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MORRISTOWN NHP • ROOSEVELT-VANDERBILT NHS • SAINT-GAUDENS NHS • SAUGUS IRON WORKS NHS • SARATOGA NHP • WEIR FARM NHS

Water Quality Monitoring Flows On

Results of the 2011 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. A total of three park streams are sampled monthly from May through October by a cooperater from the University of Vermont or a NETN hydrologic technician. 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.

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).

Monthly sampling parameters included water quality measurements (pH, specific conductance, temperature, and dissolved oxygen), weather, stream flow (discharge), and stream stage (water level). Water samples obtained in May and August were analyzed for acid neutralizing capacity (ANC), color, and nutrients. Nutrient chemistry parameters were analyzed from a grab sample.

Results and Findings

Complete details of 2011 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 2011 were within the appropriate range for Minute Man 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. 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 2011 monitoring season were circumneutral, and were all between the upper and lower Massachusetts 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



Kayakers enjoy the serene waters of the Concord River. Johnida Dockens photo.

the temperature, the less oxygen it can hold. Temperature can also determine the kinds of plants and animals found in the lake or pond. Certain species of fish, insects, and algae will predominate during the cooler temperatures of the spring and fall, yet be less apparent during the warmer temperatures of summer.



Certain species of fish, such as brook trout, need stream and river temperatures between 13° and 18°C (55° and 65°F) to thrive.

Surface water temperatures in 2011 were generally within the state water quality standards for the appropriate

stream types, excepting the July Mill Creek measurement of 22.43°C. The July and August values reflected the contributions of 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 2011, and most measurements from the two other sites were above the (6 mg/L) state DO standard. June, July and October measurements from Mill Brook and the September measurement from the Concord River were slightly below the 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. Median color values from 2006 to 2011 monitoring show that park streams tend to be highly colored. 2011 measurements from Mill Brook and the Concord River were above the median value, and the Elm Brook color was below the 2006-2011 median. 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. Monthly turbidity measurements, which began during the current monitoring season, may provide additional information on the impacts to streams from episodic runoff events.

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 showed that all streams had sufficient buffering to avoid severely depressed pH values from spring snowmelt and runoff that can contribute acidity and sediment to the stream water.

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. Test results for three forms of nitrogen were moderately high in most 2011 samples. Results for NO₂ were low at all sites. All ammonia (NH₃) test results were below the method reporting limit. All total phosphorus results were significantly above the EPA Region 14 criterion, and two other forms of phosphorus were in the moderate range in all streams. These results indicate that some nutrient enrichment is occurring in park waterways.

Summary

Most water quality parameters for the streams monitored in Minute Man National Historical Park are within state standards, and are generally within the range of non-regulatory EPA ecoregional criteria, where applicable. The majority of values are 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 Minute Man National Historical Park. Several changes will be implemented in the 2012 monitoring season, including taking monthly stream turbidity measurements, and the addition of sulfate, chloride, and dissolved organic carbon (DOC) analyses to the spring and summer water chemistry testing. These changes 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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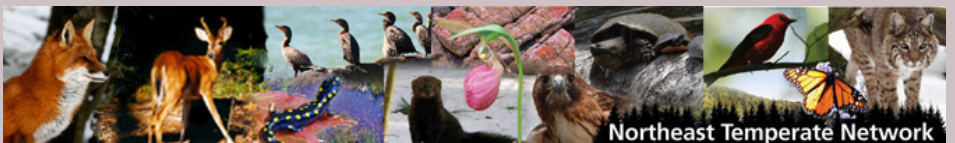
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Full Report online at:
<http://science.nature.nps.gov/im/units/NETN/index.cfm>



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