



The Temperate Times

Newsletter of the Northeast Temperate Network

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Veg-out with Saratoga's Vegetation Map & Report

In 2003, the NPS National Vegetation Inventory Program (NPS NVIP) began funding the initiative to classify and map the vegetation of Saratoga National Historical Park and to create digital geospatial databases. A preliminary vegetation map of the park was created and was used to help plan the vegetation classification plot sampling strategy. 185 plots were sampled throughout the park which revealed 303 vascular plant species that were classified into 53 vegetation associations.

The study found that the diversity and distribution of vegetation associations within the park are primarily a result of four factors: the geologic history of the region (especially glaciation); its location along the Hudson River within a temperate climate; the diverse topography including ravines, high-level hills, floodplains, and basin wetlands; and its setting within a rural agricultural landscape with both historic and modern land use practices.

The Saratoga NHP vegetation classification and map provides an effective context for interpreting vegetative resources and serves

Veg-out, cont. page 2.

What's the Buzz? Bee, Wildflower, and Deer Research in Morristown NHP

A master at observing the interconnectedness of nature, John Muir once wrote "When we try to pick out anything by itself, we find it hitched to everything else in the Universe". These connections are not always obvious, such as the case may be for the relationship between birds, wildflowers, white-tailed deer, and our most important pollinator of both natural and agricultural plants - bees. Due to a combination of factors including a lack of "top-line" predators and the creation of abundant edge habitat by humans, Northeastern forest ecosystems are becoming increasingly impacted by an over-abundant deer population. Stresses on area forests are only likely to intensify further due to climate change and the resulting phenological shifts which may throw off the synchronicity of native bee emergence with flowering times of wildflowers and plants. Morristown National Historical Park is currently playing host to a doctoral thesis to better understand these impacts on forest ecology. Caroline DeVan,

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Wildlife Tracking Program Continues this Winter

The vital signs that NETN monitors in network parks make up the key components to healthy, fully functioning ecosystems. The wildlife that lives within these parks are reliant on many of these vital signs, and a diverse array of animals that fulfill many natural functions can also be indicators of a healthy ecosystem. NETN's *TSI: Track & Sign Investigations* takes a crime-solving approach to looking for signs of wildlife, including reviewing a list of usual suspects, studying prints, and learning about the *modus operandi*, or typical behaviors of many animal species.

Tracking is not only a fun way to spend a winters day outdoors, it is also becoming a more oft utilized tool in the tool belt of many groups that monitor wildlife populations. NETN's Maine Appalachian Trail Rare Mammal Survey in 2008 used Canada Lynx tracks and sign to estimate population levels of this elusive predator, and winter deer pellet surveys are a relatively quick and easy way to get a gross estimate of their numbers.

Science communication specialist Ed Sharron will once again be leading TSI programs in the Vermont area. Over the course of the winter several public presentations will be offered at Marsh-Billings-Rockefeller NHP, as well as local schools and conferences.

Typical 'usual suspect' animal tracks and sign seen in the past on these programs have included fisher, weasels, red and gray fox, coyote, deer, bobcat, turkeys, and many more. See NETN's website and click on the TSI link at the bottom of the page to learn more about the program and to see the dates when it is being presented. *TT*



Pomfret, VT 6th graders use their tracking skills to identify a bounding fisher trail during a recent presentation of TSI at Marsh-Billings-Rockefeller NHP. Hali Roy photo.



Floodplain forests occupy low-lying areas next to streams and rivers and are subject to periodic over-the-bank flooding events and cycles of erosion and deposition. Their soils are often rich in minerals and they were often one of the first areas cleared for agriculture in the Northeast. USFWS photo.

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as a baseline for future research. This project provides the most detailed study to date of the distribution and diversity of plant associations in the park. As with other studies in the area, the vegetation inventory helped to highlight the exceptional floristic diversity of the Hudson River floodplain, adjacent uplands, and managed lands. Of the 53 U.S. National Vegetation Classification (USNVC) associations found, 15 were successional or modified types that have become established following forest clearing or the cessation of agricultural activities, from forest plantings, or from the advent of invasive species. These associations account for approximately 63% of the mapped area within park boundaries. Just over 40% of the park is classified as one of the following three successional associations: White Pine Successional Forest, Northeastern Old Field, or Early-Successional Woodland/Forest. The remainder represents land cover created or influenced by human activity such as managed fields, roads, parking lots, and buildings.

