	NA
Total Hardness	mg/L	210	220	260	NA
Transparency	feet	5.0	4.0	6.0	<4'
Ammonia	mg/L	0.052	ND	0.098	0.3
Conductivity	umhos/cm	290	320	310	1500
Nitrate	mg/L	0.632	0.168	ND	0.3
Total Phosphorous	mg/L	0.057	0.028	0.021	0.03
Total Suspended Solids	mg/L	ND	ND	ND	25

Table 3. 2020 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**	**4/16/2020**	**6/23/2020**	**8/24/2020**	**Limits**
Temperature	ºC	6.8	8.9	9.9	NA
Dissolved Oxygen	mg/L	8.50	0.15	0.40	<4.0
pH	SU	7.5	7.0	6.5	9
Alkalinity	mg/L	84	104	120	NA
Total Hardness	mg/L	160	160	140	NA
Transparency	feet	5.0	4.0	6.0	<4'
Ammonia	mg/L	0.183	1.25	2.37	0.3
Conductivity	umhos/cm	320	330	350	1500
Nitrate	mg/L	0.592	ND	ND	0.3
Total Phosphorous	mg/L	0.030	0.076	0.203	0.03
Total Suspended Solids	mg/L	ND	33.0	24.0	25

Table 4. 2020 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**	**4/16/2020**	**6/23/2020**	**8/24/2020**	**Limits**
Total Phosphorous	mg/L	0.057	0.045	0.036	0.03

Table 5. 2020 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**	**4/16/2020**	**6/23/2020**	**8/24/2020**	**Limits**
Total Phosphorous	mg/L	0.033	0.069	0.060	0.03

Table 6. 2020 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**	**4/16/2020**	**6/23/2020**	**8/24/2020**	**Limits**
Total Phosphorous	mg/L	0.036	0.083	0.056	0.03

Table 7. 2020 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**	**4/16/2020**	**6/23/2020**	**8/24/2020**	**Limits**
Total Phosphorous	mg/L	0.052	0.070	0.055	0.03

Table 8. 2020 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**	**4/16/2020**	**Limits**
Total Phosphorous	mg/L	0.037	0.03

Table 9. 2020 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**	**4/20/2020**	**Limits**
Total Phosphorous	mg/L	0.030	0.03

Table 10. 2020 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 2020, the surface water temperature was 12.1° C in April, and by August the temperature had increased to 26.6 ˚C, however, the warmest temperature of the summer was recorded in June at 27.0 °C. The pH values collected from the inlet and lake station sites throughout the year were consistent with a small range of 6.5 to 7.5, which falls within the typical range for freshwater lake systems, and is slightly lower than the historical readings of the past several years for Mt. Kemble Lake. The hardness levels were similar to last year, ranging from 210 mg/L to 260 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. This season saw these numbers increase about 200 mg/L for the entire season. Readings from the lake bottom, however, were more on par with what is typically expected for Mt. Kemble Lake.

The chemical composition of Mt. Kemble Lake’s surface water is considered moderately hard water. The alkalinity values remained consistent throughout the year from 76 to 80 mg/L, and within a comparable level compared to similar NJ freshwater lakes’ chemical composition. These numbers were very similar to observations made from the data collected the previous season. Conductivity was consistent throughout the season with values ranging from 290 to 350 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 both samples in April from the surface and bottom sampling stations. Although levels were higher than normal it did not seem to have adverse effects on the lake. 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.

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 2020, the phosphorus levels were higher overall than what was reported was in 2019. Samples from the bottom station were elevated for all sampling events, while the April sampling was elevated for the surface station. The other two samples for the rest of the season were within the acceptable range.

During the 2020 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 2020 season every sample collected from all of the locations reported numbers that were above the acceptable threshold, some being nearly triple what is acceptable. Some of the lake samples were more elevated than in previous years so there is potential that a new source of phosphorus is entering the inlet stream leading to this increase.

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 little variability in 2020, with observed secchi readings between 4 and 6 feet. Mt. Kemble Lake typically supports lake conditions that favor relatively high water clarity readings, however, in 2019 these were uncharacteristically low. 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. In 2020 the numbers were lower than usual, but closer to what is expected with a range of 4 feet to 6 feet. Total suspended solids were all below the thresholds throughout the season for Mt. Kemble Lake.

Lake Profile Description

	4/16/2020		6/25/2020		8/24/2020	
Depth (ft)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
Surface	12.1	10.94	27.0	11.31	26.6	8.79
2	12.1	10.94	26.0	11.09	26.3	8.74
4	12.0	11.00	25.5	11.45	26.3	8.70
6	11.9	11.00	24.0	11.68	25.0	5.25
8	11.8	11.00	21.1	8.58	24.5	3.81
10	11.7	10.82	17.4	11.29	23.8	0.50
12	11.6	10.82	13.7	4.80	20.0	0.33
14	9.5	9.00	12.8	1.20	16.5	0.29
16	8.8	8.47	10.1	0.16	12.9	0.25
18	8.7	8.70	8.9	0.15	11.6	0.21
20	6.8	8.50	NA	NA	9.9	0.40

Table 12. 2020 Mt. Kemble Lake Profiles

In 2020, 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. 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. 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, however, during the last monitoring event the dissolved oxygen levels were depleted after a depth of only 6 feet, which is something that typically happens during the season. Complete profile graphs are provided in the Appendix of this report.

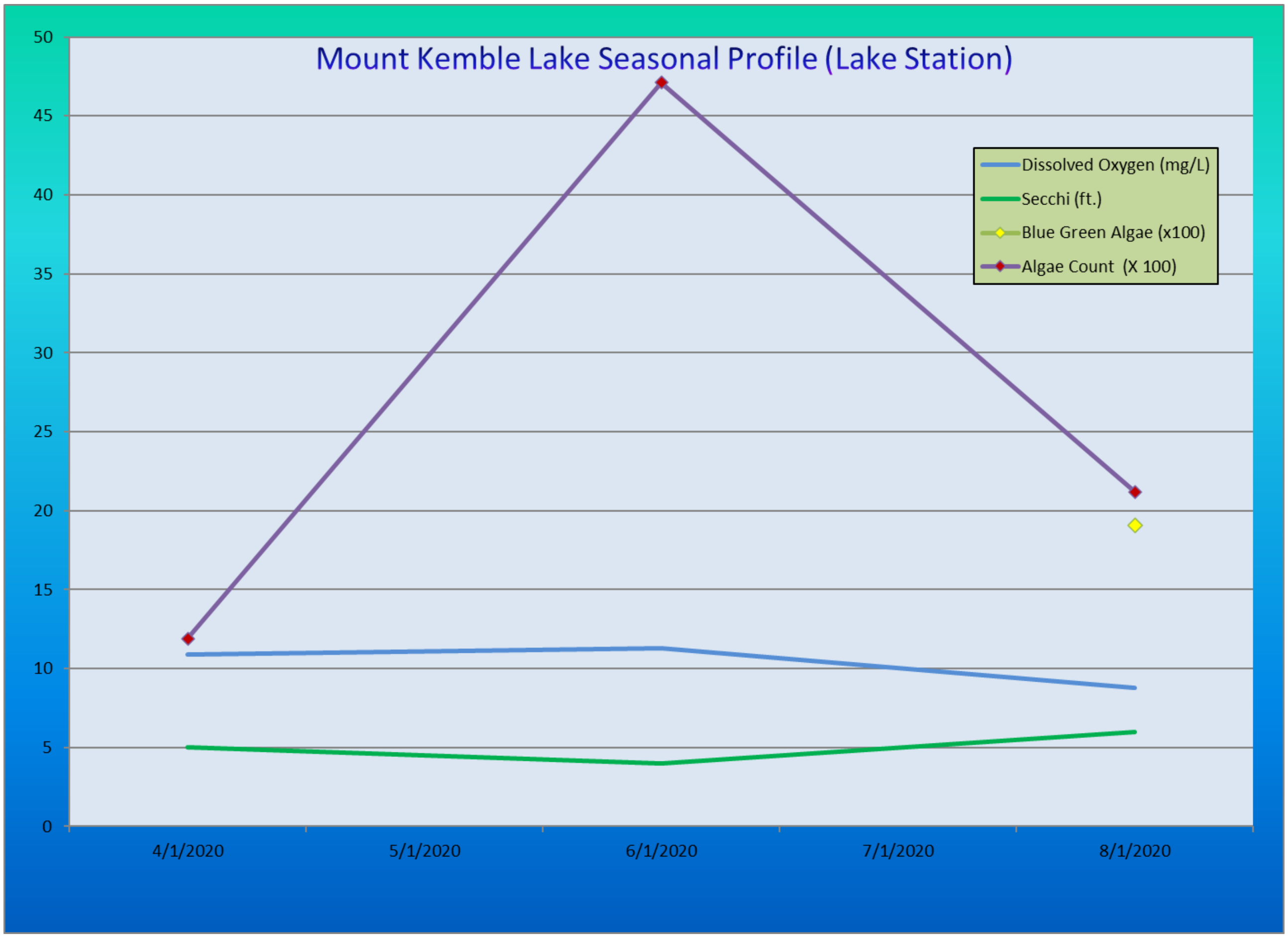


Figure 3. Mount Kemble Lake Seasonal Profile

Plankton Surveys

Phytoplankton and Zooplankton surveys were conducted at Mount Kemble Lake in conjunction with the water quality monitoring program. In 2020, 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 2020 microscopic examination data sheets and graphs are provided in the Appendix. In 2020, 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.

