



Forest Vegetation Monitoring Summary, 2011–2015

Overview

The monitoring of forest vegetation communities is a key vital sign for the 14 Cumberland Piedmont Network (CUPN) parks. Forest vegetation communities were selected as a high priority resource for monitoring by all the parks within the Cumberland Piedmont Network (CUPN). Forests are a dominant part of the CUPN landscape and provide recreational opportunities and wildlife habitat, protect soil and water resources, influence weather patterns, and store carbon that would otherwise contribute to climate change. Studying the components of a forest provides information on the overall health of the forest vegetation community. Key stressors affecting forest vegetation communities include non-native plant species, insect/fungal pests, and climate change. The network's monitoring effort is designed to detect meaningful changes in species composition and vegetation structure within each park's forested habitats and determine whether these changes are correlated with trends in key stressors (e.g., forest pests) over time.

In the first phase of vegetation monitoring, permanent plots were established across all CUPN parks over a five-year period (2011–2015). These plots will be revisited every five years in order to monitor changes and trends in forest vegetation conditions. By the conclusion of the 2015 field season, 384 permanent plots had been established across the network, including 28 plots at Fort Donelson National Battlefield (FODO; 16 plots at the Fort Donelson Battlefield unit and 12 plots at the Fort Heiman unit). This brief summarizes monitoring data collected from these 28 plots established at the battlefield (see map of plots in Figure 1).

Monitoring plots are 20 × 20 meters with multiple nested sampling frames ranging in size from 1 to 100 square meters. Data collection is intensive, with data being grouped into the following broad categories: plot characteristics (slope, landform, etc.); species presence; frequency and cover (tree, sapling, seedling and herb layers); canopy cover; tree growth and health; evidence of forest pests; snags and coarse woody debris (CWD); and community characterization/classification. The CUPN [Forest Vegetation Monitoring Protocol](#) provides detailed descriptions of the field and analytical techniques used for forest vegetation monitoring.

Significant Findings

Species Diversity

Species diversity is a function of community type which is influenced significantly by geology, slope position, slope aspect, and disturbance. In temperate regions, acidic forest types tend to have fewer overall species, while sites with more alkaline soils (i.e., limestone parent material) typically have more. Compared to other CUPN parks, plot-level plant species diversity is moderately high at the park, averaging 58 species per plot (see Figure 2). However, average species diversity is higher at the Fort Donelson unit (67 species per plot) than at the Fort Heiman unit (46 species per plot). This is likely due to the higher topographical and soil variations found at the Ft. Donelson unit than at the Ft. Heiman unit, the latter of which is relatively flat with dry, acidic soils.