Saratoga NHP supports several vegetation associations with biodiversity significance at the state and global level. While there are no large examples of globally rare associations within the park, there are small patches of four associations within the park that are considered rare by NatureServe. These include American Beech – Maple Glaciated Forest, Hairyfruit Sedge Wetland, Wild Rice Marsh, and Shale Talus Slope Woodland.

Three NY Natural Heritage natural communities within the park are considered significant from a statewide perspective, and include floodplain forest, vernal pool, and successional fern meadow. The 70-acre floodplain forest along the Hudson River near Bemis Heights is a very good example of this natural community with only a few invasive exotic plant species which can sometimes be numerous in this community type. This is the first significant occurrence of floodplain forest to be surveyed and documented by NY Natural Heritage on this reach of the Hudson River north of Troy, NY and it's discovery was considered to be one of the major highlights of this project and could prompt further searches for more examples up-and-down river from the park. Prior to this mapping effort, it was thought that very little floodplain forest remained between Fort Edward and Troy and any remaining patches were presumed to be of low quality.

A vernal pool complex found near Burgoyne's Headquarters along the tour road represents a significant occurrence of this unique community. It is

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Acadia National Park Forest Health Monitoring Notches 8th Year

With the end of the 2013 field season, NETN completed its eighth consecutive year of forest health monitoring in Acadia National Park, and nearly all 176 forest plots have been sampled twice. To help easily interpret forest ecosystem conditions, the network developed an Ecological Integrity Scorecard which assesses a host of compositional, structural, and functional measurements in relation to their natural or historical range of variation. Integrity is interpreted using three simple categories: Good, Caution, and Significant Concern. “Good” represents acceptable or expected conditions; “Caution” indicates that a problem may exist; and “Significant Concern” warns of undesired conditions that may only be treated through direct management action.

The most recent monitoring results indicate that forests in Acadia are approaching mature stages of forest succession, and that overall forest condition is good. Human land use surrounding forest plots continues to be minimal, and the majority of forest area occurs in patches greater than 120 acres. The park’s forests are largely composed of native species, and only three out of 176 plots have detected indicator invasive plant species. Beech bark disease and balsam woolly adelgid are the only major tree pests or pathogens that have been observed in plots. Forest soils are robust to nitrogen saturation, but vulnerable to acidification. Abundance of tree regeneration is adequate, and patterns of regeneration reflect those of earlier successional and mature forest stages. Impacts from deer browse on tree regeneration and understory plant species are minimal. Late-successional structure, such as coarse woody debris and large snags, is below desired levels, particularly in the eastern section of Mount Desert Island (MDI) and on Schoodic. As forests are left to mature further, these structural components are expected to increase over time.

Tree growth rates are lower than regional growth rates but this likely due, in part, to the higher proportion of late-successional and mature plots in the park than the surrounding forestlands. Overall tree mortality was rated “Good” for all units except Schoodic, which had a relatively high mortality rate for red spruce trees. Forests on Schoodic are primarily even-aged spruce-fir stands that are beginning to break up and move into later successional forest, and this may partially explain the high mortality rate. If red spruce continue dying off in large numbers on Schoodic for a long period, it may indicate a more serious forest health concern. Balsam fir and big tooth aspen also had elevated mortality rates. Higher mortality rates for balsam fir are likely influenced by the presence of balsam woolly adelgid, and big tooth aspen mortality is likely the result of forest succession.

Tree diameter distributions across all park units are typical of second-growth spruce-fir forests, with few trees of large diameter and many trees in smaller size classes. Seedling densities and composition are also consistent with patterns expected for spruce-fir forests that are reaching maturity. Regeneration is abundant, and is primarily composed of shade-tolerant species that are capable of reaching the canopy

in small canopy gaps. Red spruce is the dominant species, with this particularly being the case on Isle Au Haut (IAH) and Schoodic. Jack pine on Schoodic, and pitch pine on IAH are also common canopy species in conifer woodlands, but are uncommon in the regeneration layer.

