Quantifying the Impact Nitrogen and Phosphorus Levels on the Growth of Algae in Canyon Ferry Lake.

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Abstract:

Samples from the Canyon Ferry Lake were collected and spiked with different concentrations of phosphates (dipotassium phosphate) and nitrates (sodium nitrate). The added nitrogen concentrations ranged from 0 to 5 ppm and the added phosphorus concentration ranged from 0 to 1 ppm. The nitrogen and phosphorus spiked Canyon Ferry Lake water samples were incubated for two weeks under a 12-hour illumination cycle. The chlorophyll a concentration, which is known to correlate to algae population, of the samples were then analyzed via high-performance liquid chromatography (HPLC) and steady state ultraviolet-visible (UV-Vis) spectroscopy. The largest algae growth was found with 1.5 ppm nitrogen and 0.2 ppm phosphorus added. The possible implications for these findings for the management of Canyon Ferry Lake aquatic ecosystem will be discussed.

Introducion:

The presence of toxic algae blooms, caused by high nitrogen and phosphorus concentrations, is a problem for aquatic ecosystems. Canyon Ferry Lake on the Missouri River has been subject to algae blooms over the years due to rising nitrogen and phosphorus concentrations. The goal of this project was to determine the levels of nitrogen and phosphorus at which algae blooms occur. This project is a collaboration between the Montana Department of Environmental Quality, an introductory Chemistry class, and a senior level capstone research class.

Figure 1. a) Photograph of CH 103 students and MT DEQ collaborators gathering lake water samples from Canyon Ferry Lake. b) Google satellite image of other collection sites

Results and Discussion:

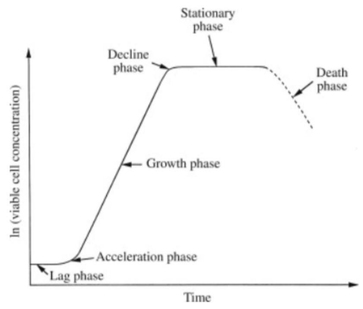

Figure 2. a) Canyon Ferry water samples were spiked with phosphate (dipotassium phosphate) and nitrate (sodium nitrate). b) The life cycle of algae as a function of time.1

Figure 3. Algae cultivation occurred in a home-build grow chamber. The grow chamber was used to cultivate the algae. There was a 120 volts lamp that was on for 12 hours each day. The shaker tables were used to keep the beakers in motion to allow the algae to continue growing.

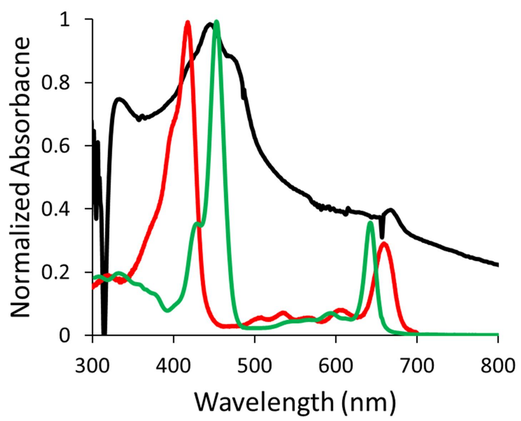

Figure 4: UV-Vis absorption spectra of chlorophyll a (red), chlorophyll b (green), and an the 0.2 ppm phosphorus and 1.5 ppm nitrogen spiked Canyon Ferry water sample (black) after incubation.

Results and Discussion (continued)

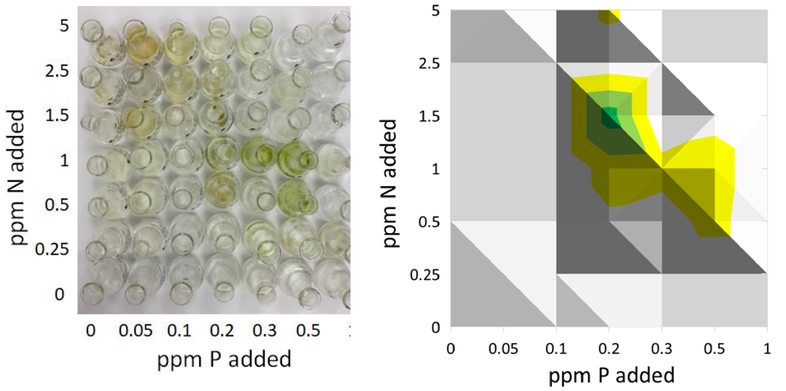

Figure 5. a) Nitrogen and phosphorus spiked algae samples after incubation arranged in a matrix. b) Contour plot of chlorophyll concentrations from the nitrogen and phosphorus spiked algae samples analyzed via steady state ultraviolet-visible (UV-Vis) spectroscopy. The absorbances were measured at a wavelength of 676 nm (nanometers) compared to the reference value. The absorbance data recorded are measured at 0-0.02 (blue), 0.02-0.04 (orange), 0.04-0.06 (grey), and 0.06-0.08 (yellow).

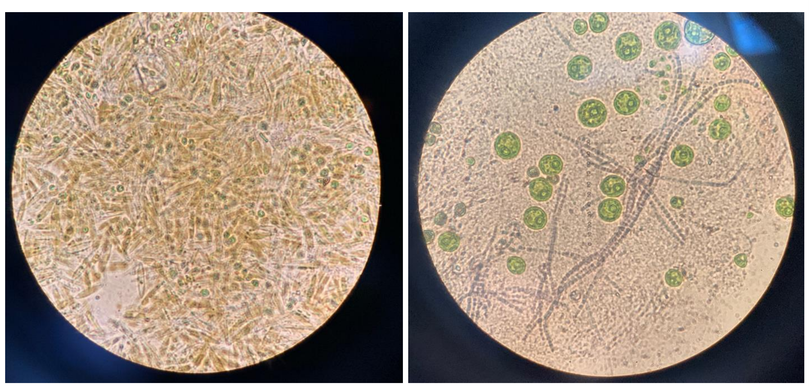

Figure 6: a) Representative 100x image from most dense brown algae growth at 0.05 ppm P and 5 ppm N. **b**) Representative 100x image from most dense green algae growth at 1 ppm P 1 ppm N