



Forest Vegetation Monitoring Summary, 2011–2015

Overview

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, just to name a few. 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 52 plots at Mammoth Cave National Park (MACA). In 2016, four additional monitoring plots had been established at MACA, and in 2017 four more monitoring plots will be established, bringing the total number of plots at MACA to 60. This brief summarizes monitoring data collected from the 56 plots established through 2016 at MACA (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 at MACA is the second highest in the CUPN network, averaging 70 species per plot (see Figure 2). In addition, of the 384 monitoring plots established across the network, the park contains seven of the twenty most diverse plots, with each plot containing 90 or more species. The most diverse plot at MACA contained 104 species—the fifth highest in the network. The park's

large size and amount of interior forest habitat; combination of both basic and acidic parent rock material; and high amount of topographic variation help contribute to the high plant diversity.

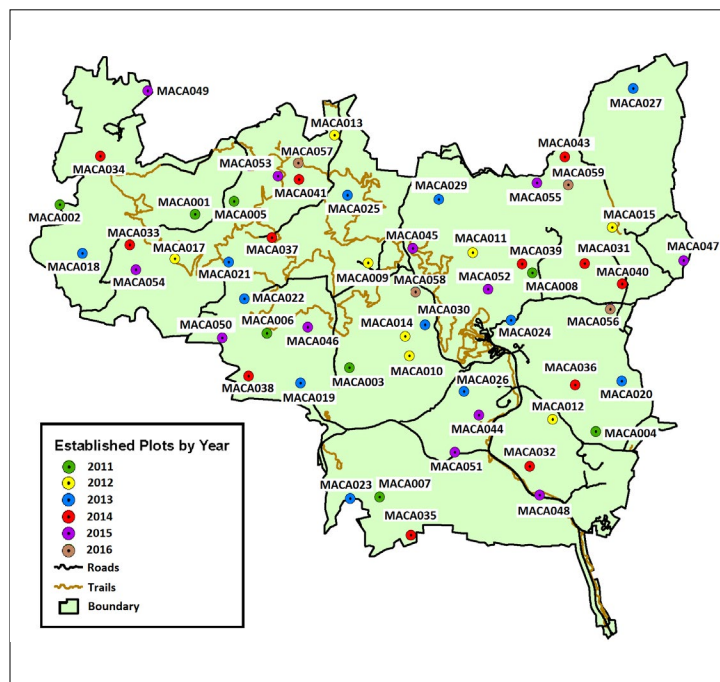


Figure 1. Map of forest vegetation monitoring sites at Mammoth Cave National Park, Kentucky. NPS map by Lillian Scoggins.

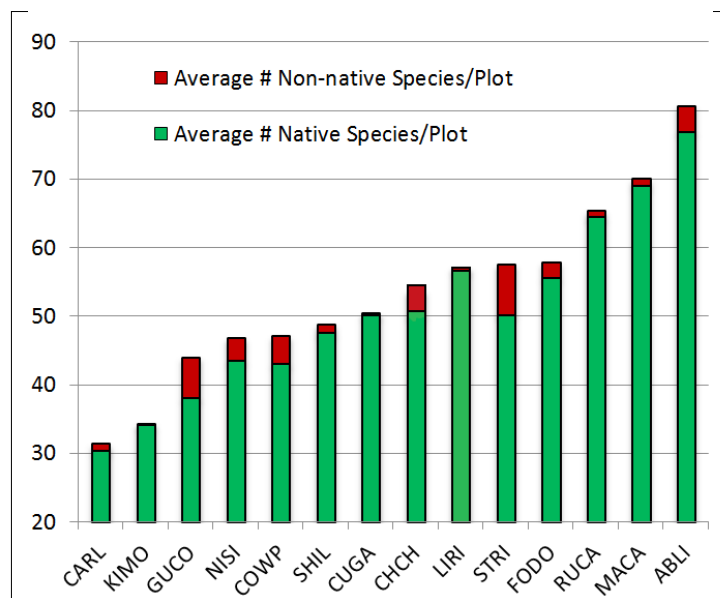


Figure 2. Plot-level average species diversity across CUPN parks, with native species shown in green and non-native species shown in red.

Significant Findings

Non-native Plants

Non-native species are present at each of the 14 parks within the network. 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 411 plants identified to species at MACA during forest vegetation monitoring, 12 of them (2.9%) were non-native. Non-native plants comprised only 1.4% of the overall average plot-level species diversity at the park (see Figure 3), which was relatively low compared to other parks across the network. Of the 56 plots established across MACA, the most commonly found exotics included Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), and multiflora rose (*Rosa multiflora*), occurring at 37 (66%), 32 (57%), and 12 (21%) plots, respectively.

While no non-native plant species not previously documented at the park were detected at monitoring plots, two species were found outside of plots. European privet (*Ligustrum vulgare*) was observed in Cedar Spring Valley in 2014, and a small population of the highly invasive common reed (*Phragmites australis*) was found in 2015 near Sloan's Pond. Common reed is a perennial grass that is ranked as a severe threat by the Kentucky Exotic Pest Plant Council. As of 2016, the population was eradicated, and no new populations have been found since.

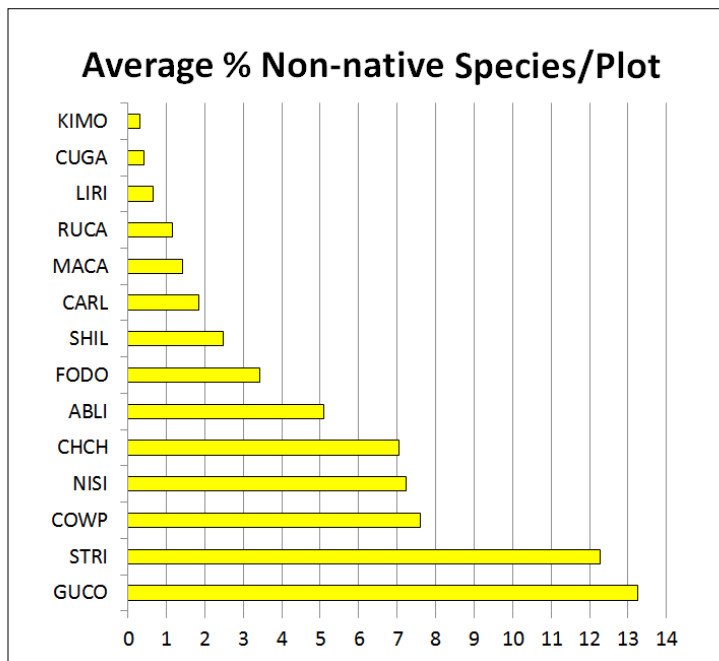


Figure 3. Plot level average non-native plant species diversity across CUPN parks by percent.

Other Findings

No new discernible issues related to tree health or decline were detected at MACA during the first phase of monitoring, though it should be noted that the emerald ash borer (*Agrilus planipennis*) continues to expand its range in Kentucky and was confirmed in Hart County in 2016. Plot revisits took place at eight of the MACA vegetation monitoring plots in 2016 and no signs of emerald ash borer were found at plots, although several recently weakened/dead ash trees have been found throughout the park.

A previously undocumented vegetation community was recorded at MACA023—"Interior Mid- to Late-Successional Sweetgum-Oak

Forest." This was reported by NatureServe as "likely present" in their 2010 inventory but was not found during that time.

NatureServe botanists added 13 species to the park's current list as "present in park" as a result of this monitoring effort. Plots are monitored at MACA during September.

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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Figure 4. NatureServe botanist and MACA park volunteer setting up a one square meter nested sampling frame at a vegetation monitoring plot at MACA.