Water Quality Update

Results of the 2012 Water Quality Monitoring Season for Saint-Gaudens NHS

Background

The Northeast Temperate Network (NETN) monitors a variety of natural resource indicators, which it calls "vital signs", for 12 parks in the northeast and the Appalachian National Scenic Trail. The vital signs for freshwater bodies are water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species. These were chosen to address the NPS Inventory and Monitoring Program objective to detect change in the status of physical, chemical, or biological attributes of the ecosystem.

Methods

Detailed descriptions of all monitoring methods can be found in NETN's Freshwater Monitoring protocol available for download from our website. In 2012, NETN hydrologic technician Brian Schuetz measured physical and water chemistry parameters each month and periodically collected water samples for analysis at the University of Maine. All monitoring data are incorporated into databases that feed into an EPA system.

Three monitoring sites in the park consist of two streams and a pond that have been measured by the park since 1997. Blow-Me-Up Brook is classified as a cold water fishery, loosely defined as water that can support, on a year-round basis, wild and stocked brook trout or other species requiring similar conditions. Blow-Me-Down Brook is considered a warm water fishery, capable of supporting bass, pickerel, sunfish, and similar species. See NETN's Google Earth park module for locations of monitoring sites.

Monthly sampling includes pH, specific conductance, temperature, dissolved oxygen, transparency, weather, stream flow (discharge), and stream and pond stage. In May (stream), June (pond) and August (both sites), water samples were obtained and analyzed for acid neutralizing capacity, color, and nutrients. Beginning in 2012, fractions of these water samples were also analyzed for dissolved organic carbon, chloride, sulfate, and chlorophyll *a* (pond).

Results and Findings

Complete details of 2012 monitoring season findings can be found in the full report which is available for downloading from the website. Brief synopses of some findings are available below.

Specific conductance measures the ability of water to carry an electrical current. If it increases it can be an indicator of pollutants in the water. Specific conductance values for 2012 were within the appropriate range for all park waters.

The **pH** of a water body reflects how acidic or basic the water is, measured on a scale of 1 to 14, with 7 being neutral. Acid waters are below 7, and alkaline waters are above 7. A one unit change in pH represents a 10-fold change in acidity or alkalinity. The pH range for New Hampshire lake and pond water quality standards is from 6.0 to 9.0. The pH values from the 2012 monitoring season were basic, with the majority of values between the upper and lower state water quality standards. The September measurement from Blow-Me-Up Brook and the May measurement from Blow-Me-Down Brook were slightly above the upper state pH standard for streams.

Temperature can affect water chemistry and biology. For example, the amount of oxygen that water can hold is directly related to the temperature of the water: the higher the temperature, the less oxygen it can hold. Temperature can also determine the kinds of plants and animals found in a lake or pond. Certain species of fish, insects, and algae will predominate during the cooler temperatures of spring and fall, yet be less apparent during the warmer temperatures of summer. Surface water temperatures appeared to be within the normal range of variability in 2012, though the July values reflected the contributions of high air temperature and solar radiation, with the measurement for Blow-Me-Down Brook reaching the highest recorded at the site to date.

Dissolved oxygen (DO) is a critical indicator of water quality because aquatic life generally needs certain concentrations to thrive. Low oxygen can directly kill or stress organisms such that they will not be able to successfully reproduce or grow. All park sites were well oxygenated in 2012, and were above the most stringent state DO standard, although (in direct relation to its record high temperature) the July value for Blow-Me-Down Pond was the lowest recorded to date.

Color in pond and stream water is caused by natural metallic ions, humus and peat materials, plankton, weeds, and industrial wastes. **Apparent color** is determined using water samples that have not had suspended particles filtered out. Color can be a rough indicator for organic acidity. Color values for 2102 samples from Blow-Me-Up-Brook were low. Blow-Me-Down-Brook and Blow-Me-Down-Pond



Tools of the trade: collecting water samples at Blow-Me-Up Brook. NPS photo.