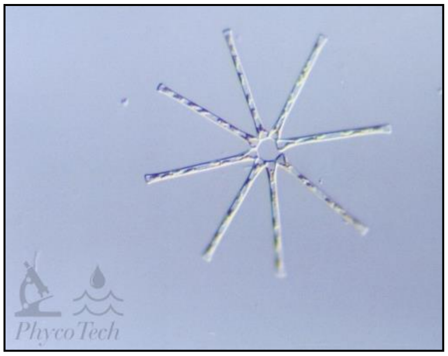
A Phytoplankton Primer

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 2020 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.

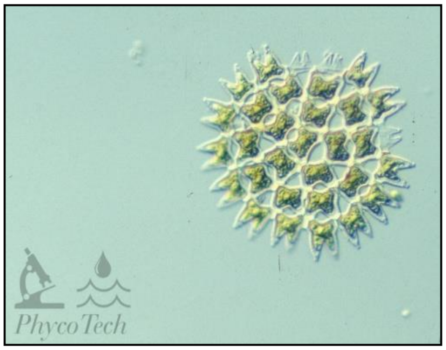
Macroscopic multi-branched phytoplankton appears to be submersed plants, especially when viewed in the water column. Physical examination reveals simple structures, no conductive tissue, and a lack of roots (instead having simplified rhizoids). Although typically only reaching heights of a few inches,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

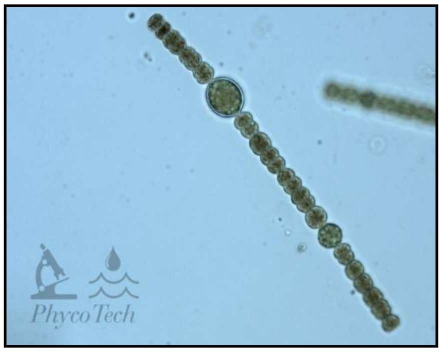


Diatoms are ubiquitous as a group, and often possess a rigid silica shell with ornate cell wall markings or etchings. The silica shells settle to the bottom substrate after they die, and under ideal conditions can become stratified. Limnologists can then study historical (and possibly even ancient) population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

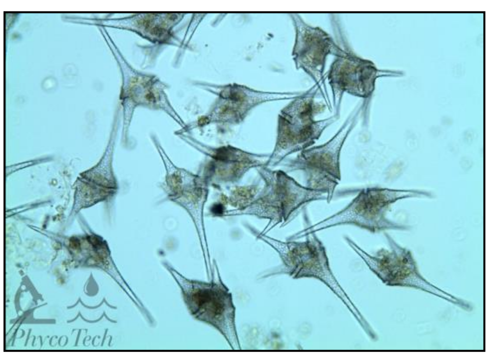


Green Algae are a very diverse group of unicellular phytoplankton. There is tremendous variability in this group which varies from family to family and sometimes even genus to genus. There are flagellated single cells, multi-cell colonies (some motile), filamentous forms and attached forms, typically 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 2020, 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, respectively. Golden Algae accounted for the majority of both observed genera at both sample sites with the most dominant being, *Dinobryon*. The second sampling occurred in June and at the time the inlet station was supporting a high density of algal growth as was the same for the lake station. Of the three samplings, this was the one that reported the most algal growth in both locations. Diversity had increased slightly to nine (9) genera at the inlet station and to seven (7) genera at the lake station. The most commonly observed genera was the green algae, *Ankistodesmus*.

Algal Group			
% Abundance	**4/16/20**	**6/23/20**	**8/24/20**
Diatoms	20.8%	0.8%	
Golden Algae	**79.2%**	0.5%	0.6%
Protozoa		0.3%	
Green Algae		**94.9%**	5.9%
Blue-green Algae			**92.4%**
Dinoflagellates		3.5%	1.1%
Euglenoids			
Total Orgs / mL	**240**	**3700**	**1700**

Table 13. Mt. Kemble Phytoplankton Assemblage Inlet

For the August sampling event, the phytoplankton density decreased to be considered moderate at both locations. The inlet station saw diversity remain the same at nine (9) genera, while the diversity decreased slightly at the lake sampling location to finish the final sampling with six (6) observed genera. The late season sampling reported that most of both samples consisted of blue-green algae. The most commonly observed was the same for both samples and was the genera, *Aphanizomenon*. In comparison to 2019, there tended to be more growth of phytoplankton throughout the season.

Algal Group			
% Abundance	**4/16/20**	**6/23/20**	**8/24/20**
Diatoms	7.3%		
Golden Algae	**91.7%**	0.6%	
Protozoa		0.25%	
Green Algae	1.0%	**94.9%**	4.6%
Blue-green Algae		0.25%	**87.2%**
Dinoflagellates		4.0%	8.2%
Euglenoids			
Total Orgs. / mL	**1090**	**4740**	**2190**

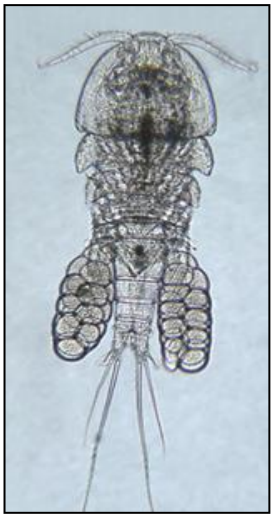
Table 14. Mt. Kemble Phytoplankton Assemblage Lake Station

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.

2020 Zooplankton Results

Zooplankton Group	4/16/2020	6/23/2020	8/24/2020
Rotifers	**73.1%**	**99.8%**	**97.6%**
Cladocera	7.5%	0.0%	1.2%
Copepoda	19.4%	0.2%	1.2%
Total Zooplankton (Orgs. / mL)	649	2471	23425

Table 16. Mount Kemble Lake 2020 Zooplankton Group Percent Abundance Distribution

In April, overall zooplankton density was 649 organisms per milliliter, which is considered moderate, but sample diversity was moderate to high with ten (10) different genera observed. At this time Rotifers accounted for approximately three quarters of the total sample at 73.1% of the total zooplankton community with *Keratella* 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 just under a quarter of the total sample.

The June sampling once again revealed a high density of zooplankton as there were 2471 organisms per milliliter. The Rotifer genera were the most commonly found accounting for nearly the entire sample at 99.8% of the total with the genera *Kellicottia* being the most commonly found within the group. At this time zooplankton diversity is considered moderate to high as a total of nine (9) different genera were found in the sample. Copepoda accounted for 0.2% of the total sample. The Cladocera genera only accounted for 0% of the total sample as there were none observed.

The final sampling of the season showed that the zooplankton composition was considered moderate as seven (7) different genera were observed once. The density of zooplankton observed was very high with a total of 23425 orgs/mL. Rotifers made up 97.6% of the zooplankton composition with *Kellicottia* being the most abundant in the sample. The Cladocerans made up a very small portion of the of the total sample at 1.2%. The same percentage of Copepoda was observed in the sample. Overall, rotifers dominate the zooplankton community in Mt. Kemble Lake.

Discussion

The 2021 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. Plant growth in 2020 was similar to what was observed the previous year as only one (1) treatment was necessary to provide season long control. **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.

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 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 2020, two (2) **Copper Sulfate** treatments were conducted as growth of unicellular algae was reducing the water clarity. In 2019 the algae growth was primarily filamentous so there was a shift in the type of algal growth observed this year. 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. Planktonic algal densities were increased in the 2020 season, and if this continues in the future, 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 2021 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 two (2) of the three (3) sampling events. Alum was not applied in 2020, but should be considered for 2021 to reduce the nutrients available for planktonic algae to grow. Alum is strongly recommended in 2021 as not only were water clarity and algae growth reduced, overall phosphorus levels were much lower in 2019 with 2020 reporting high phosphorus in all locations for the entire season. 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 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 2021 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

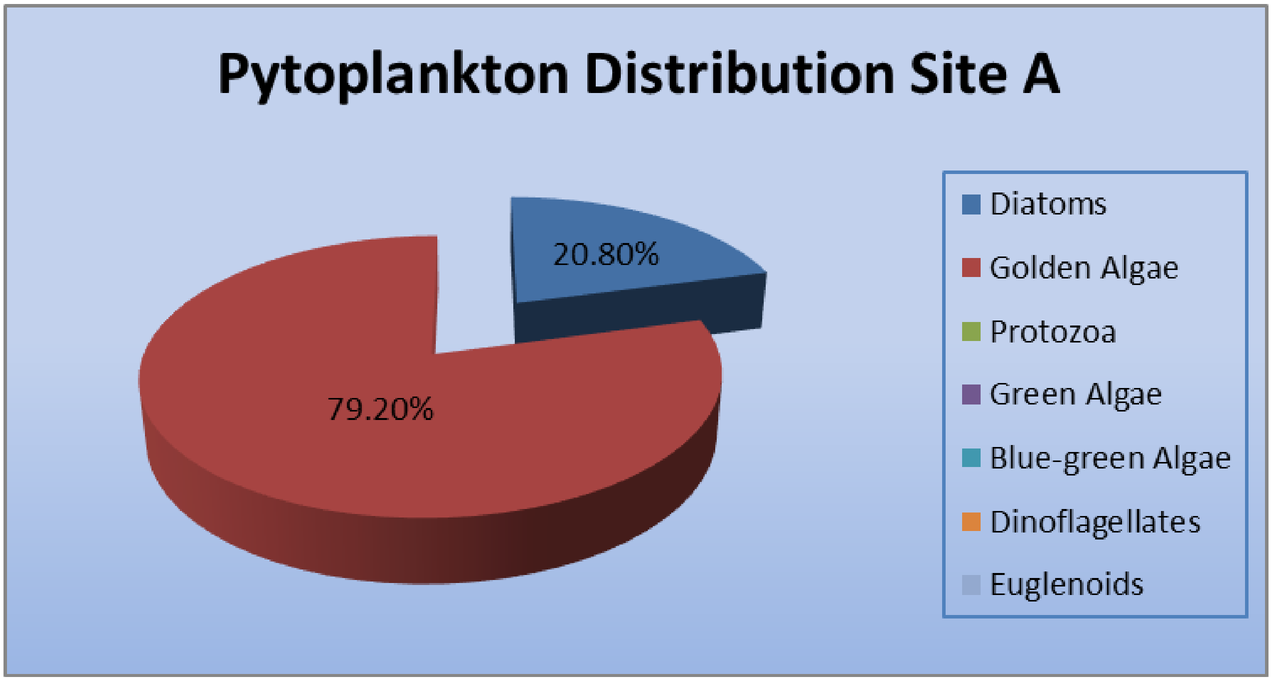
Sample from: Mt. Kemble Lake

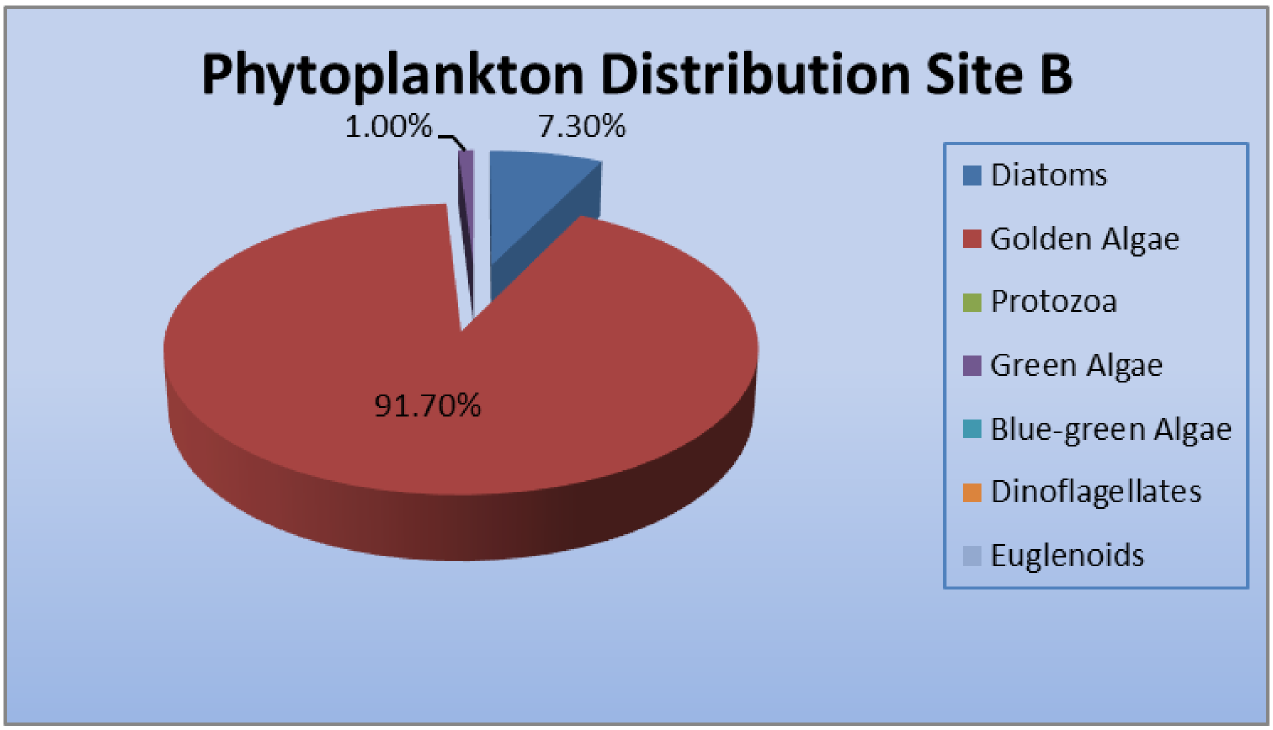
Collection Date: 04/16/20	Examination Date: 04/17/20	Amount Examined: 200 ml.
Site A: Inlet Station	Site B: Lake Station	Site C:

BACILLARIOPHYTA (Diatoms)	**A**	**B**	**C**	**CHLOROPHYTA (Green Algae)**	**A**	**B**	**C**	**CYANOPHYTA (Blue-green Algae)**	**A**	**B**	**C**
Asterionella	20	10		*Ankistrodesmus*				*Anabaena*			
Cyclotella	10			*Chlamydomonas*				*Anacystis*			
Cymbella				*Chlorella*				*Aphanizomenon*			
Diatoma				*Chlorococcum*				*Coelosphaerium*			
Fragilaria		50		*Closterium*				*Gomphosphseria*			
Melosira				*Coelastrum*				*Lyngbya*			
Navicula				*Eudorina*				*Microcystis*			
Nitzschia				*Mougeotia*				*Oscillatoria*			
Pinnularia	10			*Oedogonium*				*Pseudoanabaena*			
Urosolenia				*Oocystis*				*Synechocystis*			
Stephanodiscus				*Pandorina*				*Agmenellum*			
Stauroneis				*Pediastrum*							
Synedra	10	20		*Phytoconis*				**PROTOZOA**			
Tabellaria				*Rhizoclonium*				*Actinophyrs*			
Cocconeis				*Scenedesmus*							
CHRYSOPHYTA (Golden Algae)	**A**	**B**	**C**	*Spirogyra*				**EUGLENOPHYTA (Euglenoids)**	**A**	**B**	**C**
				Staurastrum							
Dinobryon	180	990		*Sphaerocystis*				*Euglena*			
Mallomonas	10	10		*Ulothrix*				*Phacus*			
Synura				*Gloeocystis*		10		*Trachelomonas*			
Tribonema				*Zygnema*							
Uroglenopsis				*Aulacoseira*							
				Microtinium				**PYRRHOPHYTA (Dinoflagellates)**	**A**	**B**	**C**
				Cosmerium							
								Ceratium			
								Peridinium			

SITE	**A**	**B**	**C**
TOTAL GENERA:	6	6	
TRANSPARENCY:	5.0’	5.0’	
ORGANISMS PER MILLILITER:	**240**	**1,090**	

NOTES: This is the first sampling event of 2020. Algal diversity is considered moderate at this time. Algal density is considered low at site A and high at site B. The assemblage is dominated by golden algae, which is typical for early spring. Traces of diatoms and green algae (site B only) were also observed. Water clarity is considered fair at both sites.


