



The Temperate Times

Newsletter of the Northeast Temperate Network

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Another Busy NETN Monitoring Season Begins

A long and snowy winter throughout NETN parks is finally yielding to spring. The snow pack is retreating, vernal pools are forming, amphibians are awakening, and wildflowers are starting to pop out. The coming of spring can only mean one thing: another busy monitoring season is under way and will soon be in full swing with an impressive list of activities for the 2011 season. Crews and volunteers will be monitoring water quality, forest health, coastal birds, landbirds, salt marshes, phenology, freshwater wetlands, and other network vital signs.

A few of the network's monitoring programs will be beginning their fifth or sixth year of consistent monitoring under network protocols. Though an accomplishment in its own right, this is still not long enough a time period to discern any scientifically viable trends, but with each passing monitoring season baseline

data continues to grow and will be invaluable to future studies.

While some network programs continue to mature, others are taking their first breath. Through a partnership with the EPA, wetland monitoring at Acadia National Park will begin its first year of data collection this monitoring season. The program is a mixture of intensive and rapid assessment for permanent wetlands in the park. In the first year of this long-term program, ten wetlands have been selected that are either excellent examples of wetland types or considered high priority wetlands for the park, or both.

The rocky intertidal protocol has been finalized and sites at Acadia and Boston Harbor Islands are being surveyed in preparation for full-fledged monitoring next season.
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Minuteman NHP - Captain William Smith House. Chris Devers photo.

Vernal Pools - Much More than a Mere Puddle

No NETN spring-issue newsletter would be complete without exploring the vital importance of vernal pools to the northeastern ecosystem. A vernal pool can be defined as an ephemeral (temporary) pond with an impermeable layer beneath it that is filled each spring with the meltwater of snow, rain, or seasonally raised water tables. The impermeable layer allows the pools to retain water much longer than the surrounding uplands, but - and this is a key point - the pools are still shallow enough to dry up each season. In NETN country, vernal pools are typically found in upland forest and floodplain depression systems.

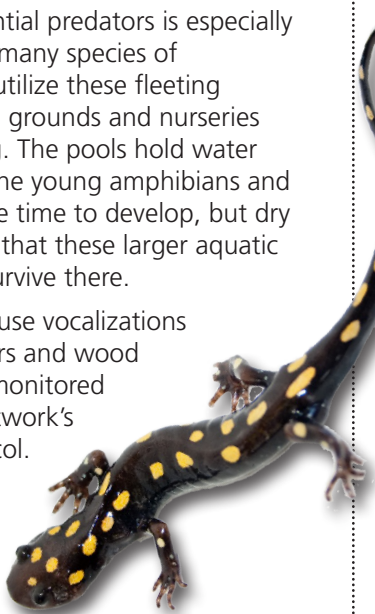
In spring, it is easiest to recognize a vernal pool by its lack of wetland vegetation such as cattails, pondweeds, and sedges. A sharper eye would also notice a lack of fish, bullfrogs, green frogs, and the larvae of some species of dragonfly.

This void of potential predators is especially important to the many species of amphibians that utilize these fleeting pools as breeding grounds and nurseries for their offspring. The pools hold water long enough so the young amphibians and invertebrates have time to develop, but dry up often enough that these larger aquatic predators can't survive there.

Amphibians that use vocalizations (i.e. spring peepers and wood frogs) are being monitored as part of the Network's phenology protocol. Pool monitoring may also be supplemented with water-level monitoring. NETN is also supporting research into mercury levels in the pools. Mercury

is a potent neurotoxin that has been demonstrated to have significant detrimental effects on amphibians including reduced reproduction performance, reduced growth and development, and impaired behavior including reduced foraging ability and ability to avoid predators.

The primary source of mercury in the environment is atmospheric deposition from anthropogenic (human produced) sources
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Spotted salamanders are one of many species that rely on the safe haven of vernal pools for breeding. Brian Gratwicke photo.

NETN Water Quality Reports Trickling In

Water quality reports for both Marsh-Billings-Rockefeller NHP and Acadia National Park have been published and are available for downloading on NETN's website (Monitoring/Lakes, Streams, & Ponds). Preliminary results in this first of a series of reports show both parks to have relatively good water quality conditions. These reports include data gathered in the first 4 years of the monitoring program (2006-2009) and display the results in graphic form, accompanied by brief

interpretations. At this early stage, the reports will not attempt to determine long-term trends for specific water quality parameters.

Monthly sampling measurements at NETN parks include pH, specific conductance, temperature, dissolved oxygen, nutrient enrichment, water quantity, and the detection of invasive plant species (see inset for an explanation of some of these terms). They were chosen to address the
water quality, cont' page 5.