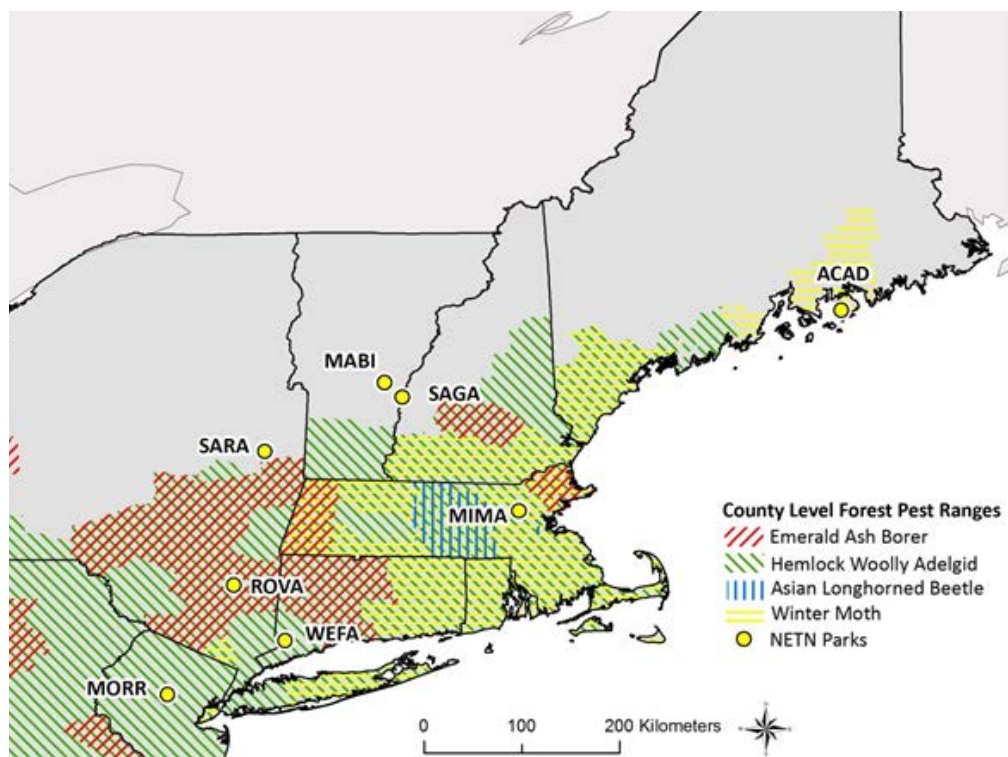
Tree composition is more diverse on MDI than IAH and Schoodic. This is particularly true for eastern MDI, which, due to the large fire of 1947, has a sizeable component of early successional forest. The early successional species of big tooth aspen and birch are relatively common canopy trees in this section of the park. However, red spruce, balsam fir, and northern hardwood species occur at higher seedling densities than birch and aspen, indicating, as would be expected, that stands are shifting to later successional forest species.

The understory is dominated by woody species. On IAH and Schoodic, shrubs make up the greatest percent cover, and this is primarily from black huckleberry and low bush blueberry plants, both of which are often abundant in conifer woodlands. Tree seedlings make up a large percentage of cover in the ground layer across all units. While fern, forb and grass species are consistently present in the ground layer, they typically occur as only a few individuals per species. These patterns are expected for spruce-fir forests, which tend to support a seedling bank of advanced tree regeneration in the ground layer and generally lack a well-developed herbaceous layer.

Acadia forests, cont. page 4



The NETN forest crew takes stand measurements in a typical spruce-fir forest at Acadia National Park. Kate Miller photo.



Exotic forest pest detections near Acadia and the other NETN parks. Pest ranges were mapped at the county level and were downloaded from the Alien Forest Pest Explorer and the Cooperative EAB Project. Asian Longhorned Beetle range only reflects the most recent detections that have yet to be eradicated. So far, Winter Moth poses the most proximal threat to the forests of Acadia.

Many of the species that are common to the forest canopy are relatively long-lived and once established in the canopy, may be somewhat resistant to stresses caused by climate change. In contrast, seedlings are relatively short-lived and more sensitive to environmental changes, and the results from this analysis serve as an important baseline to track future changes in forest composition.

Soil test results suggest forest soils in the park, which have high organic content, low pH, and low base saturation, are the most vulnerable to acidification of all network parks, despite receiving the lowest annual acid deposition rates in the network.

While over 60% of the Ecological Subsection that includes Acadia National Park is forested, forestlands outside the park are largely under private ownership and in timber production, whereas forests in the park are reserved from timber production. This difference in management regimes has resulted in park forests that are distinct from the surrounding mix of forestlands. The proportion of plots in late-successional forest and mature forest plots is higher in every park unit than the surrounding forest. Indicators of older forest structure, such as coarse woody debris, large snags, and large live trees are often more abundant in park units than the surrounding more intensively managed forests. These results suggest that forests in the park may represent regionally significant, older forest habitat, and will continue to offer more as they succeed.