Pytoplankton Distribution Site A
20.80%
79.20%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
1.00%
7.30%
91.70%
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
Asterionella			
Cyclotella			
Cymbella			
Diatoma			
Fragilaria			
Melosira			
Navicula			
Nitzschia			
Pinnularia	10		
Urosolenia			
Stephanodiscus			
Stauroneis			
Synedra	20		
Tabellaria			
Cocconeis			

CHRYSOPHYTA (Golden Algae)	A	B	C
Dinobryon	20	30	
Mallomonas			
Synura			
Tribonema			
Uroglenopsis			

CHLOROPHYTA (Green Algae)	A	B	C
Ankistrodesmus	3480	4470	
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium			
Coelastrum		10	
Eudorina			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina	10		
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus	10		
Spirogyra			
Staurastrum			
Sphaerocystis			
Ulothrix			
Volvox			
Zygnema			
Aulacoseira			
Microtinium			
Cosmerium			
Gloeocystis	10		
Golenkinia		20	

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

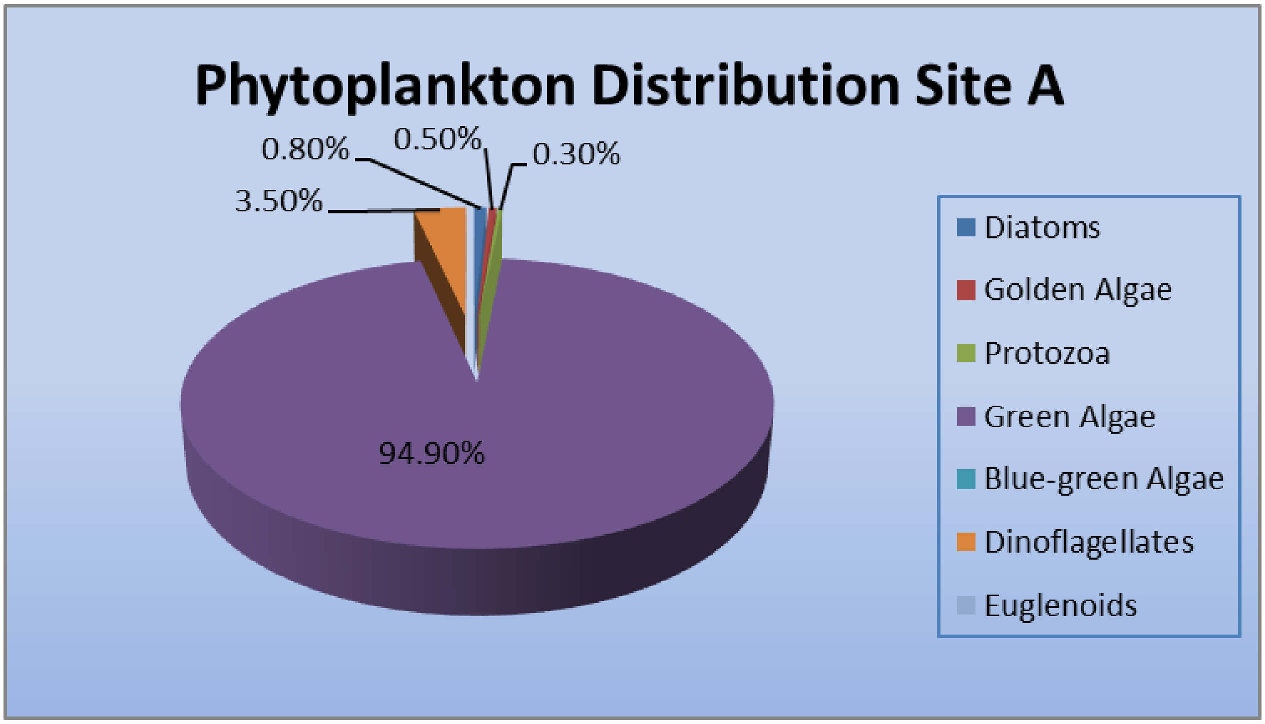
PROTOZOA	A	B	C
Actinophyrs	10	10	

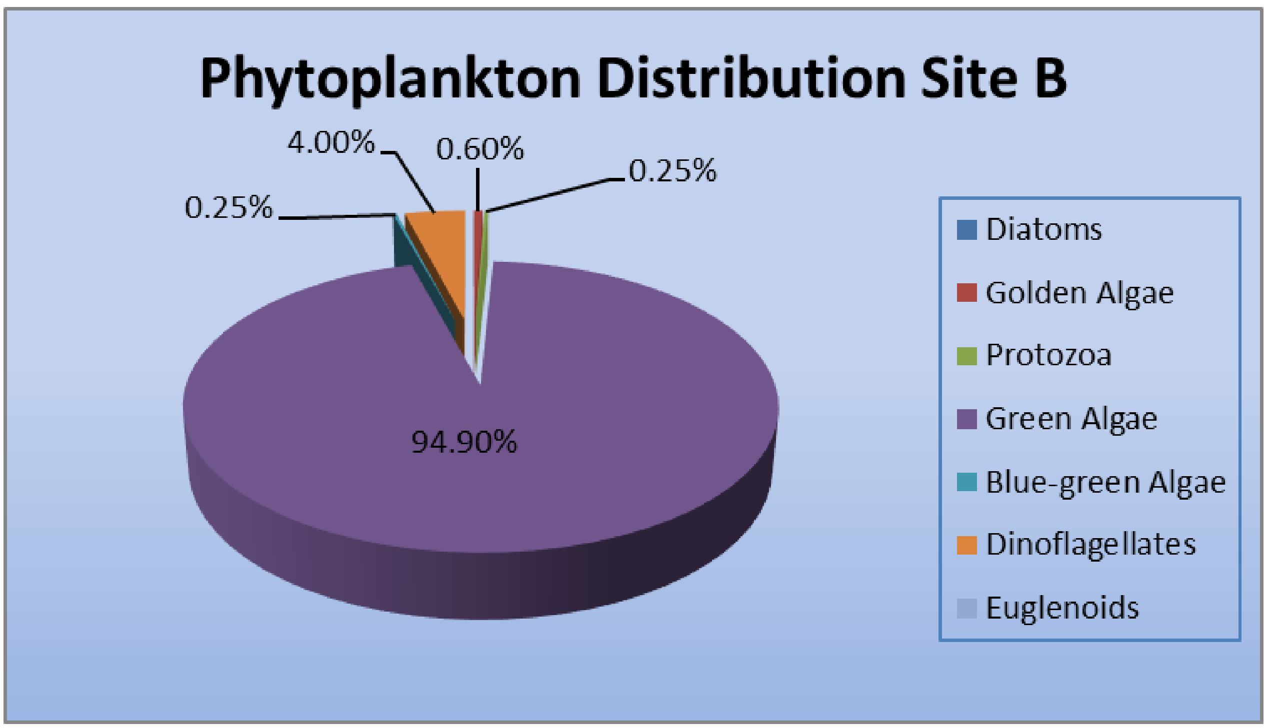
EUGLENOPHYTA (Euglenoids)	A	B	C
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	A	B	C
Ceratium			
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
0.80%
0.50%
0.30%
3.50%
94.90%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
4.00%
0.60%
0.25%
0.25%
94.90%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

MICROSCOPIC EXAMINATION OF WATER

Sample from: Mt. Kemble Lake		
Collection Date: 8/24/20	Examination Date: 8/25/20	Amount Examined: 200 ml.
Site A: Inlet Station	Site B: Lake Station	Site C:

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

CHRYSOPHYTA (Golden Algae)	A	B	C
Dinobryon			
Mallomonas	10		
Synura			
Tribonema			
Uroglenopsis			

CHLOROPHYTA (Green Algae)	A	B	C
Ankistrodesmus			
Aulacoseira			
Chlamydomonas			
Chlorella			
Chlorococcum			
Closterium			
Coelastrum	50	50	
Cosmerium	10	30	
Eudorina	10	10	
Gloeocystis			
Golenkinia			
Microtinium			
Mougeotia			
Oedogonium			
Oocystis			
Pandorina			
Pediastrum			
Phytoconis			
Rhizoclonium			
Scenedesmus	20	10	
Spirogyra			
Staurastrum	10		
Sphaerocystis			
Ulothrix			
Volvox			
Zygnema			

CYANOPHYTA (Blue-green Algae)	A	B	C
Agmenellum			
Anabaena	10		
Anacystis			
Aphanizomenon	1,560	1,910	
Coelosphaerium			
Gomphosphseria			
Lyngbya			
Microcystis			
Oscillatoria			
Pseudoanabaena			
Synechocystis			

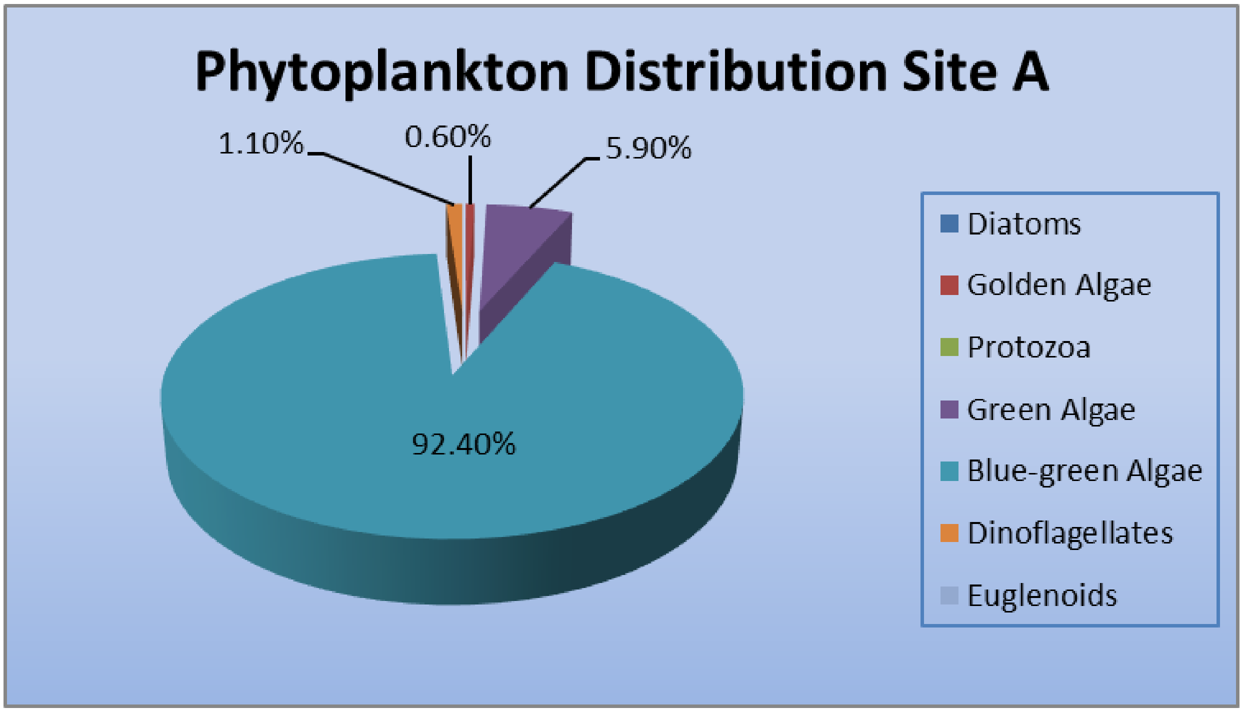
PROTOZOA	A	B	C
Actinophyrs			

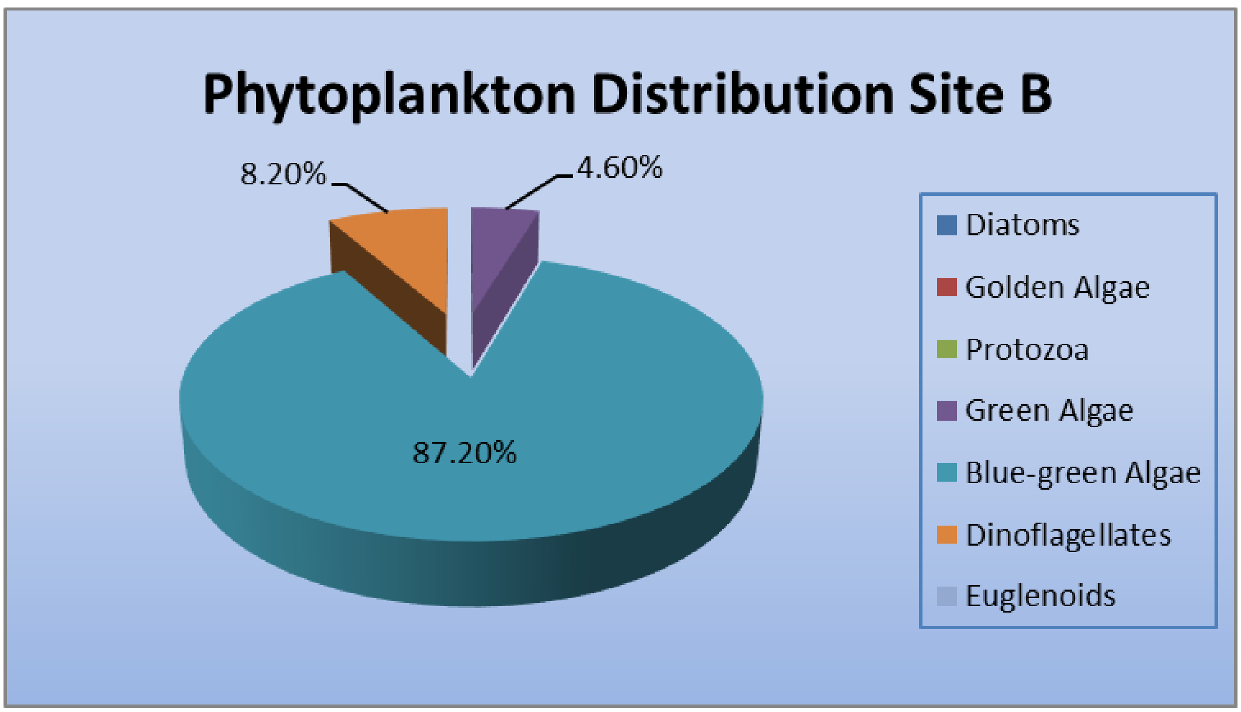
EUGLENOPHYTA (Euglenoids)	A	B	C
Euglena			
Phacus			
Trachelomonas			

PYRRHOPHYTA (Dinoflagellates)	A	B	C
Ceratium			
Peridinium	20	180	

SITE	A	B	C
TOTAL GENERA:	9	6	
TRANSPARENCY:	NA	6.0’	
ORGANISMS PER MILLILITER:	**1,700**	**2,190**	

NOTES: Since last sampling event, algal diversity remains the same at site A while site B decreased. Algal diversity continues to be moderate at both sites. Algal density decreased at each site but continues to be high. Blue-green algae, particularly *Aphanizomenon*, now dominates the assemblage. Golden algae (site A only), green algae, and dinoflagellates were observed. Water clarity increased at site B and is now considered to be fair to good.


Phytoplankton Distribution Site A
1.10%
0.60%
5.90%
92.40%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids


Phytoplankton Distribution Site B
8.20%
4.60%
87.20%
Diatoms
Golden Algae
Protozoa
Green Algae
Blue-green Algae
Dinoflagellates
Euglenoids

