BOW LAKE

2013 SAMPLING HIGHLIGHTS

STRAFFORD & NORTHWOOD, NH

NEW HAMPSHIRE
LAKES LAY MONITORING

Bow Lake volunteers collected water quality data between June 20 and September 19, 2013. A more in depth water quality survey of the Bow Lake deep sampling stations was conducted by the Center for Freshwater Biology on September 19, 2013.

Light Blue = Outstanding = Ultraoligotrophic

Blue = Excellent = Oligotrophic

Yellow = Fair = Mesotrophic

Red = Poor = Eutrophic

Light Gray = No Data

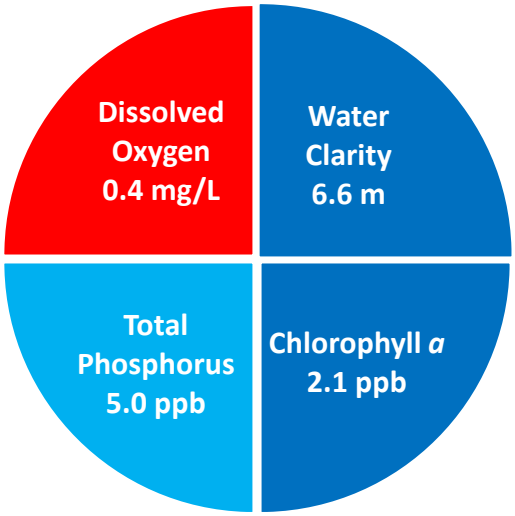

Figure 1. Average Water Quality Conditions

2013 RESULT HIGHLIGHTS

WATER CLARITY: Water clarity, measured as Secchi disk depth, averaged 6.6 meters (m) in Bow Lake. The 2013 measurements were visible deeper than the 2012 measurements.

CHLOROPHYLL: Chlorophyll *a*, a measure of microscopic plant life within the lake, averaged 2.1 parts per billion (ppb) in Bow Lake. The 2013 chlorophyll *a* measurements were lower than the 2012 measurements.

TOTAL PHOSPHORUS: Phosphorus is the nutrient most responsible for microscopic plant growth. Total phosphorus concentrations collected in Bow Lake averaged 5.0 parts per billion (ppb). The 2013 Bow Lake total phosphorus concentrations remained well below 10 parts per billion (ppb) that is considered sufficient to support green water events that are referred to as algal blooms. The 2013 total phosphorus concentrations decreased relative to the 2012 levels.

DISSOLVED OXYGEN: Dissolved oxygen is important for the health of fisheries. An oxygen concentration of 5.0 milligrams per liter (mg/L) is typically considered the threshold for the growth and reproduction of cold water fish such as trout and salmon. The Bow Lake dissolved oxygen ranged from 0.3 to 0.5 milligrams per liter (mg/L) in the bottom waters on September 19, 2013.

COLOR: Color is a result of naturally occurring "tea" color substances from the breakdown of soils and plant materials. The Bow Lake color averaged 19.2 color units (CPU) that can give Bow Lake a lightly tea colored appearance.

ALKALINITY: Alkalinity measures the lake's resistance against acid rain. The average Bow Lake alkalinity measured 4.2 milligrams per liter (mg/L). The 2013 alkalinity indicates Bow Lake is moderately vulnerability to acid rain. The Bow Lake **pH**, a measure of lake acidity, ranged from 6.7 to 6.8 units in the surface waters and remained within the acceptable range for most aquatic organisms.

SPECIFIC CONDUCTIVITY: Specific conductivity is a general indicator of pollution. The Bow Lake specific conductivity ranged from 49.0 to 59.0 micro-Siemans per centimeter (uS/cm) and indicates low concentrations of dissolved substances, such as nutrients (e.g. phosphorus and nitrogen) and other dissolved salts (e.g. sodium and chloride).

CYANOBACTERIA: Cyanobacteria are the measure of potentially harmful plant-like bacteria. Bow Lake did not participate in the 2013 cyanobacteria-monitoring. Refer to the recommendations section for further information.

Note: Site 1 Ledges (see map) was used as the reference point to give an overall representation of the Bow Lake water quality discussed in this Highlight document. For a more detailed discussion of water quality measurements, please refer to the executive summary within the annual Bow Lake report.

Table 1. 2013 Bow Lake Seasonal Average Water Quality Readings and Trophic Level Classification Criteria used by the New Hampshire Lakes Lay Monitoring Program

Parameter	Ultraoligotrophic "Outstanding"	Oligo "Excellent"	Meso "Fair"	Eutrophic "Poor"	Bow Lake Average (range)	Bow Lake Classification
Water Clarity (meters)	> 7.0	4.0 – 7.0	2.5 - 4.0	< 2.5	**6.6** meters (range: 5.3 – 8.4)	Oligotrophic
Chlorophyll *a* (ppb)	< 2.0	2.0 - 3.0	3.0 - 7.0	> 7.0	**2.1** ppb (range: 1.7 – 2.9)	Oligotrophic
Total Phosphorus (ppb)	< 7.0	15.0 – 7.0	15.0 - 25.0	> 25.0	**5.0** ppb (range: 4.0 – 7.6)	Oligotrophic
Dissolved Oxygen (mg/L)	> 7.0	5.0 – 7.0	2.0 – 5.0	<2.0	**0.4** mg/L (range: 0.3 – 0.5)	Eutrophic
Cyanobacteria (cell counts, microcystin concentration & Water safety)	The Massachusetts Department of Public Health considers dangerous microcystin (MC) levels to be 14 micrograms per liter (*ug*/l) lake water, and/or 70,000 cyanobacteria cells per milliliter lake water.			The New Hampshire Department of Environmental services posts warnings at State beaches when cyanobacteria cell numbers exceed 70,000 cells per milliliter lake water.		

