Forest Vegetation

2013 Resource Brief

National Park Service Southeast Region
U.S. Department of the Interior

Cumberland Piedmont Network
Inventory and Monitoring Program

Mammoth Cave National Park

Forest communities were selected as one of the highest priority vital signs across the network, in part because forests are such a dominant part of the landscape within the Cumberland Piedmont Network (CUPN) parks. In addition to providing recreational opportunities, forests provide wildlife habitat, protect soil and water, 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 ecosystem, which in turn allows park managers to make informed decisions on how to manage this resource for current and future generations. Stressors affecting these systems include exotic species, forest pests, and climate change, just to name a few. CUPN's monitoring effort is designed to detect meaningful changes in species composition and vegetation structure within each park's forested habitat and determine whether these changes are correlated with trends in 'key stressors' over time.

Monitoring plots consist of a 20 x 20 m square with multiple nested sampling frames ranging in size from 1 m^2 to 100 m^2. Data collection is intensive, taking about 3-4 hours for a team to complete a plot on average, 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
- Coarse Woody Debris (CWD)
- Community Characterization/Classification

In 2011-12, 16 plots were established on Mammoth Cave National Park (MACA). An additional 12 plots were established recently in 2013. In 2014 and 2015, 24 more plots are scheduled for establishment, bringing the park total to 52 plots. This resource brief highlights a few findings from the 2011-12 data collection efforts.

Forest Composition and Regeneration

MACA contains numerous forest community types but the majority of the forest matrix is comprised of oak and hickory-dominated forest types.

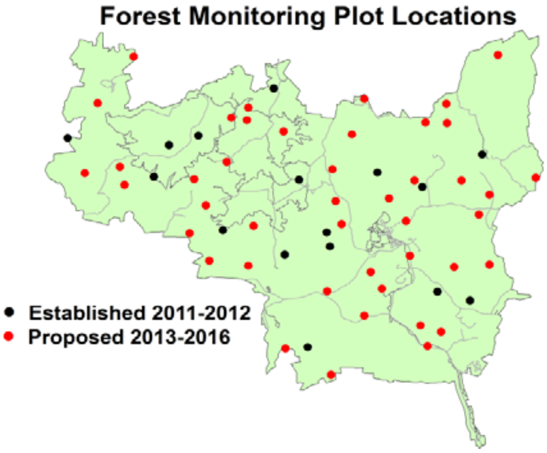

Figure 1. Location of forest monitoring plots on MACA.

This is reflected in 2011-12 forest monitoring data where oak and hickory species comprise nearly half (46%) of tree (10≥ cm DBH) basal area within sampled plots (Figure 2). Basal area measures estimate dominance in the canopy tree layer. The proportion of oak and hickory is much less in the sapling layer than in the canopy layer, comprising less than 12% of saplings counted. By contrast, shade tolerant species such as upland maple (i.e., red and sugar maple) and beech collectively comprise about 13% of the canopy but more than 35% of saplings within plots. While these data are preliminary

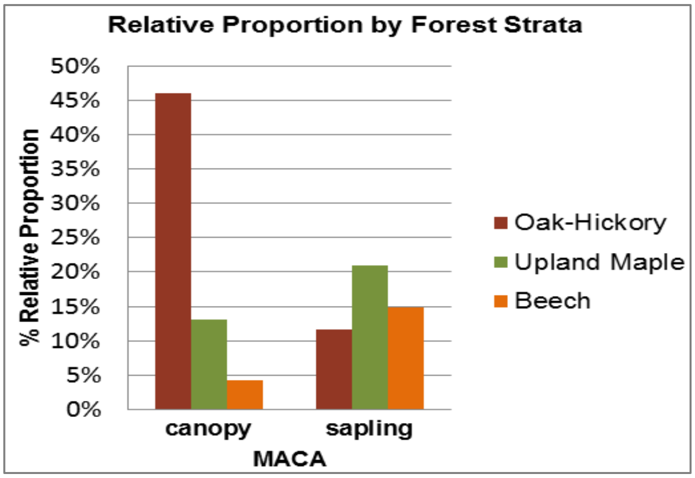

Figure 2. Tree species composition (10≥ cm DBH) based on basal area and sapling composition based on counts within forest plots on MACA.

and much more study is needed, it is worth noting that a potential future shift in composition of the canopy could be underway. CUPN will be tracking these and similar metrics as additional plots are established and plot revisits begin.

Prevalence of Exotic Species

Exotic or non-native species are displacing native flora and fauna on each of the 14 parks within CUPN. Every park has its known ‘hot spots’ where exotic species are well established. These areas tend to be around park boundaries, disturbed areas, floodplains, and/or high visitor use areas.

