



Forest Health Monitoring Update 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 Trail. Forest Vegetation is considered a high-priority vital sign and the network developed a long-term monitoring program for forest resources. The program also provides data for three additional high-priority vital signs: Forest Soil Condition, White-tailed Deer Herbivory, and Landscape Context. The overall goal of the forest monitoring program is to assess status and trends in the composition, structure, and function of NETN forested ecosystems.

Methods

The forest health monitoring program tracks site and vegetation measurements in an extensive network of randomly located, permanent forest plots that are sampled every 4 years. Most tree, stand, and diversity measurements are made within fixed-area 20 x 20 m² plots. Coarse woody debris (CWD) is assessed using line intersect sampling along three 15-m transects that originate from the plot's center. Soil samples are obtained from a location adjacent to the plot. An Ecological Integrity Scorecard is used to help simplify the reporting and interpretation of forest condition in NETN parks. The scorecard examines a host of compositional, structural, and functional data in relation to their natural or historical range, and assigns a rank of Good, Caution, or Significant Concern to each. “Good” represents acceptable or desired conditions, “Caution” indicates a problem may exist, and “Significant concern” indicates undesired conditions that may be in need of management actions. NETN recognizes that



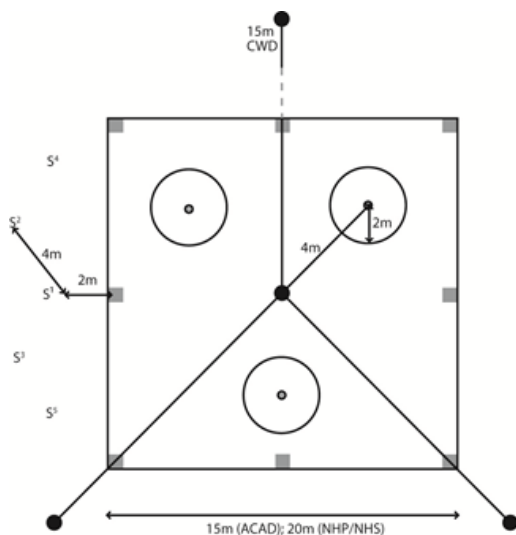
Many of Minute Man's forest plots lack coarse woody debris and snags. NPS photo.

“ecological integrity” may not be the primary goal of park resource management, particularly at historical parks and historic sites where cultural resource management may take precedence. But being able to compare the condition of park resources to ecological integrity benchmarks is still valuable because it allows for a deeper understanding of park condition, as well as a consistent baseline for assessment of management goals.

Results and Discussion

Prior to European settlement, the northern hardwood forests of the northeastern US were predominantly in late-successional and old growth stages of forest succession. Natural disturbances were primarily small-scale and stand replacing disturbances were rare (as long as 1,000-7,500 years apart for inland, post-glacial northern hardwood forests).

Presettlement forests were primarily composed of shade-tolerant tree species, and characterized by a multi-aged structure, abundant standing dead and down trees at varying stages of decay, and an understory composed of advanced regeneration of shade-tolerant tree species. The practice of logging and land-clearing for agriculture post-European settlement constituted a major disruption in the natural processes of these forests, and the second-growth forests of today are structurally and compositionally different from late successional and old growth forests. The distribution of structural stages is important for maintaining a full complement of native species, which vary in their dependence upon different successional stages. Human alteration and management have greatly changed the structural stage distributions of eastern forests such that younger forests are far more abundant, and the amount of late successional and old-growth forest has been greatly reduced compared to presettlement times. These distributions will be further affected by global climate change and outbreaks of exotic pests and pathogens.



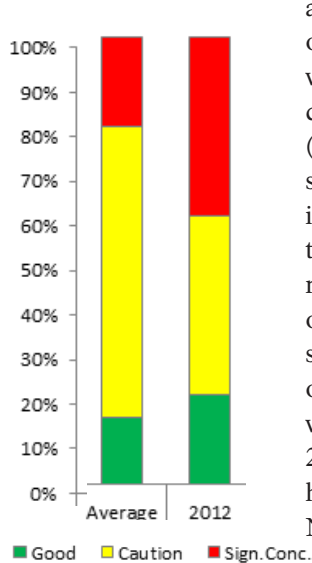
Forest plots with three 2-m radius regeneration microplots (hollow circles), eight 1m² vegetation quadrats (grey squares), and three 15-m coarse woody debris transects. S^x is location of soil sample.