In 2013 NETN began coring trees adjacent to forest plots on western MDI to better understand how stand age relates to ecological integrity, and to determine how well tree diameter

at breast height (DBH) relates to tree age. Results supported the network's assumption that larger DBH trees tend to be older than smaller trees, but only for co-dominant trees. That said, there was a lot of variability in the data, indicating that DBH is not necessarily the best predictor of tree age. In most cases, stand ages derived from tree cores supported the structural stage designated by NETN's structural stage ecological integrity measurement, but structural stages may be a bit conservative. In contrast, snag abundance and coarse woody debris, which are expected to be higher in older forests, varied greatly across park plots, and there were no clear patterns with stand age. But with only 16 plots of age data, analysis has been limited, especially for coarse woody debris and snags, which tend to be rare features on the landscape.

Comparisons between co-dominant and intermediate tree ages within the same plot revealed that plots with co-dominant trees less than 80 years old at DBH also had similar ages for intermediate trees.

This follows patterns expected for mature forests, which are generally composed of a single-aged cohort of trees. On plots with co-dominant trees over 80 years old at DBH, intermediate trees tended to be several decades or more younger, which is suggestive of a later successional forest. Overall, results from the first year of coring revealed valuable information about forest stands on western MDI, and the network expects to learn more as additional plots are cored.

In summary, 8 years of collecting data on Acadia's forest conditions has shown that it is influenced and threatened by a range of stresses, including invasive plants, exotic pests and pathogens, acid deposition, and climate change. While late-successional structure (e.g., coarse woody debris and snags) is below desired levels, the overall condition of park forests is good, especially compared to the surrounding matrix of more heavily managed forestlands, and compared to other NETN parks. Continued invasive species management and early detection efforts are vital to maintain forest condition, as invasive species have the potential to drastically alter forest composition and structure, and may respond more favorably than native species to climate change. As long as forests are left to mature, and management activities do not reduce the potential for development of late-successional structure (e.g., cutting and/or removing coarse woody debris), network scientists expect the ecological integrity of park forests to continue to improve and be regionally significant in their low level of invasive plants, and extent of older forest structure and habitat.^{TT}



Too many white-tailed deer can completely change the look and ecology of a forest through their browsing activities. This forest displays a very evident "browse line" and dearth of growth in the understory which is typical of forests with an overabundance of deer. NPS photo.

What's the Buzz, from page 1

a PhD candidate at the New Jersey Institute of Technology, is spearheading the study which is taking a closer look at the relationship between white-tailed deer browsing habits, wildflower availability and emergence times, and insect pollinator populations - particularly bees. As generalist herbivores, deer preferentially feed upon certain tree and shrub seedlings and saplings that can reduce the diversity and abundance of flowering plants. Damage can be so severe that many ecologists and forest biologists consider the over abundant deer population to be the single greatest threat to the ecological health of northeastern forests. In Morristown NPH, bee communities are being surveyed in order to study potential trophic cascades (an ecological process that starts at or near the top of the food-chain and eventually makes its way to the bottom) of deer feeding habits on floral resources also used by bees.

In the past it was thought that an ecosystem was built from the bottom up and ecological restoration projects often focused on the plant community with the belief that non-target species would also be restored once a critical mass of healthy plants had been established. Scientists believed that when this happened, insects, small mammals, birds, larger herbivores and finally the top predators fell neatly into a balance with each other. We now know that this may have been putting the cart before the horse, since some non-target species (such as insect pollinators) may actually be integral to the long-term success of plant restoration.

Studies of trophic cascades, where one or two keystone species greatly influences the ecology and behavior of dozens of other species, is relatively new to science. Perhaps the most famous example of a trophic cascade is what happened in Yellowstone National Park after the reintroduction of wolves in 1995. Before wolves were brought back into the mix, they had been absent from the Yellowstone ecosystem for almost 70 years. In that time, the numbers of deer and elk became artificially high and despite efforts by the park to control them, they reduced vegetation in some areas to almost zero (is this starting to sound familiar?). When wolves came back on the scene many interesting and sometimes unexpected things began to take place. To no one's surprise, they began to hunt elk and deer but, more significantly, they also completely changed the behavior of these animals. Ungulates started to avoid parts of the park where they could be most easily preyed upon by the wolves - particularly valleys and gorges. Almost immediately those places started to regenerate, with the height of the trees quintupling in just 6 years in some cases. What were once over browsed, bare valleys soon became filled with saplings of aspen, willow and cottonwood trees. When this happened, many migratory bird species started moving in again and beaver numbers increased as well. Beavers in turn created niches for other species with the ponds they made providing habitat for otters, muskrats, ducks, fish, and amphibians. Perhaps most unexpectedly though, the wolves also changed the behavior of park rivers. With more streamside vegetation, erosion abated and rivers began to meander less. More pools formed, and more riffle sections were created - all of which are ideal fish and other wildlife habitat. It seems Mr. Muir may have been on to something.