Water Quality Measurements Defined:

Why We Measure What We Measure

As this article bandies about terms like *specific conductance* and *nutrient enrichment*, it is useful to take a moment to define these less obvious terms and why they are integral to NETN's monitoring program.

pH levels:

Water with a high pH level is more likely to be what is considered "hard" water. The pH of pure water is 7. In general, water with a pH lower than 7 is considered acidic, and with a pH greater than 7, basic (alkaline). Most New England states indicate that a pH between 6.5 and 8.5 meets state water-quality standards. Alkalinity is a measure of the capacity of the water to resist a change in pH that would tend to make it more acidic. The measurement of alkalinity and pH is needed to determine the corrosiveness of the water.

Specific conductance:

Specific conductance measures the ability of water to pass an electrical current and is an indicator of pollutants in the water. Directly related to the level of dissolved ions in the water, specific conductance values can range from less than 20 to more than 1,000 microsiemens per centimeter (uS/cm), but is most often less than 100 uS/cm. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, sulfate, sodium, calcium and others.

Conductivity in streams and rivers is affected by the geology of the area through which the water flows. Streams that run through granite bedrock will have lower conductivity, and those that flow through limestone and clay soils will have higher conductivity values. High conductance readings can also come from industrial pollution or urban runoff - water running off of impermeable man made surfaces such as streets, buildings, and parking lots. Extended dry periods and low flow conditions also contribute to higher specific conductance readings.

Water temperature:

Aquatic organisms are dependent on certain temperature ranges for optimal health. Temperature also affects many other parameters in water, including the amount of dissolved oxygen available, the types of plants and animals present, and the susceptibility of organisms to

parasites, pollution and disease.

Dissolved oxygen:

Fish and other aquatic organisms need oxygen to live. As water moves past their gills (or other breathing apparatus), molecules of oxygen gas in the water called dissolved oxygen (DO), are transferred from the water to their blood. Like any other gas diffusion process, the transfer is efficient only above certain concentrations. In other words, oxygen can be present in the water, but at too low a concentration to sustain aquatic life. Oxygen also is needed for many chemical reactions that are important to natural functions of lakes.

Oxygen is produced during photosynthesis and consumed during respiration and decomposition. Because it requires light, photosynthesis occurs only during daylight hours. Respiration and decomposition, on the other hand, occur 24 hours a day. This difference alone can account for large daily variations in DO concentrations and explains why DO is at its lowest levels just before dawn.

When pollution contributes oxygen-demanding organic matter (like sewage or lawn clippings) or nutrients that stimulate growth of organic matter, average DO decreases. Dissolved oxygen concentrations are reported in units of milligrams of gas per liter of water - mg/L (The unit mg/L is equivalent to parts per million - ppm).

Nutrient Enrichment:

Nutrients from agricultural areas, stormwater runoff, urban development, fertilized yards and gardens, failing septic systems, land clearing, municipal and industrial wastewater, and runoff from construction projects and recreational activities all contribute to accelerated enrichment. As lakes become nutrient-enriched, they produce more algae (sometimes leading to algae blooms) and aquatic plants. They may also increase numbers of certain fish species.

Water quantity:

Measures of water quantity are necessary for monitoring the physical status of freshwater ecosystems, and are fundamental to the interpretation of water-chemistry measures. As such, Inventory and Monitoring Program hydrologists identified water quantity measurements, such as discharge and lake levels, as a top priority for NETN parks.

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such as mining, power plants, and industry. Once it has entered the environment, mercury is transformed in aquatic systems to methylmercury. Methylmercury is of particular concern because it can bio-accumulate in organisms and bio-magnify up the food chain.

While mercury transformation has been fairly well studied in other aquatic systems, such as lakes and streams, research in vernal pool systems is lacking. The concern is that amphibians that spend significant amounts of time in vernal pools as either young or breeding adults, are being exposed to significant amounts of methylmercury. Mercury contamination is a likely contributing factor to the global decline of amphibians and amphibian exposure to methylmercury is a significant pathway for methylmercury to enter upland ecosystems and move up through the food chain.

Working in a partnership with NETN and the University of Vermont, Eric Davis is researching the environmental factors that are unique to vernal pool ecosystems. Since the 2010 field season he has been collecting water chemistry data for vernal pools and exploring how their ephemeral nature and proportionately high periphery areas that are continually in flux from anoxic (lack of oxygen) to aerobic (oxygen present) conditions affect the methylation of mercury. Results of the study will be published when they become available. TT



With ice still clinging to its surface, Eric Davis takes a water sample from one of Marsh-Billings-Rockefeller's vernal pools in mid-April. Ed Sharron photo.

Turnover Time for NETN Lakes and Ponds

Many of the lakes in NETN parks are deep enough to stratify, or form “layers” of water with different temperatures. Because of the unique properties of water, it is most dense (heaviest) at 39.2° F, and less dense (lighter) at temperatures warmer or colder than that precise number.

