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Background:

The lakes in Central Maine are a wonderful natural resource that supports a wide variety of plant, fish and animal species. The lakes are also a valuable recreational resource that are used for fishing, boating, and sightseeing. Unfortunately, many of these lakes are suffering from eutrophication, a complex biogeochemical process in which elevated nutrient levels in lakes allow explosive growth in phytoplankton species. Phytoplankton are free-floating, micron-sized plants that in large numbers reduce lake water clarity and impart a green or brown color to the lake.

As living organisms, phytoplankton need basic chemical building blocks to grow and reproduce.

\[
106\text{CO}_2 + 122\text{H}_2\text{O} + 16\text{HNO}_3 + \text{H}_3\text{PO}_4 \xrightarrow{\text{light}} (\text{CH}_2\text{O})_{106}(\text{NH}_3)_{16}(\text{H}_3\text{PO}_4) + 132\text{O}_2
\]  

This is the general equation for photosynthesis where \((\text{CH}_2\text{O})_{106}(\text{NH}_3)_{16}(\text{H}_3\text{PO}_4)\) can be considered the average chemical composition of phytoplankton. The reaction is nonspontaneous and requires sunlight to operate. The reverse of reaction 1 is cellular respiration, which is the energy source for most animals. As in all chemical reactions, the limiting reagent will control the maximum amount of products produced. Carbon dioxide and water are plentiful in aquatic systems so that phosphate or nitrate is usually the limiting reagent. In Maine lakes phosphate is generally the limiting reagent. However, nitrate concentration may play a significant role in determining the type of phytoplankton that grow in the lake. Of significant local interest is the recent bloom of Gloeotrichia in
Great, Long, and Snow Ponds that may be influenced by low nitrate concentrations in these lakes.

The goal of this project is to evaluate new Ultraviolet Multi-Wavelength analysis, UVMW, methods for nitrate analysis for rapid and inexpensive analysis of nitrate and total dissolved nitrogen. We will focus on the following questions:

1. What is the detection limit of UVMW for nitrate in pure water?
2. How does dissolved organic material in “real” lake water influence UVMW?
3. Can digested samples be analyzed by UVMW?
4. How does sample handling and storage influence the results?
5. How does UVMW compare to traditional azo-dye methods for nitrate analysis?

References:


