



Seeing the Forest and the Trees

Monitoring Program Yields Insights into Forest Health in Delaware Water Gap National Recreation

From a mountaintop vista in the Delaware Water Gap NRA, forests spread across the Delaware River Valley. This vast sea of green is a complex ecosystem that provides habitat for countless plants, animals, fungi, and insects. Beyond providing beautiful landscapes for hiking, boating, and other outdoor recreation, forests maintain soil stability and protect water quality. Forests also influence our weather and reduce some gases that contribute to climate change.

Understanding the current condition of park forests and how the forests are changing is critical to long-term management of park ecosystems. One reason that monitoring forest health is so important -- **the forests are constantly changing**. Storms, pests, pathogens, drought, and new species all play a role in shaping the forest. Studying the different components of a forest gives us information on the health of the forest, which allows park managers to make better informed decisions on how to manage park resources. In particular, mortality (how many trees are dying), recruitment (how many trees are growing into the canopy), and tree growth are important indicators of forest health and vitality.

Across 50 national parks throughout the eastern United States, the National Park Service's Inventory and Monitoring Program has established more than 2,000 long-term forest health monitoring plots that provide important information about the forest dynamics of these protected areas. Long-term monitoring increases park managers' understanding of park ecosystems, improves their ability to steward park resources, and allows them to adjust to and mitigate threats to park vegetation. In 2015, the **Eastern Rivers & Mountains Network** (ERMN) concluded its ninth season of monitoring forests in eight national parks sampling nearly 350 plots twice over that time span. A newly released report (available online) offers the latest answers to the question below, and provides management recommendations based on the most recent analysis of the monitoring data. On the back side of this brief is a summary of the findings from recent monitoring efforts.

“How are park forests changing over time in relation to weather, climate, landscape dynamics, invasive species, deer browse, and natural processes such as disturbances and succession?”

The forests of Delaware Water Gap NRA. Doug Manning photo.

NOT WANTED: These Bugs in Your Park Emerald Ash Borer

This metallic green exotic beetle (*Agrilus planipennis*) was discovered near Detroit, Michigan in the summer of 2002 and had spread to western Pennsylvania by 2007. The beetle larvae (the immature stage) feed on the inner bark of ash trees (*Fraxinus* spp.), impacting the tree's ability to transport water and nutrients. Emerald ash borer has not been detected in the counties surrounding Delaware Water Gap NRA; however, it will likely invade the park in the next few years. Park managers and visitors should be on the lookout for signs of borer infestation, ash decline, or woodpecker activity on ash trees (see <http://www.emeraldashborer.info/>). Monitoring data from ERMN will provide information on ash mortality and how forests change once the beetle arrives.



Emerald ash borers are having a big impact on ash trees in many ERMN parks.

Walnut Twig Beetle (causes Thousands Canker Disease)

Thousand cankers disease affects black walnut (*Juglans nigra*) trees and is caused by the combined activity of a fungus (*Geosmithia morbida*) and the walnut twig beetle (*Pityophthorus juglandis*). When these tiny beetles carrying the fungus bore into a tree, the fungus causes cankers in the inner bark, disrupting the flow of nutrients through the tree. Black walnuts dying from this disease were found in southeastern Pennsylvania in 2011. Park managers should be vigilant for signs of black walnut decline, especially along the floodplain of the Delaware River where black walnut trees are common.



Walnut twig beetles, tiny but terrible for black walnut trees. Whitney Cranshaw, Bugwood photo.



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How are the Forests Changing...

On Upper Slopes and Mountain Tops?

In drier habitats, oak and hickory trees dominate the forest canopy, often with blueberries, huckleberries, and mountain laurel bushes growing underneath. These forests are being shaped by periodic outbreaks of the exotic gypsy moth (*Lymantria dispar dispar*) whose caterpillars voraciously feed on oak leaves (and many other trees) until the entire forest is defoliated and the forest floor becomes unusually sunny. This extra sunlight has encouraged many white pine seedlings to grow into young trees, especially on the Pennsylvania side of the park. Typically, young white pine seedlings would not thrive in a mature, shady oak-hickory forest.

When gypsy moth caterpillars defoliate a tree, the tree often regrows its leaves, which drains the tree's stored energy and causes stress. In recent years, white oak trees in the park have been dying at a higher rate than other species, likely as a result of the gypsy moth caterpillar outbreaks and the droughty conditions on the ridgetops where the white oaks are common. Throughout the eastern United States, white oak has been in decline over the past two centuries, as fire suppression has had greater negative impact on white oak, compared with other oak species.

Areas in the park where many oak trees have died as a result of gypsy moth outbreaks may be opportunities for park managers to restore the oak forest. In these areas, oak seedlings are often being

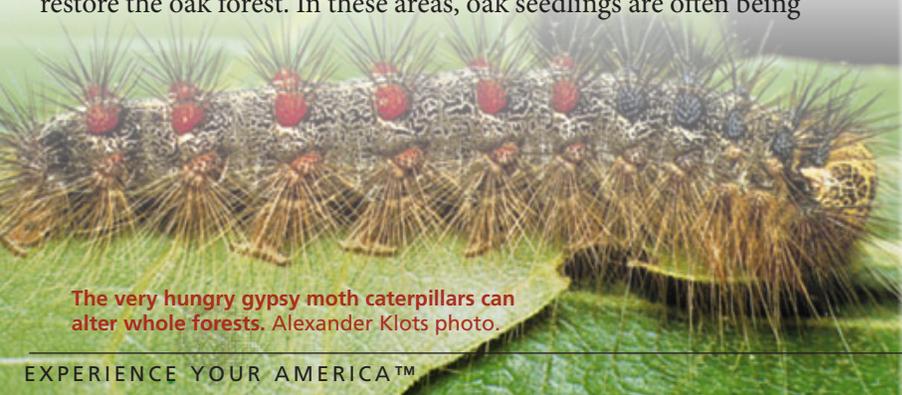
shaded by red maple seedlings. The strategic use of prescribed fire can control maple seedlings, while promoting oak seedlings and establishing a young oak-dominated forest that provide food and habitat to hundreds of species.

In Old Fields and Shrublands?

The park contains many abandoned pastures and shrubby old fields in which trees are currently establishing. These young, fast-growing trees will eventually create forests, unless invasive exotic shrubs like multiflora rose, Japanese barberry, autumn-olive, and honeysuckles dominate the fields and prevent trees from growing. Controlling invasive species is critical to protecting and promoting these young forests.

On Lower Slopes in the River Valley?

In mesic habitats, the composition of the forest canopy is relatively stable. The most common species, such as white pine, red maple, sugar maple, red oak, black birch, and tuliptree have either strong growth or solid recruitment into the canopy. In the longer term, shade-tolerant species such as sugar maple and American beech may become more prominent in these habitats because their seedlings and saplings can thrive under a mature forest canopy with little direct sunlight. Ash seedlings are very common in mesic forests, however, these seedlings are not predicted to survive to reach the forest canopy unless an effective biological control for emerald ash borer is discovered.



The very hungry gypsy moth caterpillars can alter whole forests. Alexander Klots photo.

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Full Report online at:

<http://science.nature.nps.gov/im/units/ermn/monitor/vegetation.cfm>

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