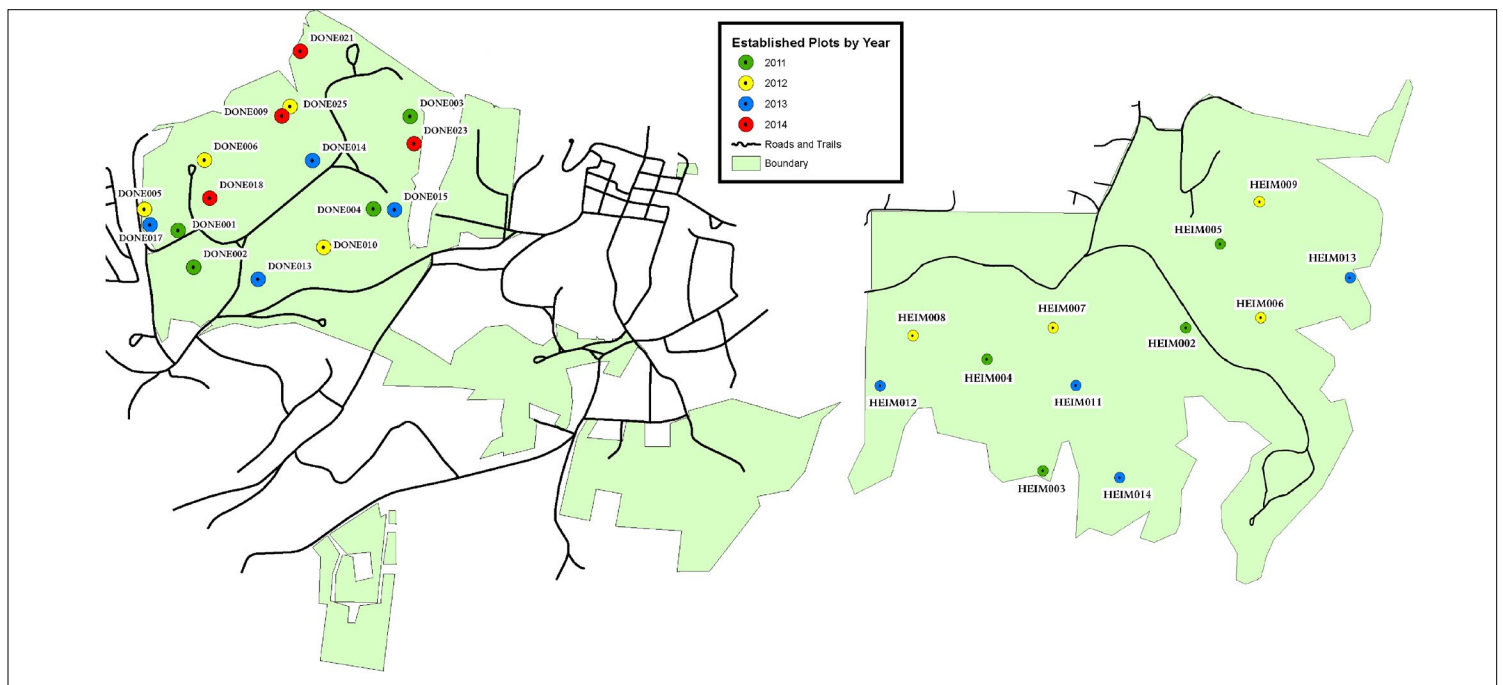


Figure 1. Map of forest vegetation monitoring sites at Fort Donelson National Battlefield, Kentucky and Tennessee. NPS map by Lillian Scoggins.

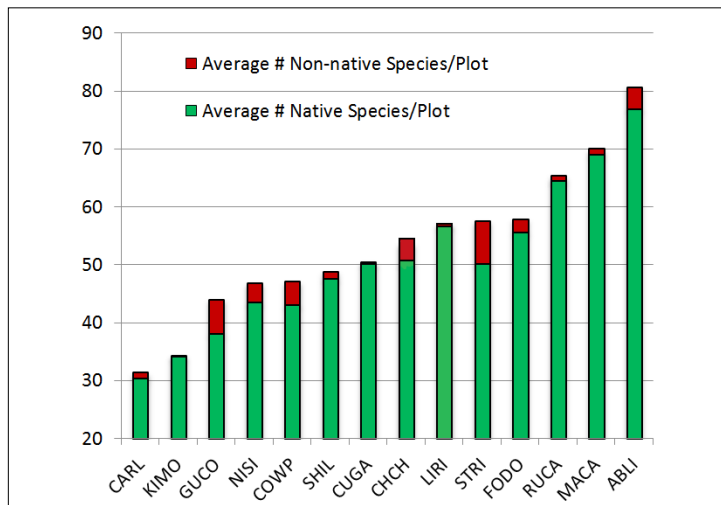


Figure 2. Plot-level average species diversity across CUPN parks, with native species shown in green and non-native species shown in red.