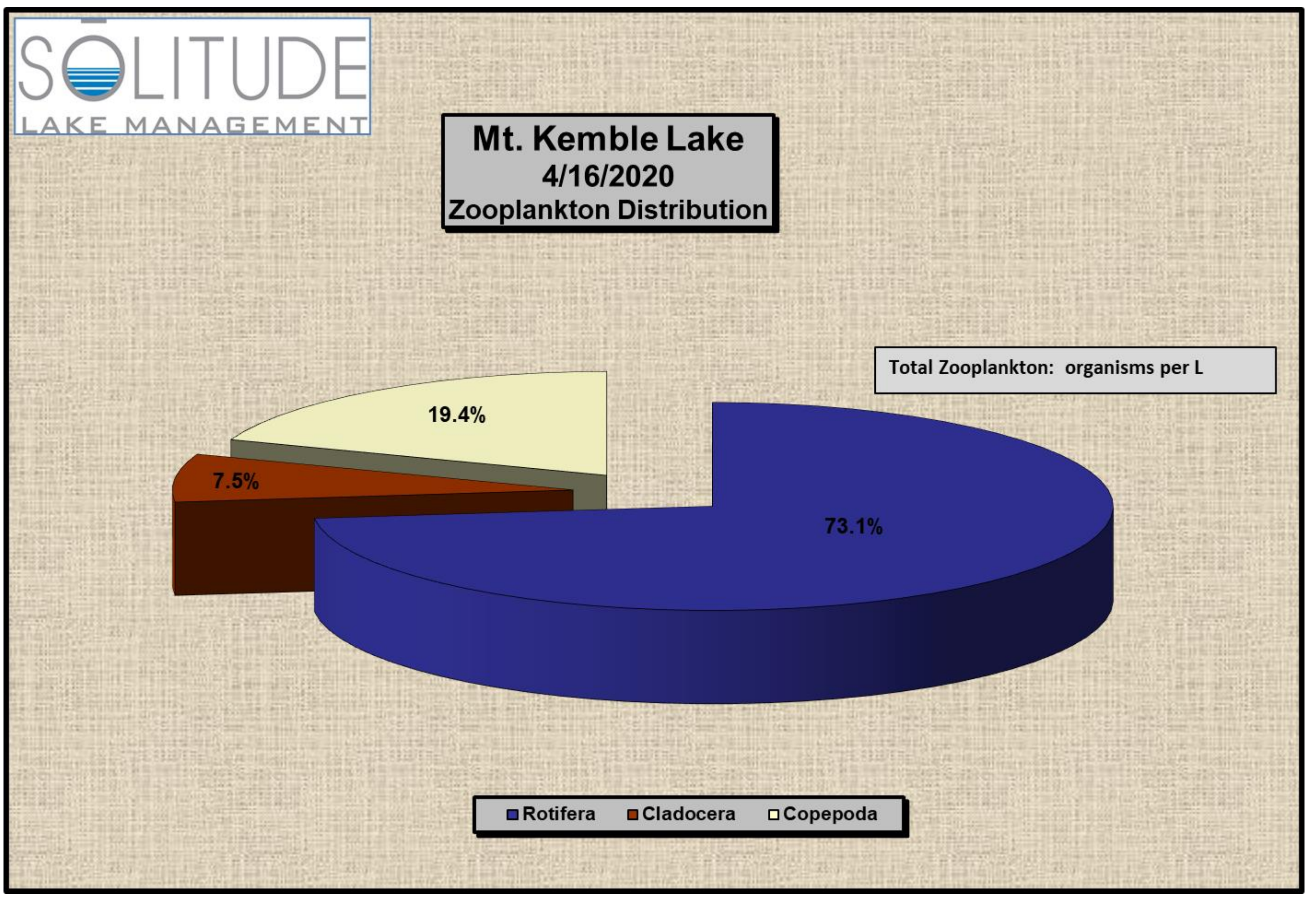
APPENDIX E: ZOOPLANKTON ENUMERATION CHARTS

Zooplankton Count Results

Site: Mt. Kemble **Date: 04/16/20**

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	**Flosculariaceae**	Conochilidae	*Conochilus*	1	0	0	0.33	333	68.8	5
	Ploima	Brachionidae	*Anuraeopsis*	4	1	0	1.67	1667	68.8	24
			Keratella	8	29	10	15.67	15667	68.8	228
			Euchlanis	1	1	0	0.67	667	68.8	10
		Asplanchnidae	*Asplanchna*	12	10	13	11.67	11667	68.8	170
		Synchatidae	*Polyarthra*	0	8	0	2.67	2667	68.8	39
							0.00	0	68.8	0
							0.00	0	68.8	0
									Total:	**475**
Cladocera	**Cladocera**	Bosminidae	*Bosmina*	10	0	0	3.33	3333	68.8	48
							0.00	0	68.8	0
									Total:	**48**
Copepoda										
	Cyclopoida	Cyclopoidae	*Microcyclops*	8	5	0	4.33	4333	68.8	63
			Nauplius	2	4	6	4.00	4000	68.8	58
			Cyclops	0	0	1	0.33	333	**68.8**	5
									Total:	**126**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
649	475	73.1%	48	7.5%	126	19.4%

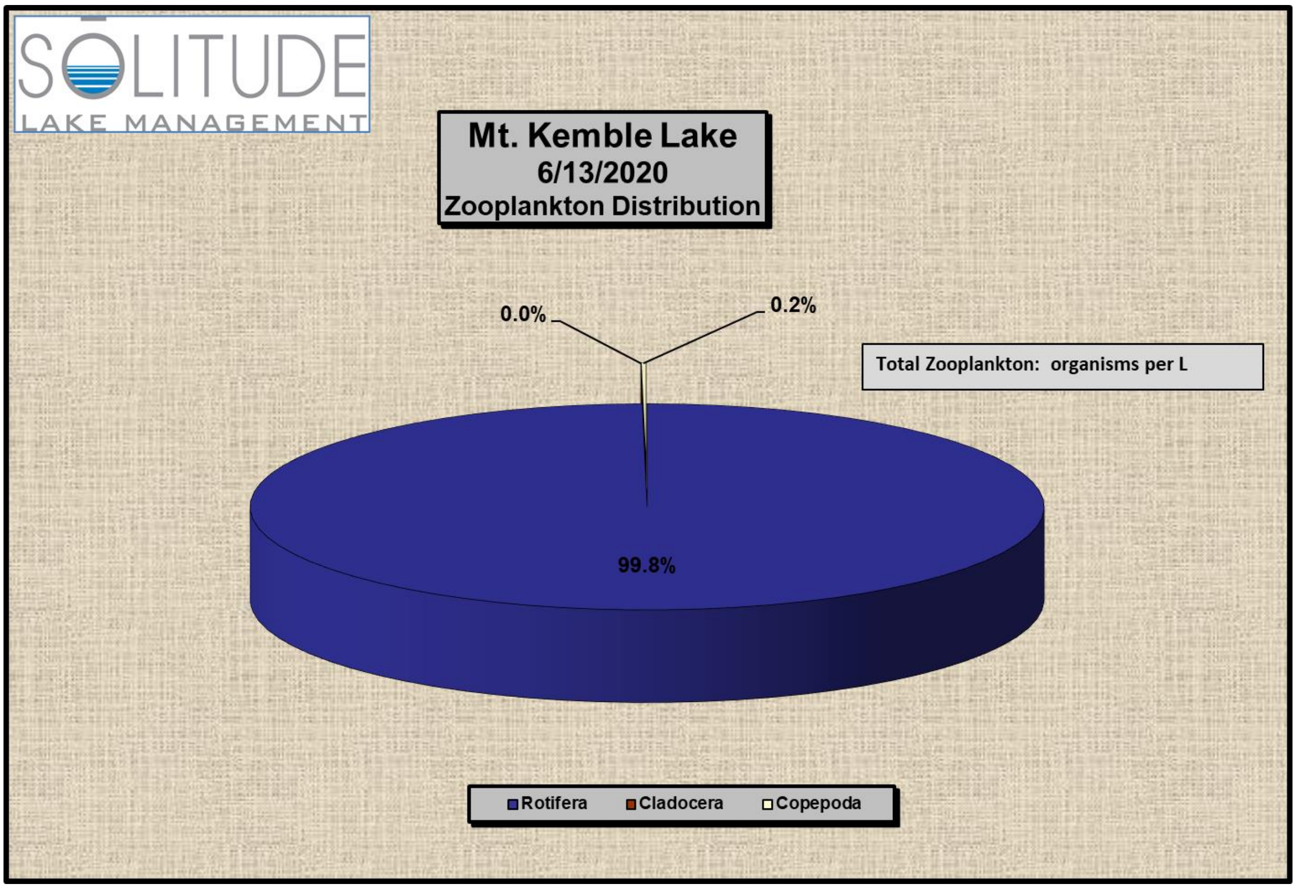


Zooplankton Count Results

Site: Mt. Kemble **Date: 06/23/20**

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*	72	29	91	64.00	64000	68.8	930
			Kellicottia	69	48	102	73.00	73000	68.8	1061
			Anuraeopsis	0	1	0	0.33	333	68.8	5
		Asplanchnidae	*Asplancha*	24	16	27	22.33	22333	68.8	325
		Synchatidae	*Polyarthra*	12	2	7	7.00	7000	68.8	102
	Flosculariaceae	Filinidae	*Filinia*	4	5	0	3.00	3000	68.8	44
		Conochilidae	*Conochilus*	0	0	1	0.33	333	68.8	5
							0.00	0	68.8	0
									Total:	**2471**
Cladocera							0.00	0	68.8	0
							0.00	0	68.8	0
									Total:	**0**
Copepoda	**Cyclopoida**	Cyclopoidae	*Nauplius*	8	4	7				
			Microcylcops	0	0	1	0.33	333	68.8	5
							0.00	0	68.8	0
							0.00	0	**68.8**	0
									Total:	**5**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
2476	2471	99.8%	0	0.0%	5	0.2%

