

Cumberland Piedmont Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure 3

Establishment and Location of Sampling Sites—Version 2.0

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Summary

This standard operating procedure (SOP) explains the procedures used for establishing and locating foliar injury assessment locations to be followed by the Cumberland Piedmont Network (CUPN).

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
May 2020	Johnathan Jernigan	Added a current site list and modified some of the body text to remove references to outdated items, such as USFS split plots.	Original v1.0 didn't contain a site list since sites were chosen as parks were sampled, after v1.0 was published.	2.0

Procedures

Establishment of Sampling Sites

Selection of foliar injury assessment sites is based upon criteria established in the U. S. Forest Service protocol (USFS 2008). The USFS uses non-randomly selected sites. The USFS criteria include:

- Ease of access—the most easily accessible site(s) are preferred, but other factors from this list should also be considered.
- Size of opening—at least 3 acres (130,680 square feet) is preferred, but smaller openings may be considered.
- Number of species—more than three species is preferred by the USFS and by the network, but the network will allow plots with only one species.
- Number of plants—the USFS requires 30 plants from two species but three or more species is preferred. For the network, every effort will be made to meet the requirement, but sites with fewer plants and species will be accepted.
- Condition of the soil—low drought potential with good fertility is preferred, but moderately dry and moderately fertile soils are acceptable. The USFS protocol notes that soil drought potential and fertility directly affect plant health and can, when soil moisture is low, reduce a plant's gas exchange across its leaf surfaces, thereby reducing ozone dosing of the leaf. The goal of this protocol is to detect ozone injury if it exists. Therefore, sites with optimal conditions for plant health will be chosen.
- Site disturbance—no recent disturbance or obvious soil compaction is preferred, but a site with little disturbance and no obvious widespread soil compaction is acceptable.

Further, shading at the site should be minimal. No plant should be sampled that had most of its leaves being shaded for more than five to six hours per day. Many of CUPN's sites are successional and as plant counts at those sites diminish due to shading, those sites should be replaced if possible. If site replacement is not possible, then sampling at the site should continue until no unshaded plants remain.

The Cumberland Piedmont Network recommends that the opening size, soil conditions and site disturbance criteria be used as established in the USFS protocol. The species count and plant count criteria, however, may be relaxed a bit. Every attempt will be made to meet these criteria, but in some instances meeting the criteria will not be possible. Samplers collect data from as many plants as possible from at least two species with at least 30 plants from two species being the target.

The USFS protocol allows split plots—two separate sites that are pooled and treated as one site. Detailed discussions of split plots may be found in the USFS protocol. However, the network decided not to use split plots in early 2015 due to (among other considerations) complications with naming

conventions for split plots and how that affected database design. The USFS also had a policy of having one site within each hexagon of their hexagonal grid. Split plots were a way for them to combine multiple locations when one location did not satisfy species diversity within a given grid hexagon. Combining sites is not necessary for the network because we have the flexibility to sample without a minimum number of species per site (even though at least two species per site with 30 plants each is preferred and will always be sought). Split plots are only mentioned here so the authors can be explicit about not using them.

Current Sampling Sites

The Cumberland Piedmont Network currently monitors foliar injury at 26 sites across its 14 parks, with a 27th site scheduled for addition in 2024 (at Mammoth Cave National Park, to help with QA/QC of species commonly examined at other CUPN parks). A list of the current sites for each park is shown in Table 1. The list was developed over the course of the first cycle through the sampling rotation. The number of sites per park ranges from one to three, depending on available areas that meet USFS criteria, disjunct park units, and sampling logistics. While the list of sites is intended to be permanent, it is likely some sites could become unusable in the future. It is also possible the authors may wish to add sites to a given park in the future. In such cases, the list of siting criteria in the section above will be considered and this SOP will be updated to reflect the change in sites.

Table 1. List of CUPN ozone foliar injury sites.

Park Abbreviation	Site ID	Site Name
Abraham Lincoln Birthplace NHP	ABLI0001	Visitor Center
Abraham Lincoln Birthplace NHP	ABLI0002	Knob Creek Low Field
Abraham Lincoln Birthplace NHP	ABLI0003	Knob Creek High Field
Carl Sandburg Home NHS	CARL0001	Sandburg Pasture
Chickamauga & Chattanooga NMP	CHCH0001	Lookout Mountain
Cowpens NB	COWP0001	Picnic Loop
Cowpens NB	COWP0002	Green River Road
Cumberland Gap NHP	CUGA0001	Daniel Boone Trail
Cumberland Gap NHP	CUGA0002	Hensley Settlement
Fort Donelson NB	FODO0001	Graves Water Quality Site
Fort Donelson NB	FODO0002	Buckner's Defense
Fort Donelson NB	FODO0003	River Battery
Guilford Courthouse NMP	GUCO0001	Francisco Monument
Guilford Courthouse NMP	GUCO0002	Kotis Tract

Park Abbreviation	Site ID	Site Name
Kings Mountain NMP	KIMO0001	Fire Tower Road Power Line
Kings Mountain NMP	KIMO0002	Park Road East
Little River Canyon National Preserve	LIRI0001	Feed Plot
Little River Canyon National Preserve	LIRI0002	Road02 Feed Plot
Mammoth Cave NP	MACA0001	Great Onyx Job Corps
Mammoth Cave NP	MACA0002	Barrens (to be established 2024)
Ninety Six NHS	NISI0001	Bumble Bee Hill
Ninety Six NHS	NISI0002	Charleston Road
Russell Cave NM	RUCA0001	Visitor Center
Shiloh NMP	SHIL0001	Russian Tenant Field
Shiloh NMP	SHIL0002	Faulkner Property
Shiloh NMP	SHIL0003	Spain Field
Stones River NB	STRI0001	Beasley Field

Literature Cited

United States Forest Service (USFS). 2008. Phase 3 Field Guide–Section 9. Ozone Bioindicator Plants (east). Southern Research Station. Knoxville, Tennessee. 49pp.