*** Dissolved oxygen concentrations taken from the bottom layers**

LONG TERM TRENDS

WATER CLARITY: The Bow Lake water clarity has increased approximately 50 centimeters (cm) over the past twenty-nine years of water quality monitoring. However, the trend of increasing water clarity is not statistically significant.

CHLOROPHYLL: The Bow Lake chlorophyll *a* concentration has increased approximately 1.5 parts per billion (ppb) over the past twenty-nine years of water quality monitoring. However, the trend is not statistically significant.

TOTAL PHOSPHORUS: Bow Lake total phosphorus concentrations have decreased over the past twenty-four years of sampling. However, the trend is not statistically significant

WATER CLARITY: Over the past twenty-nine years of sampling, water clarity has decreased approximately 20 centimeters (cm), although this is not a statistically significant trend. Water clarity has, however, shown an increase of approximately 100 centimeters (1 meter) over the past three years.

In summary, there are indications of decreasing Bow Lake water quality between 1984 and 2013. A trend of decreasing water transparency corresponds to a trend of increasing chlorophyll *a* concentrations. Furthermore, short-term algal blooms have been documented in Bow Lake over the past decade and have included nuisance cyanobacteria blooms.

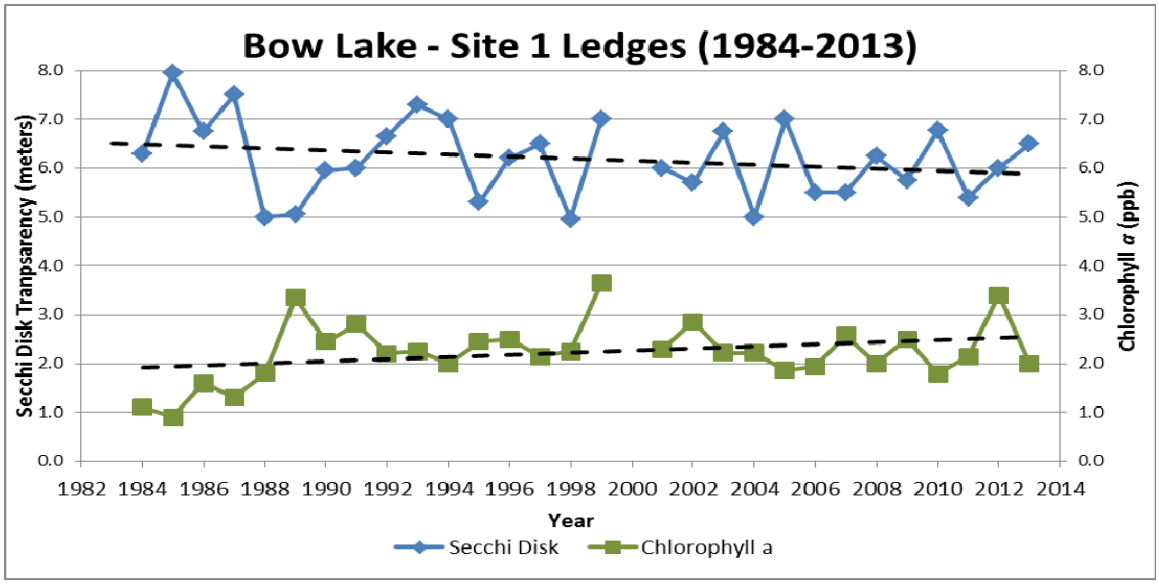

Figure 2. Changes in water clarity (Secchi disk depth) and chlorophyll *a* measured between 1984-2013 at Site 1 Ledges. There has been a decreasing water clarity trend shown by shallower Secchi disk transparency with time. However, the trend is not statistically significant (dashed line). Algal growth (chlorophyll; dashed line) has increased over the past twenty-nine years of sampling. However the trend is not statistically significant.

Recommendations:

- Implement a simple cyanobacteria monitoring routine into the conventional water quality monitoring methods including monthly water samples. Cyanobacteria collections throughout the summer and fall months can give insight as to how these populations are distributed throughout the seasons and when they are most likely to be at harmful levels. If you are interested in discussing additional water quality monitoring options that would meet your needs please contact Bob Craycraft @ 862-3696 or via email, bob.craycraft@unh.edu.

- Implement Best Management Practices within the Bow Lake watershed to minimize the adverse impacts of polluted runoff and erosion into the lake. Refer to "Landscaping at the Water's Edge: An Ecological Approach" and "New Hampshire Homeowner's Guide to Stormwater Management: Do-It-Yourself Stormwater Solutions for Your Home" for more information on how to reduce nutrient loading caused by overland run-off.
    - https://extension.unh.edu/resources/files/Resource001799_Rep2518.pdf
    - http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-11-11.pdf

Bow Lake

Strafford & Northwood, NH

2013 Deep water sampling site locations with average seasonal water clarity

Aerial Orthophoto Source: NH GRANIT
Site locations GPS coordinates collected by the UNH Center of Freshwater Biology

University of New Hampshire
Cooperative Extension

New Hampshire Lakes Lay Monitoring