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Water Quality Monitoring Update

Results of the 2012 Water Quality Monitoring Season for Minute Man NHP

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. 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. A total of three park streams are sampled monthly from May through October. All monitoring data are incorporated into a series of comprehensive databases that feed into an EPA data system.



A view of the Concord River from the North Bridge. NPS photo.

Two streams, Mill Brook and Elm Brook, as well as the Concord River wend their way through the park. One water quality monitoring site was selected on each of these water bodies. Mill Brook and Elm Brook are classified as capable of supporting cold water fisheries, loosely defined as waters that can support, on a year-round basis, wild and stocked brook trout or other species requiring similar conditions. The Concord River is considered capable of supporting warm water fish (bass, pickerel, sunfish). See NETN’s Google Earth park module for locations of monitoring sites.

Monthly sampling measurements include pH, specific conductance, temperature, dissolved oxygen, weather, stream flow (discharge), and stream stage (water level). Grab samples of water obtained in May and August were analyzed for acid neutralizing capacity, color, and nutrients. Beginning in 2012, fractions of these water samples were also analyzed for dissolved organic carbon, chloride, and sulfate.

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 from 2012 were within the appropriate range, and were generally within the range of the data from previous years.

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. Massachusetts standards, similar to those of most northeast states, indicate that a pH between 6.5 and 8.3 is within the acceptable range. pH values from the 2012 monitoring season were circumneutral or slightly basic and were all between the upper and lower state water quality standards.

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 in 2012 were generally within the state water quality standards for the appropriate stream types, excepting the high June and August Mill Brook measurements which likely reflected the contributions of low flow, high air temperature, and solar radiation.

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. Elm Brook was well oxygenated throughout 2012, and most measurements from the two other sites were above the state DO standard. Corresponding to the high surface temp in August, that month's measurement from Mill Brook was slightly below the state 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. Median color values from 2006 to 2012 monitoring show that park streams tend to be highly colored. Spring and summer measurements from Elm Brook were very close to each other in value and just below the overall median, while the Mill Brook and Concord River values were more variable. Much of the color is likely due to runoff and sediment input to the streams, rather than dissolved constituents, since the samples were not filtered before analysis.

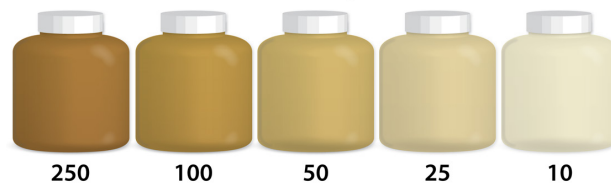
NETN began measuring **dissolved organic carbon (DOC)** in 2012. Carbon is a nutrient required for biological processes. Sources of organic carbon in water include humic substances from plant and soil organic matter, wetland peat deposits, and atmospheric deposition. Certain forms of DOC can contribute 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. DOC concentrations in most streams in temperate zones range from 1 mg/L to 20 mg/L, with a worldwide mean of 5.75 mg/L. Park DOC concentrations were moderate in 2012, with most values slightly higher than this mean.

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 the 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

Turbidity (NTU)

Water Samples:



Samples of different turbidity levels.

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 all park streams during 2012 were all in the low range of dry-weather turbidity of surface waters, which normally ranges from 0 to 10 NTU.

Most water quality parameters for the streams monitored in Minute Man National Historical Park are within state standards, and were generally within the range of non-

Summary

regulatory EPA ecoregional criteria, where applicable. The majority of values were within the ranges of the historic NETN monitoring data from the park. Monitoring under the NETN protocol builds on the historic water quality monitoring by park staff and other agencies to provide critical baseline information on the chemical and physical status of the water resources of the park. Several changes implemented in the 2012 monitoring season 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 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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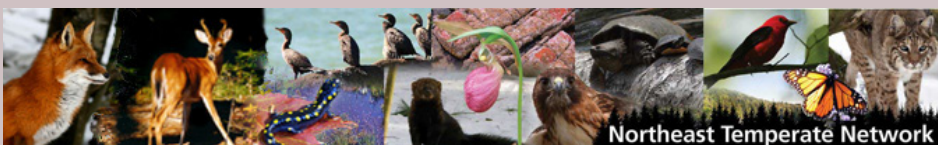
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Full Report online at:
<http://science.nature.nps.gov/im/units/netn/monitor/programs/lakesPonds/lakesPonds.cfm>



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