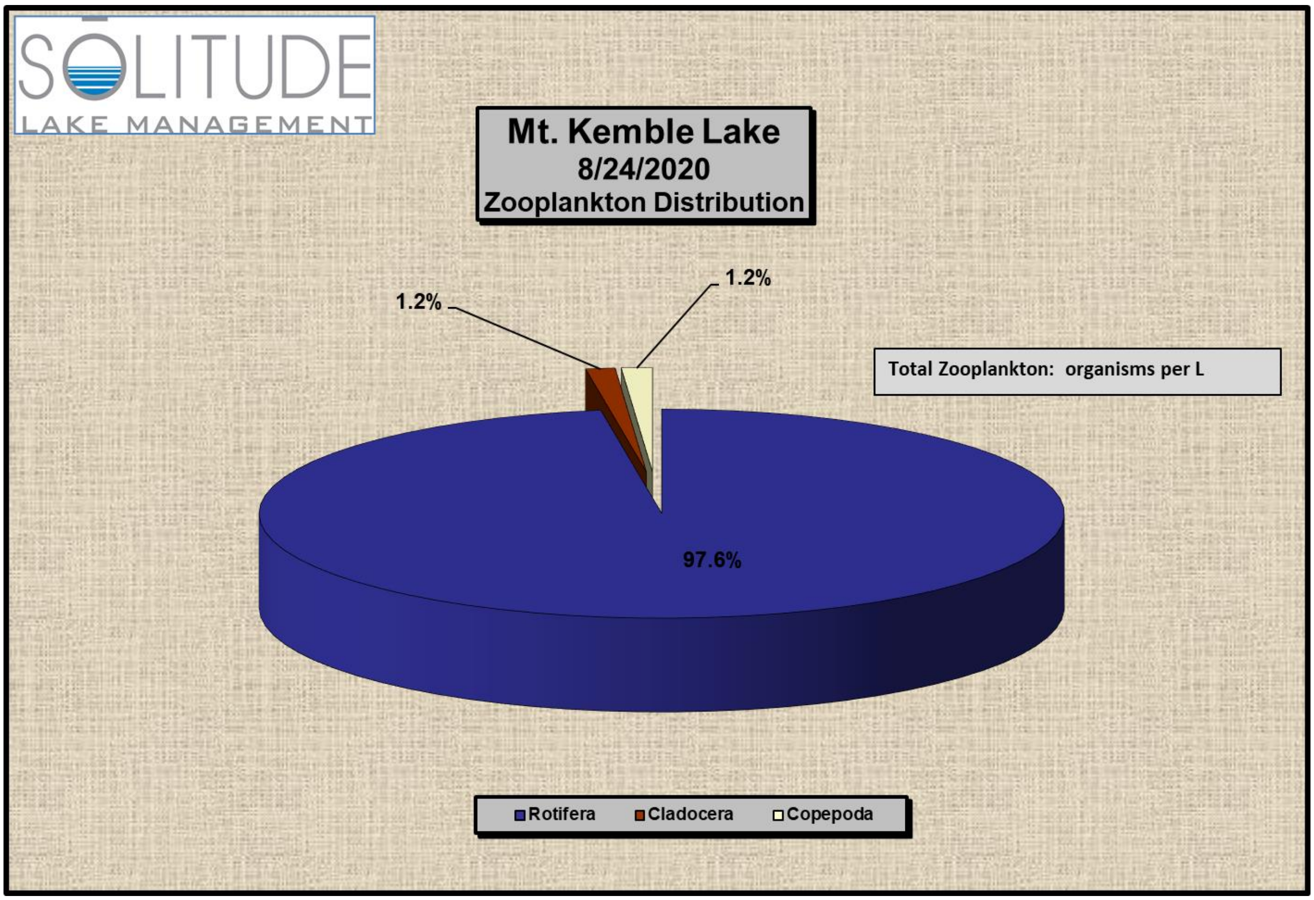


Zooplankton Count Results

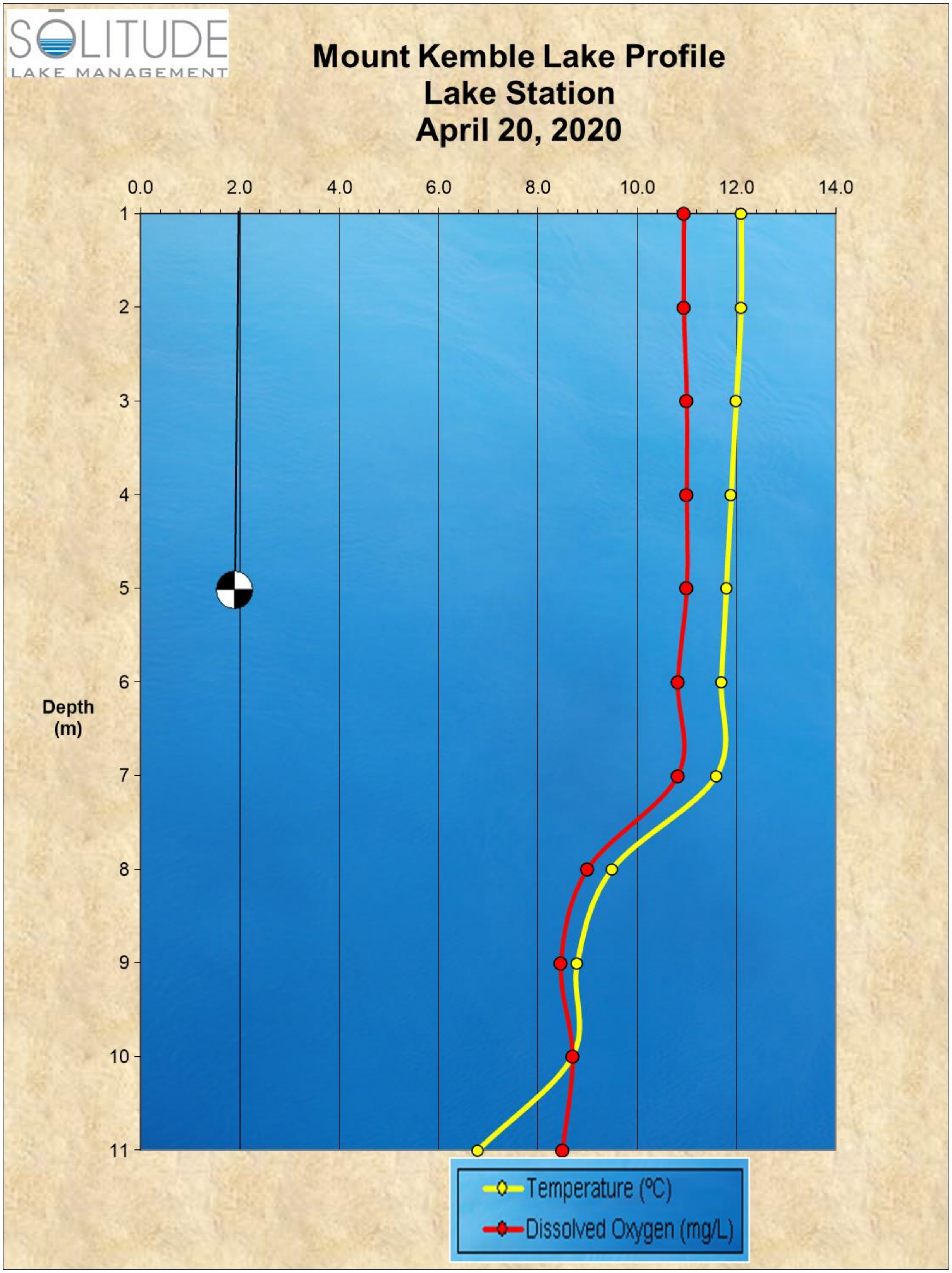
Site: Mt. Kemble **Date: 08/24/20**

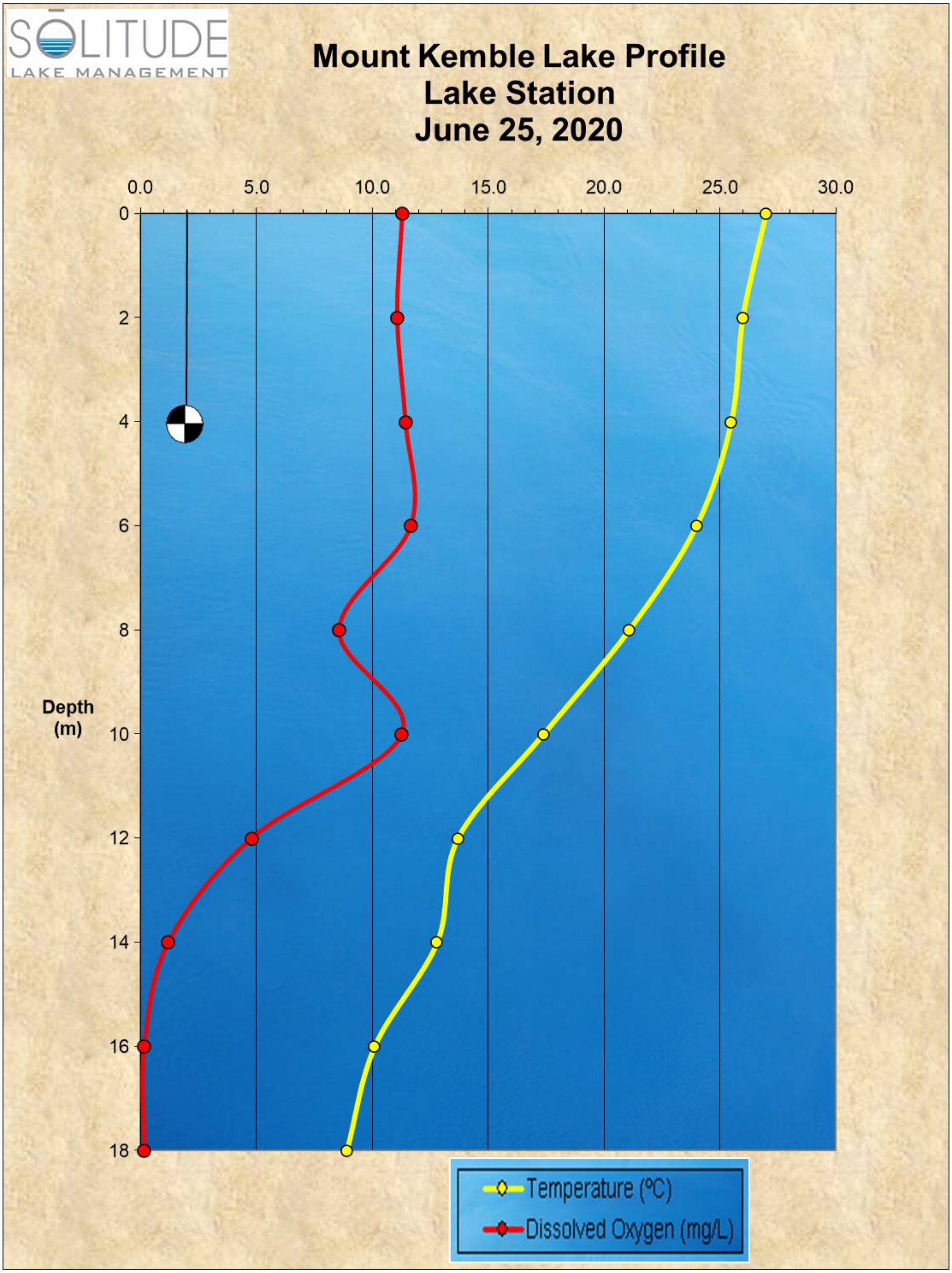
Group	Order	Family	Genus	Replicate A	Replicate B	Replicate C	Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
Rotifera	**Ploima**	Branchionidae	*Keillicottia*	971	1603	1963	1512.33	1512333	68.8	21982
			Keratella	15	43	78	45.33	45333	68.8	659
		Asplanchnidae	*Asplanchna*	4	10	30	14.67	14667	68.8	213
	Flosculariaceae	Filinidae	*Filinia*	0	1	0	0.33	333	68.8	5
							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:	**22859**
Cladocera	**Cladocera**	Bosminidae	*Bosmina*	0	17	40	19.00	19000	68.8	276
							0.00	0	68.8	0
									Total:	**276**
