Natural Lake Biosciences

BioBoost Nest™
Where Bacteria Loves to Live

To: [redacted] [redacted]

Sample(s): [redacted]

Received: [redacted]

Analyzed: [redacted]

Problem(s): Water Quality & Algae ID

Water Quality Analysis
Filtered analysis performed on sample filtered through 0.2µm pore filter

	[redacted] Top	[redacted] Bottom
pH @ 13.2 °C	6.42	6.43
Total Nitrogen (ppm N)	1.3	0.8
Total Phosphorus (ppm P)	0.03	0.03
Turbidity (NTU)	23.52	23.06
Filtered NH_3 (ppm NH_3-N)	0.07	0.10
Filtered NO_2^- (ppm NO_2-N)	0.001	0.001
Filtered NO_3^- (ppm NO_3-N)	0.3	0.3
Filtered PO_4^{3-} (ppm PO_4-P)	0.00	0.01
Total Alkalinity (ppm as $CaCO_3$)	90	75
Phenolphthalein Alkalinity (ppm as $CaCO_3$)	0	0

Key	
Normal	Typical fresh water conditions, providing a healthy lake environment
Elevated	Possibility/higher probability of blue-green algae and algal scums, extensive macrophyte problems, and anoxia
High	Algal scums, anoxic bottom waters, fish kills, few macrophytes, very poor water clarity , stunted fishery

Microscopic Analysis: Water Samples

Sample concentrated by centrifuge

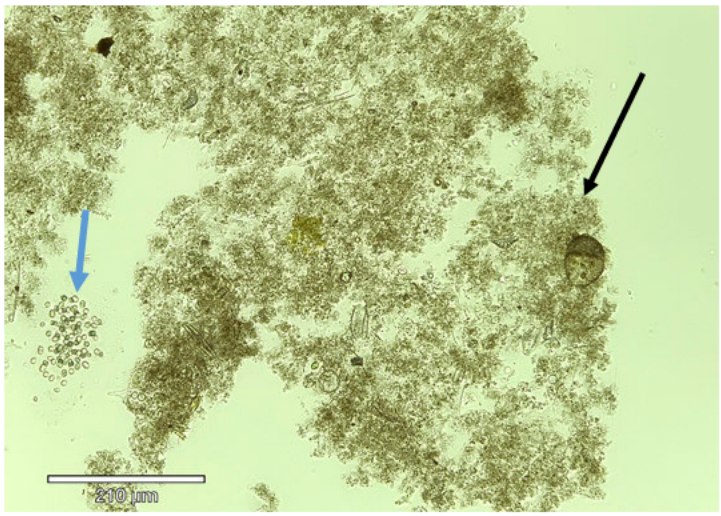

Figure 1. 100x magnification (m): The water samples consisted mostly of bacteria floc (black arrow) which were composed of dead organic material and algal remains. Diatoms were occasionally observed within floc as well as *Microcystis* (blue arrow). Solids were captured better on the Bottom sample than the top sample.

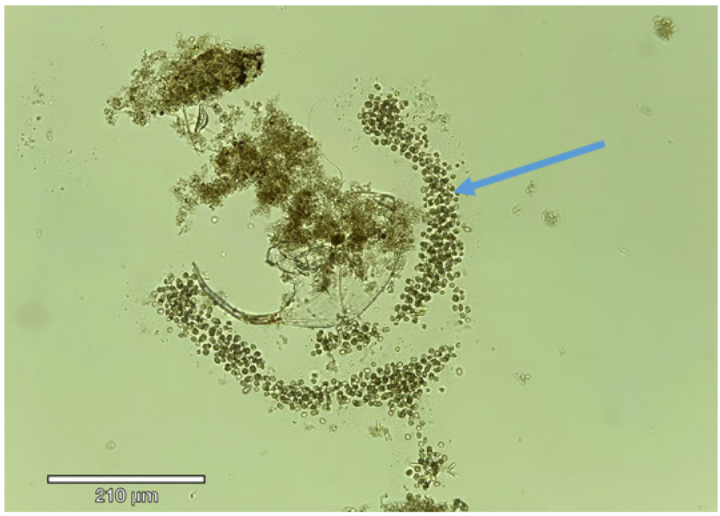

Figure 2. 100x (m): Cyanobacteria was observed in both samples, specifically *Microcystis* (arrow). Larger and more colonies were observed in the Bottom sample.

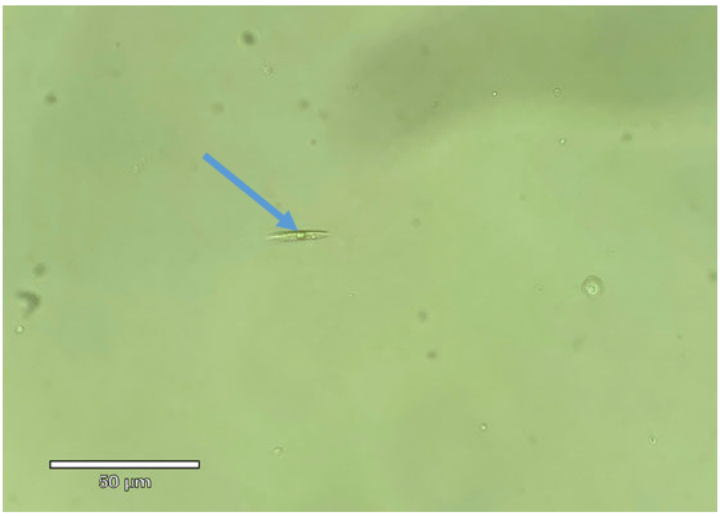

Figure 3. 400x (m): Free bacteria was observed mostly in the bulk liquid; however, green planktonic algae was observed as well. The alga appears similar to *Elakatothrix*.