In fall, cooling temperatures chill a lake's surface causing the water to densify and sink to the bottom. Eventually the entire lake reaches about 39°F. As the surface water continues to cool throughout fall and winter, it becomes less dense and “floats” on top of the denser 39 degree water, until ice is formed at 32°F. The lake water below the ice remains near 39.2° F. This situation is referred to as *winter stratification* and is stable because the ice prevents wind from mixing the water.

As spring temperatures melt the ice and raise surface water temps above 32 degrees, the increasing water density along with wind action cause this surface water to sink and mix with deeper water—a process called *spring turnover*. At this time, most of the lake is at the same temperature, and surface and bottom waters mix freely which helps circulate nutrients throughout the lake. Lakes with a small surface area (like the 14 acre Pogue at Marsh-Billings-Rockefeller NHP), especially if protected from the wind, typically mix for only a few days. In comparison, large lakes (such as Acadia's 436 acre Eagle Lake) can circulate for weeks.

In late spring/early summer the sun warms the lake surface and increases its temperature difference from the deeper waters. In lakes deeper than about 12 feet, the temperature differences eventually create a physical barrier strong enough to resist the wind's mixing forces. The lake now stratifies into three distinct “layers” of water—called *summer stratification*. The upper layer is a warm (lighter), well-mixed zone called the **epilimnion**. Below this is a transitional zone where temperatures rapidly change called the **metalimnion**.

The metalimnion is very resistant to wind mixing. Beneath the metalimnion and extending to the lake bottom is the colder (heavier), usually dark, and relatively undisturbed **hypolimnion**. Often in the summer, the hypolimnion will become depleted of oxygen. The bacteria responsible for decomposition consume the oxygen and access to atmospheric oxygen is cut off by stratification. Summer stratification continues until fall when surface waters begin to cool and sink. The metalimnion begins to “erode” and weaken, and continues to do so as the lake cools. Wind energy helps mix the lake deeper and deeper. When the whole lake reaches a similar temperature, wind forces are again able to mix the lake from top to bottom in a process called *fall turnover*. The transition from summer stratification to fall turnover can occur within just a few hours, especially if accompanied by strong winds. Stratification is more than just an interesting natural phenomenon and has important implications for fisheries management, phytoplankton (algae) populations, and water supply quality. TT

Weir Farm NHS's small Weir Pond likely only mixes for a few days during the spring. D. Hubbs photo.

Invasives Species: Eradicate Early and Often

As NETN forest monitoring crews prepare for the 2011 season, they will be prepped on how to keep a wary eye out for unwanted intruders into NETN forests and fields. In broad terms, an invasive species is an organism that has been introduced deliberately or unintentionally into an environment in which it did not evolve, is capable of establishing self-sustaining populations in “untransformed ecosystems”, has no natural enemies to limit its reproduction and spread, and is likely to cause harm to human health or the environment. Early detection monitoring of invasive plants, animals and diseases was ranked among the top priorities for NETN in the vital signs selection process due to the clear identification of, and concern about, the effects these organisms can have on park ecosystems. The known ecological impacts of invasive species include loss of threatened and endangered species, altered structure and composition of terrestrial and aquatic communities, and reduction in overall species diversity. Invasive infestations can also be extremely expensive to control.

While long-term changes associated with invasive species are being monitored through other NETN protocols, it is also critical to catch new populations of invasive species early in their invasion of new and sensitive habitats. Only when invasions are caught early will the chance of eradication remain high.

Early detection monitoring in NETN parks includes the creation of individual park early detection species flip-books;

opportunistic surveillance monitoring of invasive plant and forest pest species that focuses on educating monitoring field crews, cooperators, volunteers, and resource managers on invasive species identification; and a coherent framework for reporting and spreading the word on potential infestations. This allows park resource managers to put limited time, money, and effort towards the highest priority risks.

Invasive plants are species that have become a “weed” pest - a plant which grows aggressively, spreads, and displaces other plants. Invasive plants tend to appear on disturbed ground, and the most aggressive can invade existing ecosystems. Like plant species, invasive insects can be introduced into new environments in a variety of ways. One example is when Etienne Leopold Trouvelot, a French immigrant living in Massachusetts in the 1860’s, released a Lepidopteran species in his own backyard. An amateur naturalist fascinated with silkworms, he brought some gypsy moth egg masses back from his native country. The larvae spread, and by the 1880’s the caterpillars were defoliating his neighborhood. Today they feed on forests

throughout the eastern U.S. and cost millions of dollars to contain.