What's the Buzz, cont. page 6

NETN Hits the Books

NETN has authored a chapter in a new book dedicated to the natural resource management decision making process. The book's snappy title?: *Application of Threshold Concepts in Natural Resource Decision Making*. While it is not likely to compete in popularity with any book in the Suzanne Collins portfolio, this important book explores the challenges natural resource managers face in the difficult decision-making environment that National Parks present. Managing parks will only continue to become more complex in an era of rapid or abrupt ecological shifts that climate change will likely cause.

Looking back on the long natural history of Earth has shown that once an ecological threshold is crossed, that ecosystem is not likely to return to its previous state. Future climate changes are likely to drive what are currently stable systems across new ecological thresholds.

With this in mind, the book is designed to help resource managers see the value of including ecological threshold concepts in resource management. NETN's chapter describes and illustrates how concepts of ecological integrity, thresholds, and reference conditions can be integrated into a research and monitoring framework. NETN assesses "ecological integrity" by measuring the composition, structure, and function of an ecosystem in relation to its natural or historical range of variation, as well as changes caused by natural and human sources. Two case studies are presented using ongoing monitoring by the NPS I&M program that shows how an ecological integrity approach can be used to communicate ecosystem status to resource managers. In Rocky Mountain National Park, a Wetland Ecological Integrity case study uses an analytical approach that specifically puts threshold detection into the process of establishing assessment points. The Forest Ecological Integrity protocol that NETN uses in Northeastern National Parks is the second case study, and explores how this method is utilized for reporting ecological integrity to resource managers and other park management decision makers. The book will be available for purchase on Amazon.com and other vendors starting in March.^{TT}

Wolf reintroduction to Yellowstone has not been without controversy and other consequences, but it did inform science that in order to have a fully functioning, self-regulating trophic system in Yellowstone, a top-line predator needed to be re-added to the equation. Top-line predators such as wolves and mountain lions have been missing from the ecosystem of the eastern half of the country for well over a century in many places, and although eastern coyotes have begun to fill in that niche to a small degree, the deer population has exploded across much of the region in recent decades. With deer putting extreme pressures on the floral resources available to pollinators, and bees in particular, there are concerns that these insects may be in decline. Human influences such as habitat destruction and climate change are only exacerbating the problem. Many insect species are dependent on only one or two varieties of host plants. The greater the variety of plant species, the greater the number of bee, butterfly and other insect species there are which can also influence the numbers and kinds of wildlife and bird species in the area.

In Northeastern forests, bees forage primarily in the early spring, visiting the first wildflowers in the understory. Competition from invasive plant species (which deer often avoid) and high levels of deer browsing in some forests have decimated understory wildflower diversity, but the impacts of this loss on bee communities have yet to be quantified. Impacts on birds have been proven however, through data collected by the Vermont Center for Ecostudies and Cornell's Lab of Ornithology, which showed over browsing by deer on understory vegetation can make it extremely difficult for shrub and ground-nesting birds such as Wood Thrushes, White-throated Sparrows, Hermit Thrushes, and Black-throated Blue Warblers to find suitable nesting sites. Deer browsing also impacts the quantity and quality of bee nesting availability. By selectively browsing on shrubs, deer may reduce potential cavity nesting sites for bees while simultaneously increasing the availability of bare ground and potentially benefiting below-ground nesting bees.

