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

Water Quality Remains Good for Pogue Pond and Stream

Results of the 2011 Water Quality Monitoring Season for Marsh-Billings-Rockefeller 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. Sampling is performed monthly from May through October. In 2011, a cooperator from the University of Vermont or a NETN hydrologic technician 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 a series of comprehensive databases that feed into an EPA data system. A stream sampling site represents Pogue Stream - the only stream within the park, and it has been monitored annually since 2006. Pogue Stream 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. The stream monitoring site was selected as the most downstream site within the park boundary with easy access and the ability to obtain an accurate discharge measurement over a range of water flows. There is also a pond monitoring site at the Pogue, an 11 acre pond situated at the headwaters of Pogue Stream. See NETN’s Google Earth park module for locations of monitoring sites.

Monthly sampling includes water quality measurements (pH, specific conductance, temperature, and dissolved oxygen), transparency (pond site only), weather, stream flow (discharge), and stream and pond stage (water level). In May (stream only), June (pond only) and August (both sites), water samples were obtained and analyzed for acid neutralizing capacity (ANC), color, and nutrients. The pond sampling procedure entailed collecting all measurements and water samples from the deepest point of the pond (approximately 10 feet).

Results and Findings

Six years of monitoring under the NETN protocol have provided critical baseline information on the chemical and physical status of the Pogue and Pogue Stream. Refinements of the monitoring

protocol and enhanced quality assurance and quality control procedures have improved the data quality with each subsequent year, allowing a better understanding of the seasonal and temporal variability of individual constituents within each water body. 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. 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 moderate to high range.

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. Vermont standards, like those of most New England states, indicate that a pH between 6.5 and 8.5 is within the acceptable range. pH values from the 2011 monitoring season were moderately basic, and mostly were within the upper and lower Vermont water quality standards.



A misty morning on the 11 acre Pogue pond. Ed Sharron photo.



A Secchi disk helps measure a water body's transparency level. Pictured are a Secchi disk, measuring tape, and viewing scope (left) and view of submerged Secchi disk through viewing scope (right). NPS photos.

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 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. Surface water temperatures appeared to be within the normal range of variability in 2011, though the Pogue did reach over 80°F in July, a reflection of 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. Both sites were well oxygenated in 2011, and were above the more stringent Vermont 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. Apparent color measurements from 2011 samples showed the Pogue to be moderately colored, and both spring and summer values were very close to the overall average. Pogue Stream color values were lower than those of the Pogue.

Transparency measurements can provide simple and affordable assessments of pond and lake productivity. Variation in precipitation is one of the major factors contributing to annual shifts in transparency. Often during drier conditions lakes and ponds will become clearer due to lower runoff of nutrient and soil inputs. In contrast, decreased transparency readings can often be attributed to the effects of high levels of spring and fall precipitation, as well as the cumulative effects

of a high rainfall year. It is difficult to obtain transparency measurements with a Secchi disk in the Pogue. Due to the water clarity and shallow depth, the disk hit the pond bottom before disappearing from the observer's view in all 2011 measurements. In measurements taken with the 120 cm turbidity tube, the small target disk on the bottom of the tube was always still visible as well. During 2012 season, NETN is now measuring light attenuation using an underwater photocell to provide additional information on the water clarity and trophic characteristics of the Pogue. Stream turbidity (of Pogue Stream) will also be measured in the field with an electronic meter.

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. Nutrient levels are low (nitrogen) to low-moderate (phosphorus) but could be susceptible to increased loading from runoff. There were no indications that any significant nutrient enrichment took place during the 2011 season.

Summary

All water quality parameters for the Pogue and Pogue Stream are within state standards (with the exception of the Pogue pH of 8.59 in June), and are generally within the range of non-regulatory EPA ecoregional criteria, where applicable. Values were within the ranges of historic NETN monitoring data, although summer total nitrogen levels were the highest reported to date. Both water bodies were well buffered, and are unlikely to be affected by atmospheric acid deposition. The implementation of more sensitive measures of water clarity and turbidity during the current 2012 season will provide additional information on the water clarity and trophic characteristics of the Pogue and Pogue Stream.

More Information

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Full Report online at:
<http://science.nature.nps.gov/im/units/NETN/index.cfm>



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