Significant Findings

Non-native Plants

Non-native species are present at each of the 14 parks within CUPN. Ideally, forest vegetation baseline monitoring and revisits to plots will help park managers understand how heavily non-native plants are affecting the native plant populations in their parks. Of the 258 plants identified to species at the park during forest vegetation monitoring, 12 of them (4.5%) were non-native. While non-native plants comprised 3.4% of the overall average plot-level species diversity at FODO (see Figure 3), they were more prevalent at the Fort Donelson Battlefield unit (5.5%) than at the Fort Heiman unit (0.7%). In fact, only 4 of the 12 plots on the Fort Heiman unit contained non-native species, while all but one plot on the Fort Donelson Battlefield unit contained non-native species. Of the 28 plots established across the battlefield, the most commonly found non-native plant species included Japanese honeysuckle (*Lonicera japonica*) and Chinese privet (*Ligustrum sinense*), occurring at 17 (61%) and 13 (46%) plots, respectively. Fortunately, no non-native plant species not previously documented at FODO were found at any monitoring plots.

Other Findings

No new discernible issues related to tree health or decline were detected at the park during the first phase of monitoring, though it

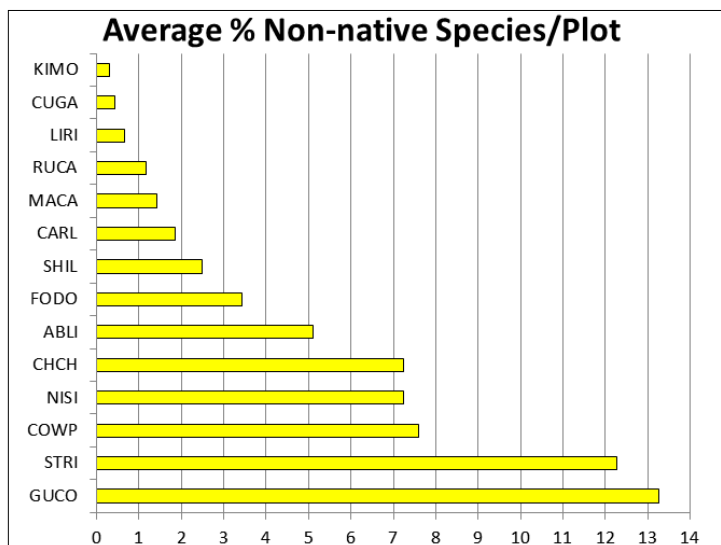


Figure 3. Plot-level average non-native plant species diversity across CUPN parks by percent.

should be noted the emerald ash borer (*Agrilus planipennis*) continues to expand its range in Kentucky, Tennessee, and neighboring states (visit http://emeraldashborer.info/documents/MultiState_EABpos.pdf for current map of known emerald ash borer extent). Plot revisits took place at eight of the park vegetation monitoring plots in 2016, and no signs of emerald ash borer were found.

HEIM002 was a plot which had quite a bit of standing dead blackjack oak (*Quercus marilandica*), as well as bracken fern (*Pteridium aquilinum*) and various grasses. At one time, this area may have been part of a western Kentucky barrens site. Perhaps this area was historically more open and subject to fire, as blackjack oak is a very shade-intolerant species, but with modern-day fire suppression practices, more shade-tolerant oaks such as southern red oak (*Quercus falcata*) and post oak (*Quercus stellata*) now dominate the canopy.

At the completion of the 2015 field season, NatureServe botanists added 25 species to the park's current list as "present in park" as a result of this monitoring effort. Plots are monitored at FODO during the second week of August.

About the Cumberland Piedmont Network

In 1999, the National Park Service initiated a long-term ecological monitoring program, known as "Vital Signs Monitoring," to provide the minimum infrastructure to allow more than 270 national park system units to identify and implement long-term monitoring of their highest-priority measurements of resource condition. The overarching purpose of natural resource monitoring in parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems, and to determine how well current management practices are sustaining those ecosystems.

The NPS Vital Signs Monitoring Program addresses five goals for all parks with significant natural resources:

- Determine the status and trends in selected indicators of the condition of park ecosystem,
- Provide early warning of abnormal conditions,
- Provide data to better understand the dynamic nature and condition of park ecosystems,
- Provide data to meet certain legal and congressional mandates, and
- Provide a means of measuring progress towards performance goals.

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