At least one exotic species was detected within 12 of the 16 plots established on MACA in 2011 and 2012. By comparison, exotics were detected on 10 plots per park on average across the network.

A total of seven exotic species were detected within plots on MACA. Those occurring on more than one plot include Japanese honeysuckle (*Lonicera japonica*) (10 plots), Japanese stiltgrass (*Microstegium vimineum*) (10 plots), Chinese privet *(Ligustrum sinense*) (two plots), and Chinese lespedeza (*Lespedeza cuneata*) (two plots).

Within each 400 m^2 plot a series of 1 m^2 frames were also sampled to measure the overall prevalence or frequency of species. On average 7.7 species were detected within the 1 m^2 frames within MACA plots of which 0.45 were exotic (Figure 3). In other words, on average nearly 6% of the species detected within the 1 m^2 sampling frames were exotic species. Based on these preliminary data, MACA’s overall diversity is high and overall incidence of exotics is moderate amongst CUPN parks.

The occurrence and prevalence (or frequency within plots) of exotics are high priority metrics for monitoring by CUPN as additional plots are established and plot revisits begin.

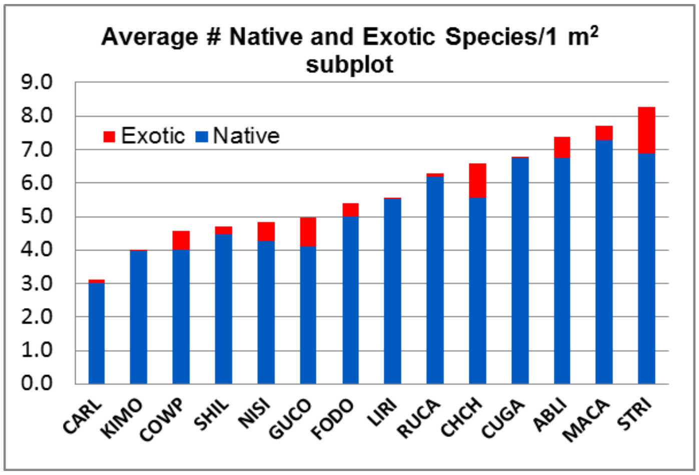

Figure 3. Average number and nativity of species detected in 1 m^2 subplots within CUPN's forest monitoring plots.

Species Diversity

Species diversity is a function of community type which is influenced significantly by geology, slope position, slope aspect, and natural disturbance regime. Within CUPN, acidic forest types tend to have fewer overall species at the 20 x 20m plot level while sites with more alkaline soils typically have more at that scale. Parks like MACA and ABLI with a larger diversity of pH and topography (basic and acidic parent rock both present combined with high amounts of topographic variation) also tend to be the most diverse at a large geographic scale (Table 1). While these raw numbers are of interest, the important questions include whether species community composition and diversity numbers are higher or lower than expected for a particular community type, and whether rare or sensitive species presence/absence is changing over time.

Table 1. Average number of species detected on 20x20 m forest monitoring plots in CUPN Parks, 2011-2012

	Park Code	Number of Plots	Mean Species (Mean ± SE)
Abraham Lincoln Birthplace NHS	ABLI	16	72 ± 3.69
Carl Sandburg Home NHS	CARL	16	30 ± 3.34
Chickamauga and Chattanooga NMP	CHCH	16	54 ± 5.15
Cowpens National Battlefield	COWP	16	47 ± 4.43
Cumberland Gap NHP	CUGA	16	52 ± 5.3
Fort Donelson National Battlefield	FODO	16	57 ± 4.27
Guilford Courthouse NMP	GUCO	16	44 ± 2.27
Kings Mountain NMP	KIMO	16	34 ± 3.09
Little River Canyon National Preserve	LIRI	16	59 ± 4.13
Mammoth Cave National Park	MACA	16	66 ± 4.42
Ninety Six NHS	NISI	16	46 ± 2.57
Russell Cave National Monument	RUCA	16	64 ± 3.63
Shiloh NMP	SHIL	16	48 ± 3.63
Stones River National Battlefield	STRI	16	55 ± 3.69

Other Preliminary Findings and Notes

- No new discernible issues related to tree health or decline were detected.
- A total of four previously unconfirmed species were detected and added to the park’s species list as part of this monitoring effort. Fortunately, all of the newly added species are native.

Currently 28 plots have been established on MACA with plans to establish an additional twenty-four plots over the next two field seasons. These additional plots are needed to assure a representative sample of the park is taken and statistically meaningful results can be reported. The results within this resource brief are a summary of plots established in 2011 and 2012 only (16 plots). As such, results presented within this resource brief are preliminary.