To help better understand these complex relationships, the Morristown NHP study is comparing plant and pollinator communities within deer exclosures (fenced in areas that deer cannot access) and "control sites" outside of deer exclosures where the animals have free reign. NETN is indirectly playing a part in the study in that bee nest boxes are strategically located about 60 meters away from NETN permanent forest monitoring plots. The nest boxes are checked for colonization by cavity nesting bees such as mason and leaf-cutter bees. Cavity nesting bees are solitary (as opposed to the social honey bees) and use pre-existing holes or cavities to make their nests. These kinds of bees in particular are being studied in part because they emerge in early to mid-spring and are phenologically sensitive to temperature. In other words, they time their emergence based on how warm it is outside. The study is also keeping track of the "phenological synchrony" between the bees and the flowers they rely upon to determine



Looking up into a nest box affixed to a tree in Morristown NHP. Mud caps covering a hole indicate a bee nest. Carol DeVan photo.

their sensitivity to climate variability. The nest boxes are being monitored for species diversity and colonization rates, and the bees' nests are studied to determine pollen usage. This information is then compared and contrasted with plant data collected by the NETN forest monitoring crew in the nearby forest study plots in order to determine how plant communities may influence nest site selection by cavity nesting bees. In 2012, three species of bees nested in the boxes, two of which were non-native. Not surprisingly, preliminary results have shown that plant communities within deer exclosures have a much higher abundance of insect pollinated plants than unprotected areas. By providing areas with a high diversity and abundance of native flowering plants, deer exclosures could help to support insect pollinator communities. For this same reason, many landscape designers, horticulturalists, and garden centers are increasingly recommending that homeowners landscape with indigenous plants whenever possible, and to protect them from deer browsing. In the hardest hit places these small plots may be the last remaining refugia for many native insect populations.

Information collected during the study will be used to determine the impact of deer exclosures vs. control sites on bee community composition as well as on floral community data, bee nest-site availability, and nest box colonization rates. It is hoped that this project will help to inform ecological restoration in eastern deciduous forests by determining both how one restoration technique (deer exclusion) impacts bee communities and by providing further information on what might be causing limitations on these pollinators in the area. By understanding which aspects of restoration support bee diversity and abundance, park managers will be able to focus their efforts for more directed management of this important pollinator group.

For total community restoration, the interactions between plants and other organisms, including their insect pollinators, must be better understood and supported. This study is taking a step towards strengthening that understanding.^{TT}

comprised of several pools of varying size and depth totaling about 2.5 acres. The vernal pool series is characterized by fluctuating water levels as well as the presence of a variety of invertebrates and amphibians, including fingernail clams, wood frogs, and spotted salamanders. Pools range from sparsely vegetated to supporting somewhat dense cover depending on the season and the amount of overhead tree canopy cover.

A rare successional fern meadow, also located near Burgoyne's Headquarters, represents only the second state occurrence of this community type documented by NY Natural Heritage. An impressive nine fern species highlighted the diversity of just one 10 m x 10 m plot. While NY Natural Heritage places successional communities at a lower conservation priority, this occurrence within the park is a very good quality example and is likely uncommon or rare for this part of NY. Fern meadows are primarily a fire-maintained community and in the future there will likely be fewer of these sites without prescribed fire to ensure their long term viability.

Speaking of fire, at least two other associations are maintained by fire as prescribed in the Saratoga NHP Fire Management Plan: Little Bluestem Old Field and Steeplebush

/ Reed Canarygrass Successional Wet Meadow. While the park also uses fire to maintain other vegetation associations, such as Northeastern Old Field and Northeastern Successional Shrubland, these herbaceous types can also be maintained via mowing and herbicide application and are not as fire-dependent as are the other associations.

This inventory project illustrates the diverse vegetation mosaic that has become established along the Hudson River, and provides a valuable resource for park interpretive staff to educate visitors about the diverse ecological processes affecting Saratoga NHP. Within the park the vegetation pattern is structured by several physical and biological factors interacting in time and space. The climatic effects of consistent precipitation and temperature range influence vegetation established in the entire inventory area and region. The interaction of topography, geology, soils, and precipitation events which provides surface water runoff and groundwater feeding seeps, springs, wetlands, streams, and ultimately the Hudson River. The complete, impressively weighty (400 plus pages) report will be published this winter, and will contain in-depth details on all vegetation association types.^{TT}

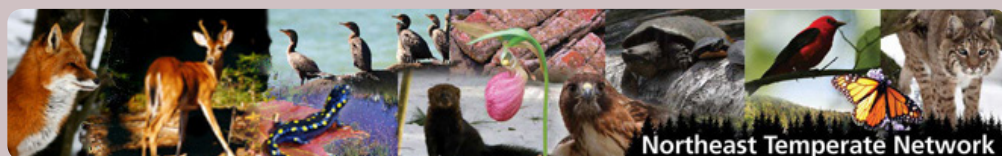


Several vegetation association types within Saratoga NHP are maintained and enhanced through the park's fire management practices. NPS / David Crary photo.



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