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Water Quality Monitoring Update

Results of the 2012 Water Quality Monitoring Season for Weir Farm 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 the network’s website. Weir Pond, the largest fresh water body in the park, was sampled monthly from May through October by NETN hydrologic technician Brian Schuetz. Physical and water chemistry parameters are measured each month and water samples are periodically collected for analysis at the University of Maine. All monitoring data are incorporated into a series of comprehensive databases that feed into an EPA data system.

Monthly sampling measures include pH, specific conductance, temperature, dissolved oxygen, transparency, weather, and pond stage. In June and August, 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*. The pond sampling procedure entailed collecting all measurements and water samples from the location of the deepest point of the pond (approximately 1.5 meters). Nutrient chemistry was analyzed from a half-meter grab sample, obtained by submerging a sample bottle directly into the pond with a gloved hand.

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. Although Connecticut has no numeric pond water quality standards for pH, the stream water quality standards, similar to those of most northeast states, indicate that a pH between 6.5 and 8.0 is within the acceptable range. All of the pH values from the 2012 monitoring season were outside of this range, and significantly higher than much of the historic NETN monitoring data. The main cause behind this may be the time of day the water sample was taken and how it relates to CO₂ concentrations. CO₂ dissolved in water forms a mild acid. When CO₂ is high, pH falls. In the morning, CO₂ levels are high as a result of respiration that occurred in the pond overnight. As the sun rises, plants and algae begin photosynthesis and consume CO₂ causing the pH to rise as the day progresses. Algae blooms can also significantly increase this effect. Unlike previous years in which Weir Pond was monitored in the morning, all 2012 pH measurements (excepting October) were taken in mid-afternoon. Although acid neutralizing capacity measurements showed that Weir Pond was sufficiently buffered to avoid severely depressed pH values from episodic acid deposition, 2012 measurements did suggest the presence of a significant source of alkalinity.

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.



Weir Pond. Bill Gawley photo.

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. Weir Pond's surface water was generally well oxygenated in 2012 and was above the state minimum DO standard.

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. Results from 2012 samples showed park waters were highly colored but within the range of 2006 to 2012 historic data values.

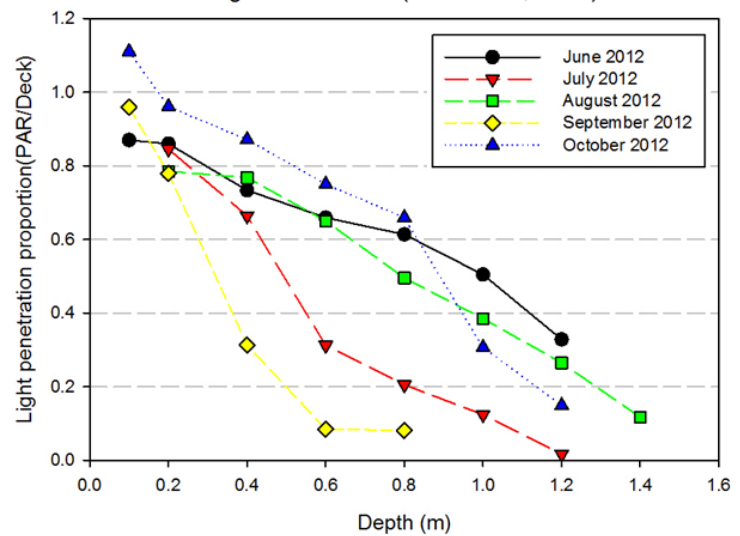
Acid neutralizing capacity (ANC) is also known as alkalinity, or buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. ANC measurements for 2012 illustrated that Weir Pond is very well-buffered, 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 attenuation. It also affects the transport (solubility and bioavailability) of metals, including mercury, in aquatic systems. Weir Pond DOC concentrations were moderate in 2012, likely reflecting the surrounding wetland vegetation.

Because of its shallow depth, it is difficult to obtain transparency measurements with a Secchi disk in Weir 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.

Nutrient enrichment and the acceleration of eutrophication (when waters become rich in mineral and organic nutrients that promote a proliferation of plant life - especially algae) have been identified in most NETN parks as one of the stressors of greatest concern. Several forms of total and dissolved phosphorus and nitrogen are measured to give managers information regarding the status and productivity of freshwater systems. Both spring and summer Total Phosphorous and Total Nitrogen measurements were below the overall historic median values, and below state standards for eutrophic and mesotrophic ponds. Test results for three types of Nitrogen were very low with all results below the method reporting limits. The data indicate that although

Light Penetration (Weir Pond, 2012)



The light penetration profile of the Pogue helps with the interpretation of other WQ measurements, such as DO.

residential areas within the watershed may contribute nutrients to Weir Pond, these inputs were minimal in 2012.

Summary

Most 2012 water quality parameters for Weir Farm NHS were within state standards, and the majority of values were within the ranges of the historic NETN monitoring data. Monitoring under the NETN protocol builds on the historic water quality monitoring by the National Park Service and other agencies to provide critical baseline information on the chemical and physical status of the water resources at the park. 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 the monitoring data. As more data are collected, the ability to detect changes outside this natural range of variability will increase, which in turn 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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