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Water Quality Update

Results of the 2013 Water Quality Monitoring Season

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 2013, physical and water chemistry parameters were measured each month and water samples were periodically collected for analysis at the University of Maine. All monitoring data are incorporated into databases that feed into an EPA system.

One stream sampling site was selected to represent Pogue Brook, the only stream within the park. Pogue Brook can be 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. Additionally, a pond monitoring site was established at The Pogue, a 4.5 hectare pond situated at the headwaters of Pogue Brook.

Monthly sampling included several water quality measures, transparency and light attenuation (pond only), stream turbidity, weather, stream flow (discharge), and stream and pond levels. In May (stream only), June (pond only) 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. The pond sampling procedure entailed collecting all in-situ measurements and water samples from the deepest point of the pond (approximately 3.4 meters).

Results and Findings

Complete details of 2013 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 from 2013 were within the appropriate range for moderate to high ionic strength waters, although values for The Pogue in August and September were among the lowest recorded.

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. pH values from the 2013 monitoring season were moderately basic for Pogue Brook, and were within the upper and lower Vermont water quality standards. However, pH values were higher than the standard (with the exception of September and October) for The Pogue. These values were also among the highest recorded at the Pogue since NETN's monitoring program began.

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 generally appeared to be within the normal range of variability in 2013, although July values were in the upper end of this range.

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 DO measurements in 2013 showed surface waters were well oxygenated and above the more stringent state 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. Color values from the 2013 samples showed that both The Pogue and Pogue Stream are very close to median 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. Acid neutralizing capacity measured in the 2013 samples was lower in the spring samples from Pogue Brook, reflecting the acidic influence of snowmelt and runoff. The summer value in The Pogue was the lowest recorded to date. Both sites were very well-buffered, likely due to the underlying geology.

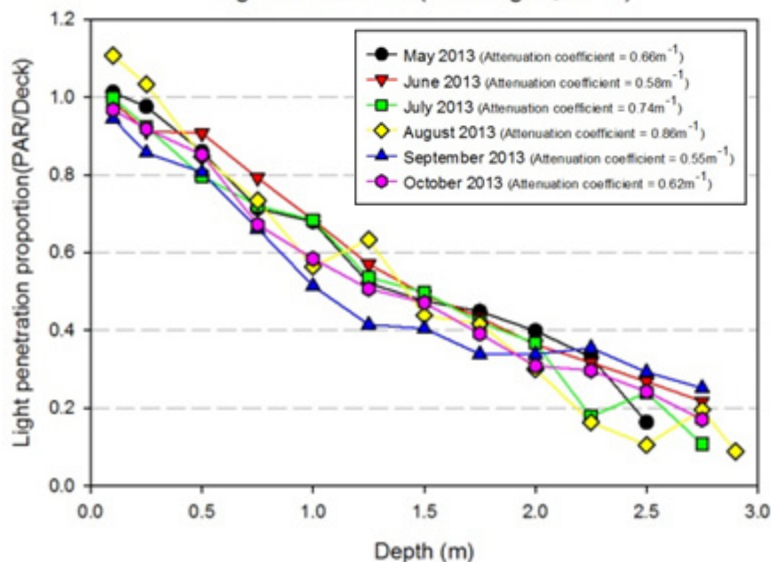
NETN began measuring **dissolved organic carbon (DOC)** in 2012. Carbon is a nutrient required for biological processes. Sources of organic carbon in water include humic substances from plant and soil organic matter, wetland peat deposits, and atmospheric deposition. Certain forms of DOC can contribute 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 to moderate in 2013 with very little seasonal change, and closely reflected apparent color.

Because of its shallow depth, it is difficult to obtain transparency measurements with a Secchi disk in The Pogue (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 2013 profiles are displayed in the included graph.

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 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 measured in Pogue Brook during 2013 were all less than 1.5 NTU, in the low range of dry-weather turbidity of surface waters, which normally ranges from 0 to 10 NTU.

Invasive aquatic plant monitoring conducted during 2013 indicated that they do not currently exist at The Pogue. During future visits to all NETN parks, Didymo (also known as “rock snot”) will especially be looked out for. Didymo is a highly invasive algae species that has recently invaded the northern reaches of the Connecticut River in New Hampshire and the White River and Battenkill Rivers in Vermont. Since non-native, invasive plants have recently been detected with increasing frequency in New England lakes and ponds, it has become crucial to closely monitor the status of park waters.

Light Penetration (The Pogue, 2013)



Summary

Most water quality parameters for the Pogue and Pogue Brook were within state standards and EPA criteria, and were usually within the ranges of the historic NETN monitoring data. The exception was the Pogue, with a surface pH between 8.6 and 8.8 during four of six monitoring events (the state upper pH standard is 8.5).

Eight years of monitoring under the NETN protocol has provided critical baseline information on the chemical and physical status of the Pogue and Pogue Brook. 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, are helping to 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

To see the park’s water monitoring sites, visit the Google Earth Park Maps web page (accessible through the leftmost suite of menu choices on NETN’s homepage), where you can also view associated watersheds as well as other NETN monitoring sites.

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Full Report online at:
<http://irmafiles.nps.gov/reference/holding/494446>

NETN Water Quality Monitoring webpage:
<http://science.nature.nps.gov/im/units/netn/monitor/programs/lakesPonds/lakesPonds.cfm>



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