As the above example shows, it is often easier to understand the benefits of early detection by calculating the costs of an invasion where it was not done. Damages associated with alien invasive species effects and their control amount to approximately \$120 billion a year. As an example, the total cost of destruction by introduced rats on U.S. farms is more than \$19 billion per year, while invasive weeds, pest insects, and plant pathogens cause several billion dollars

PERENNIAL PEPPERWEED [*Lepidium latifolium* L.] LELA2



Problem: Perennial pepperweed (PP) is native to southern Europe and western Asia.^{2,4} PP is an invasive plant that has become established in parts of New England and throughout the western US.⁴ As PP establishes and expands, it creates large monospecific stands that displace native species (Fig 1).^{1,4}

Habit: Erect, rhizomatous, semi-woody perennial (Fig. 2).^{1,2}

Reproduction: Primarily vegetatively via rhizome-like roots; seeds rarely germinate.^{1,2}

Leaves: Green to gray-green, glabrous, but sometimes hairy; basal leaves stalked, up to 1 ft. (30 cm) long and 3 in. (8 cm.) wide with serrate margins (Fig. 3).^{1,2} Stem leaves smaller, ranging from 3-10 in (7-25 cm) in length, tapered at the base, entire to weakly serrate and sessile to stalked (Fig. 4).^{1,4}

Stems: 1.5 m (5 ft.) tall plants emerge from thick, minimally branched roots or semi-woody crowns. Glabrous, although sometimes hairy.³

Flowers: Early summer to fall; small white 4-petaled flowers are borne in



HERB

Example of a page from Saugus Iron Works NHS flip book for invasive species early detection.



If the large Asian Long-horned Beetle becomes established among network parks, it will wreak havoc upon their sugar maple trees. Craig Nagy photo.

worth of losses to crops, pastures, and forests annually in the United States. The chestnut blight fungus and the virtual elimination of the American chestnut from U.S. forests and towns in the early 1900’s demonstrate the potential devastating economic and ecological consequences of invading species.

Eradication of well-established invasive species is difficult if not impossible in many cases, but early detection and associated management responses have proven effective in reducing if not eliminating the associated costs and consequences. TT

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objective to detect change in the status of physical, chemical, or biological attributes of ecosystems.

Marsh-Billings-Rockefeller NHP

All water quality measurements for the Pogue and Pogue Stream are within state standards, and are generally within the range of EPA criteria, where applicable. The values are similar to the extremely limited historical observations from the NPS Baseline Water Quality Data Inventory and Analysis. Both water bodies were well buffered, with pH values between 8.0 and 8.5, and are unlikely to be affected by atmospheric deposition of pollutants. Nutrient levels are low (nitrogen) to moderate (phosphorus) but could be susceptible to increased loading from runoff.

Acadia National Park

Park lake levels and stream flows vary with the seasons, and it is clear that changes in water quantity and its effects on water quality must be viewed together with the apparently increased

variation in annual and seasonal environmental/climatic patterns experienced in recent years. Dissolved oxygen levels are within the expected ranges for each water body tested in the park. Results of summer (May-June/August) nutrient sampling showed that phosphorus, nitrogen and chlorophyll *a* concentrations from 2006 to 2009 are relatively low, and are generally within historical ranges for Acadia waters.

Four years of monitoring under the NETN protocol have provided critical baseline information on the chemical and physical status of NETN park waters. 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. Water quality reports for other NETN park sites will be posted to the website as soon as they are published in the coming months. *TT*



Stream monitoring in Acadia National Park. M. Goff photo.



Some of the tools of the trade for the Northeast Regional Migration Monitoring Network. Brian Olsen photo.

monitoring, from page 1.

The Northeast Regional Migration Monitoring Network (a coalition of partners from the NPS, US Fish & Wildlife Service, and several academic institutions) will add to two years of research helping to determine how migrating species - such as waterfowl, seabirds and shorebirds - use the Gulf of Maine's complex network of islands and coastal areas. Using a combination of decades-old monitoring techniques and newer technologies, Network researchers are examining migratory movements made by both large groups of birds and individuals.

NETN's phenology monitoring program continues its second year of data collection with audio recording devices set out in both Vermont's Marsh-Billings-Rockefeller NHP and New York's Saratoga NHP. The audio data is later analyzed with computer software that can recognize the calls of springtime amphibians and birds.

The invasive species early detection program will continue to have park staff, forest monitoring crews, and the visiting public help keep a close eye out for any invasive plants or other pests on the Network's "Most Wanted" list. This has become especially important since Asian Longhorn Beetles and Emerald Ash Borers have been detected not far from some network parks.

Check in on NETN's website throughout the year to keep tabs on network monitoring efforts and the resulting published reports. *TT*



Northeast Temperate Network

54 Elm Street
Woodstock, Vermont 05091
802-457-3368
<http://science.nature.nps.gov/im/units/netn/>



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