Copepoda										
	Cyclopoida	Cyclopoidae	*Nauplius*	3	4	5	4.00	4000	68.8	58
			Microcyclops	1	17	30	16.00	16000	68.8	233
							0.00	0	**68.8**	0
									Total:	**291**

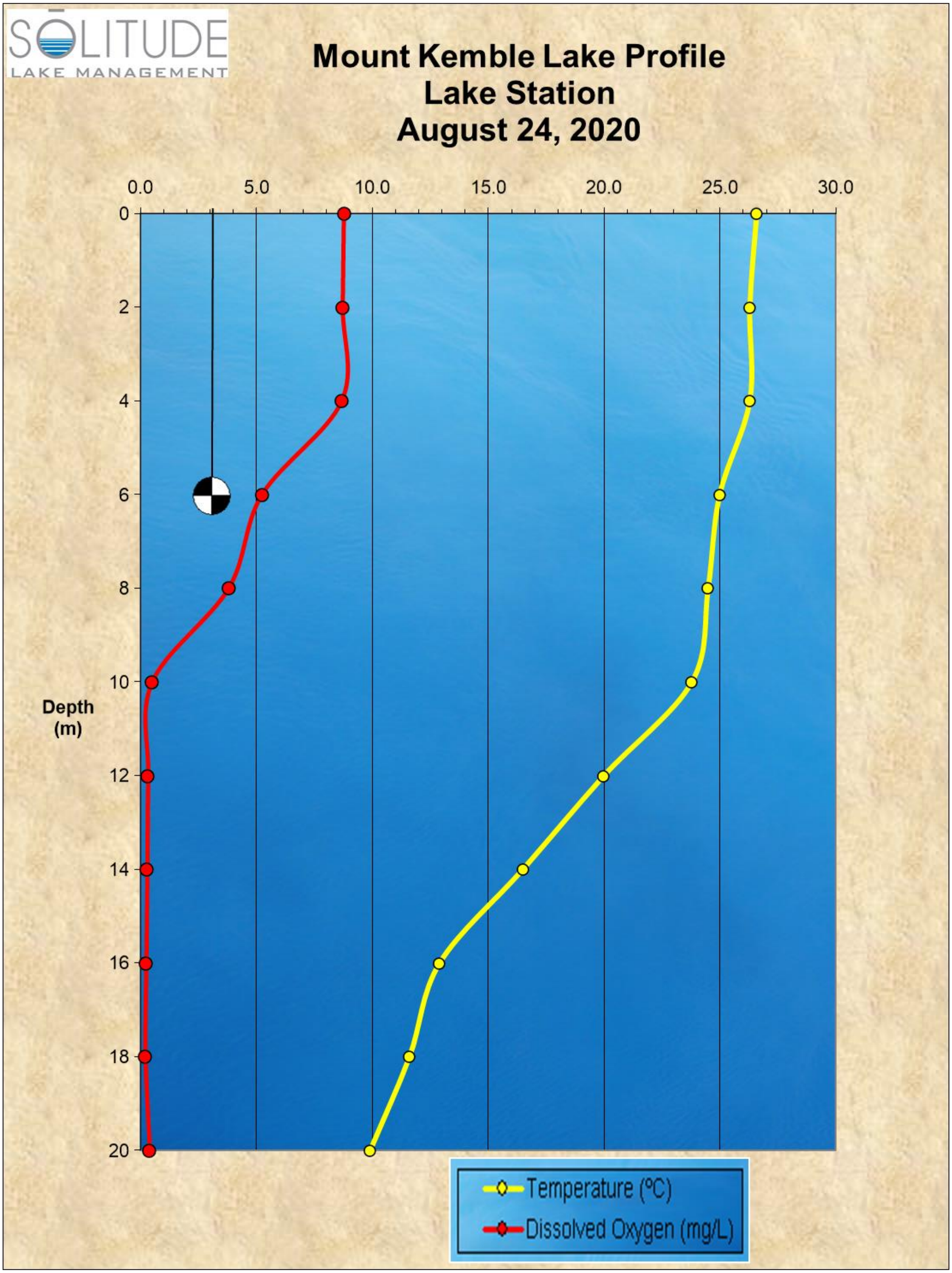
Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
23425	22859	97.6%	276	1.2%	291	1.2%



APPENDIX F: DISSOLVED OXYGEN – TEMP. PROFILES




SOLITUDE
LAKE MANAGEMENT
Mount Kemble Lake Profile
Lake Station
June 25, 2020
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Depth
(m)
0
2
4
6
8
10
12
14
16
18
Temperature (ºC)
Dissolved Oxygen (mg/L)


SOLITUDE
LAKE MANAGEMENT
Mount Kemble Lake Profile
Lake Station
August 24, 2020
0.0
5.0
10.0
15.0
20.0
25.0
30.0
0
2
4
6
8
10
12
14
16
18
20
Depth
(m)
Temperature (ºC)
Dissolved Oxygen (mg/L)