Comparison of existing distributions with those expected under natural conditions provides an indicator of how much has been altered and habitat availability. Out of all parks in the network, desired levels of late successional forest were only met at Minute Man.

Dead wood, in the form of fallen coarse woody debris (CWD) and standing dead trees (snags), is an important structural feature of forests that provides habitat for many taxonomic groups, including mammals, birds, amphibians, and insects. In addition, tip-up mounds caused by wind-throw contribute to forest soil turnover and create important microhabitats for vegetation. Land management practices and hazard tree removal can reduce the quantity or quality of these features, but thoughtful land management can maintain or enhance snags and CWD. Minute Man was rated Significant Concern, for CWD, and had the lowest ratio and CWD volume of all the parks sampled in NETN.

Tree regeneration was assessed through looking at the quantity and composition of young trees in the forest understory, which will impact future canopy structure and composition. Regeneration can be affected by invasive species, acid deposition, and climate change, as well as selective browsing by a historically high population of white-tailed deer. A high percentage of plots were rated Caution due to negative seedling ratios in the park, even though the average deer browse index was fairly low. Other factors such as stand development and/or invasive species may be behind the negative seedling ratio for the park.

Tree condition and forest pests were assessed by looking at tree condition based on observations of specific tree health problems and canopy foliage condition. As the season progresses, most trees develop minor foliage problems, but more extensive damage to canopy foliage may be indicative of tree health problems within



Proportion of plots receiving Good, Caution, and Significant Concern ratings for tree condition. Average bars include data collected in 2010 and 2012.

a species or across a region. Four out of the ten plots sampled in the park were rated *Significant Concern*, all due to high-levels of insect damage (holes in leaves) on red maple. The species behind the increased damage is unknown, and the main concern is that it may be the winter moth - a non-native insect that feeds on the leaves of a range of hardwood and deciduous shrub species, including maples, oaks and blueberries. Winter moth was first detected in New England in 2003 in eastern Massachusetts, and has since spread throughout coastal New England. NETN will continue

to monitor insect damage on leaves with special attention to potential winter moth infestations in Minute Man.

Invasive exotic species have the potential to impact structure, composition, and function of forested ecosystems, and are one of the leading threats to biodiversity and ecological integrity of ecosystems worldwide. Early detection of invasive exotic plants is an important NETN vital sign that has been incorporated into several long-term monitoring protocols, and the status and trends of invasive exotic species are monitored in all NETN forest plots. Averaging nearly five species per plot, Minute Man NHP had the highest number of indicator invasive exotic species per plot in the network, and was rated *Significant Concern*.

Tree growth and mortality rates are important indicators of tree health and vitality. Tree growth rates can decline in response to environmental factors or anthropogenic stress, and tree mortality is often preceded by some years of reduced tree growth. These ratings are based on regional growth rates derived from U.S. Forest Service Forest Inventory and Analysis (FIA) data collected from plots in the same Ecological Subsection of the park. Minute Man showed an overall growth rate within 60% of the FIA growth rate, which was one of the highest of all NETN parks. Black walnut had a particularly high growth rate in the park (based on five trees from a plot in a historic walnut orchard).

Conclusions

Invasive species, particularly thickets of exotic shrubs, are negatively impacting forest condition in the park. Without management efforts, these exotic shrub thickets are expected to persist and spread into new areas. Forest pests also pose a significant threat to forest health, particularly Asian longhorned beetle (ALB), emerald ash borer (EAB), and winter moth, which are all found in isolated areas of Massachusetts. Early detection and rapid response of ALB and EAB are particularly important, not just for the health of forests in Minute Man, but for hardwood forests in the entire northeastern US.

More Information

For a more detailed description of the forest protocol, including background information, field methods, and sample design, download the NETN Forest Health Monitoring Protocol from the network's Forest Health Monitoring webpage, where you can also download the complete 2012 report. The website includes a chance to do a fly over above all the park's forest plots through using Google Earth, which will also allow users to view ground-level photos of each plot with NETN's photo-browser (Google Earth Park Maps link is on the leftmost menu items on NETN's homepage).

Contacts:	Phone/Email:
Kate Miller	207-288-8736
NETN Plant Ecologist	kathryn_miller@nps.gov
Brian Mitchell	802-457-3368 ext. 37
NETN Program Manager	brian_mitchell@nps.gov
Full Report online at:	
http://science.nature.nps.gov/im/units/NETN/	



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