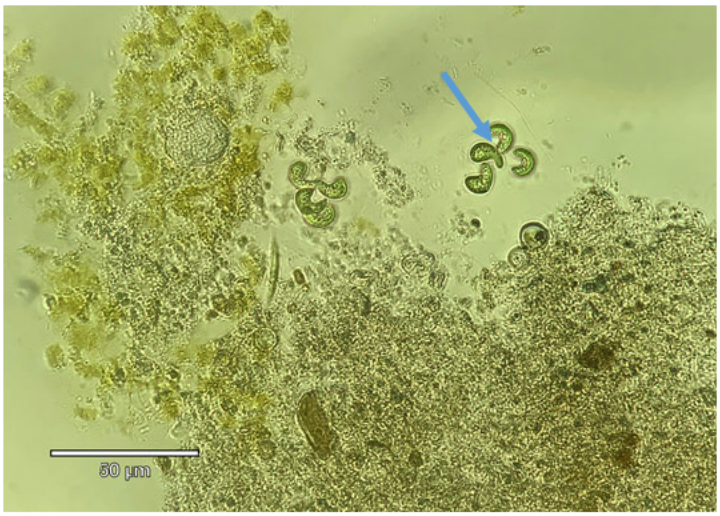

Figure 4. 400x (m): Low levels of *Kirchneriella* (arrow) was observed in the Top sample.

Summary:

Microcystis is a planktonic, unicellular cyanobacterium that forms gelatinous colonies and floating bright green pond scum. Microscopically, these colonies are spherical when young and gradually form lobate or irregular shapes of dense cells irregularly distributed in mucilage. The individual cells are spherical and can be blue-green, yellowish, or black in color due to the presence of numerous gas vesicles. The gas vesicles help keep the colonies close to the air-water interface of a pond for optimal light and gas exchange. The surrounding mucilage is usually fine and colorless but sometimes may be distinct giving the colonies a refractive outline. *Microcystis* is similar in appearance to *Coelosphaerium*, which has cells peripherally arranged in one layer around a hollow center and the colonies may be spherical or lobed with surrounding mucilage. *Microcystis* can rapidly take over a pond due to the disintegration of colonies into small clusters of cells and binary fission resulting in massive amounts of new colonies. The cells are somewhat tolerant of dark anaerobic conditions and can form benthic reservoirs in eutrophic water bodies. Most blooms occur in eutrophic freshwater that is very calm and warm. Several strains of *Microcystis* are known to produce toxins such as the hepatotoxin microcystin, which is dangerous to human and animal health.

Understanding Your lab Results

pH	Surface layer commonly 7 to 8.5 Bottom layer commonly 6 to 7.5 Ideal 7.2 to 7.6; acceptable 6.8 to 8.0	pH in samples is artificially high due to decomposition. Field testing of pH is more accurate.
Total Nitrogen	Normal: 0.45-0.70 ppm Elevated: 0.70-2 ppm High: >2.0 ppm	TN = NO_3 + NO_2 + NH_3 + digested organic nitrogen compounds. Main sources are fertilizers and animal droppings.
Total Phosphorus	Normal: 0.012-0.024 ppm Elevated: 0.024-0.096 ppm High: 0.096 ppm	Includes dissolved P and particulate P from soil particles, mineral compounds, and organic matter. Particulate P can accumulate in sediments.
Turbidity	Normal: <1 NTU Elevated: >5 NTU High: >25 NTU	Causes: clay particles, muck suspension by currents or animals, shoreline erosion, runoff, or presence of plankton. Reduction depends on cause.
NH_3	Normal: 0.1 ppm Elevated: 0.1-0.25 ppm High: 0.6 ppm	Sources: ag runoff, lawn fertilizer, ducks and geese, fish, and decaying organisms, including plants and algae.
NO_2	Normal: 0.1 ppm Elevated: 0.1-0.25 ppm High: 0.6 ppm	High concentrations require further research.
NO_3	Normal: 0.1 ppm Elevated: 0.1-0.25 ppm High: 0.6 ppm	Top layer of lake may have low levels due to algae uptake. Bottom layer will be higher due to decay. Algae uses NO_3 as nitrogen source for growth.
PO_4^{3-}	Normal: Below detection limits Elevated: 0.01ppm High: 0.025 ppm	Algae and aquatic plants use only the orthophosphate (PO_4^{3-}) form.
Total Alkalinity	Optimal = 100 ppm Acceptable = 50-400 ppm Minimum = 50 ppm	Measures ability to withstand changes in pH (buffering capacity). Algae often causes high pH swings.
Phenolphthalein Alkalinity	Done for Naturalake Biosciences research	Measures non-carbonate alkalinity, mostly hydroxides.