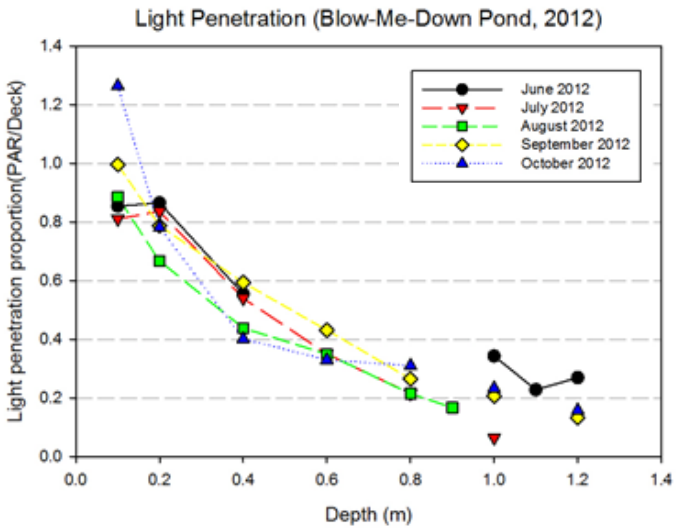
were highly colored and all measurements were more variable. This could be the effect of runoff and sediment input to the systems, rather than dissolved constituents, since the samples were not filtered before analysis.

Acid neutralizing capacity (ANC) is also known as alkalinity, or buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. Acid neutralizing capacity in 2012 followed the typical seasonal pattern of ANC in spring samples being lower than August (summer) values. This is likely due to the contribution of episodic acidification from spring snowmelt and runoff (and also illustrates the ability of the robust ANC to counteract the acidification pulses). All sites were very well-buffered, likely due to the underlying geology.

NETN began measuring **dissolved organic carbon** (DOC) for the first time in 2012. Carbon is a nutrient required for biological processes. Sources of organic carbon in water include humic substances from plant and soil organic matter, wetland peat deposits, and atmospheric deposition. Certain forms of DOC can contribute to "tea" color in water, which can affect light penetration. It also affects the transport (solubility and bioavailability) of metals, including mercury, in aquatic systems. Park DOC concentrations were low in 2012, and closely reflected apparent color values.

Because of its shallow depth, it is difficult to obtain transparency measurements with a Secchi disk in Blow-Me-Down Pond (the disk hits pond bottom before disappearing from view). Because of this, in 2012 NETN started measuring light penetration profiles in the pond. These measurements can tell a lot about the conditions affecting lakes and ponds. Nearly all the energy that drives and controls lake processes is derived from solar energy, which is converted to chemical energy via photosynthesis. This chemical energy is then transported to other areas of the ecosystem as various forms of organic matter. Solar energy, absorbed by the lake and dissipated as heat, plays a large role in defining a lake's thermal structure, stratification, and circulation patterns. By understanding the quantity and behavior of the light entering a lake system, we can learn more about how the light is utilized in the system. Results from 2012 profiles are displayed in the included graph.

This was also the first year of turbidity testing for network waters. **Turbidity** is the measure of the relative clarity of a liquid. It is measured by passing light through a water sample to determine how much light is scattered, and the results are reported in nephelometric turbidity units (NTU). Turbidity is caused by suspended matter or impurities that interfere with the clarity of water. These impurities may include clay, silt, finely divided inorganic and organic matter, soluble colored organic compounds, and plankton and other microscopic organisms. Turbidity can create aesthetic, ecological, and health issues, and could be an indication of runoff from construction, roads, agriculture, or other types of pollution. Suspended solids prevent sunlight from reaching aquatic plants, inhibiting



The light penetration profiles help with the interpretation of other WQ measurements, such as DO.

photosynthesis which may reduce the amount of dissolved oxygen in the water. Sediment also absorbs heat, so turbidity can raise the surface water temperature. Turbidity can make it hard for fish to see their prey, and heavy loads of suspended solids can even clog fish gills and filter-feeding structures of aquatic macroinvertebrates. Turbidity values in 2012 were all in the low range of dry-weather turbidity of surface waters.

Summary

Most 2012 water quality parameters for the pond and streams monitored in the park were within state standards, and were generally within the range of EPA criteria. The majority of values were also within the ranges of the historic NETN monitoring data.

Seven years of monitoring under the NETN protocol have provided critical baseline information on the chemical and physical status of the water resources at Saint-Gaudens National Historic Site. Several changes implemented in the 2012 monitoring season, including the addition of sulfate, chloride, chlorophyll *a*, and dissolved organic carbon analyses to the spring and summer water chemistry testing, will expand the scope and usefulness of monitoring data. As more data are collected, the ability to detect changes outside the natural range of variability will increase, which will more clearly indicate the status of the vital signs of water quality, nutrient enrichment, water quantity, and the detection of invasive plant species.

More Information

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Full Report online at:
http://science.nature.nps.gov/im/units/netn/monitor/programs/lakesPonds/lakesPonds.cfm

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