

Cumberland Piedmont Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure 15

Deviations and Summary of Major Changes—Version 1.22

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This standard operating procedure (SOP) was modeled after:

Tierney G., B. Mitchell, K. Miller, J. Comiskey, A. Kozlowski, D. Faber_Langendoen and C. Seirup. 2018. Northeast Temperate Network long-term forest monitoring SOP's: 2018 revision. National Park Service. Woodstock, Vermont.

Overview

This SOP documents:

- Known **deviations** from established methods. Deviations are situations where data were collected in a manner that is substantially different from the methods documented in the SOPs used during a particular field season.
- **Major changes** in the protocol. Major changes are fundamental shifts in the way data are collected that cannot easily be rectified with earlier data. Major changes are not deviations, provided that the changes are documented in the SOPs. Ideally, any time there is a major change in methods the network will use both methods long enough to determine whether the results from the different methods are sufficiently correlated to allow old data to be corrected. In some cases (especially early in the use of the protocol), the small amount of data lost by the protocol change will not be worth the cost of overlapping methods.

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Known Deviations and Major Changes

This SOP is intended to capture major changes in data collection over time, so that changes that may impact data analyses are all summarized in one place. This SOP is also intended to capture those situations where procedures were not followed as specified in the SOPs that were current at the time of data collection. Individual plot deviations, such as datasheets missing data, are generally not recorded within this SOP. For example, in 2018, MACA020 (plot 020 in Mammoth Cave National Park) had seven intensive corners sampled because the field crew deemed a corner unsafe for sampling due to the presence of a yellowjacket nest nearby. This and similar individual plot deviations are noted in the database but not in this SOP. As such, data users should consult the protocol database for anomalies in the dataset in addition to reviewing this SOP.

Overall Protocol Changes and Data Issues

1. Sampling rotation:
 - a. 2011: Sampling was originally designed on a two-year rotation in smaller parks and a four-year rotation in larger parks (Cumberland Gap National Historical Park and Mammoth Cave National Park).
 - b. 2013 and later: To accommodate additional plots in all parks, the decision was made to implement a five-year rotation for all parks.
 - c. 2020: (Deviation in sampling rotation) Due to restrictions on travel and fieldwork related to the COVID 19 pandemic, field crews did not travel and complete scheduled Year 5 plots at Chickamauga and Chattanooga National Military Park and Cumberland Gap NHP. Field sampling was only completed at Mammoth Cave NP in 2020 where travel was not required.
 - d. 2021: (Deviation in sampling rotation) Plots not sampled at Chickamauga and Chattanooga NMP and Cumberland Gap NHP in 2020 were added to the sampling effort in 2021. Thus, in 2021, 16 plots were completed at Chickamauga and Chattanooga NMP and 16 plots at Cumberland Gap NHP.
2. Park-specific sampling design:
 - a. 2011 and 2012: Eight plots were established each year at every park. Smaller parks were scheduled to begin revisits in 2013 and 2014 (16 established plots in each park) with a break in 2015. Larger parks (Mammoth Cave NP and Cumberland Gap NHP) were scheduled to continue establishing eight more plots per year in 2013 and 2014 (32 established plots in each park) with a break in 2015. In 2016, the first revisit cycle would begin for larger parks and the second revisit cycle would begin for smaller parks.
 - b. 2013 and later: It was decided to establish additional new plots at all parks, such that the smaller parks (less than 2000 hectares [4,942 acres {ac}]) would have between

20–28 total plots each, and the larger parks (5,000 to 20,000 hectares [12,355 to 49,421 ac) would have between 32–60 plots each.

- i. Carl Sandburg Home National Historic Site, Cowpens National Battlefield, Guilford Courthouse National Military Park, Ninety Six National Historic Site, Russell Cave National Monument, Stones River National Battlefield: In 2013, four additional plots were established at each park, bringing the number of established plots at each park to 20.
- ii. Kings Mountain National Military Park, Shiloh National Military Park: In 2013, eight additional plots were established at each park, bringing the number of established plots at each park to 24.
- iii. Abraham Lincoln Birthplace National Historic Park, Fort Donelson National Battlefield: In 2013, four additional plots were established on both the DONE and HEIM units (Fort Donelson NB) and the KNOB unit (Abraham Lincoln Birthplace NHP). In 2014, four additional plots were established on the DONE unit and the KNOB unit, bringing the number of established plots at each park to 28.
- iv. Little River Canyon National Preserve: In 2013–2014, eight additional plots were established each year, bringing the number of established plots at the park to 32.
- v. Chickamauga and Chattanooga NMP, Cumberland Gap NHP: In 2013–2015, eight additional plots were established each year at each park, bringing the number of established plots at each park to 40.
- vi. Mammoth Cave NP: In 2013–2015, 12 plots were established each year. Plot revisits began in 2016 for the eight plots established in 2011 and in 2017 for the eight plots established in 2012. Four new plots were also established each year in 2016 and 2017, bringing the number of plots at the park to 60.

3. Botanical expertise

- a. 2011–2018: The role of lead botanist on a field crew was filled via a cooperative agreement with NatureServe.
- b. 2019 and later: The role of lead botanist on a field crew was filled through a combination of a cooperative agreement with Austin Peay State University and professional services agreements with experienced botanists.
- c. 2022: Protocol states, “At minimum, crews will consist of a botanist capable of identifying all woody and herbaceous plants on a park” This has historically been interrupted as a professionally trained and experienced botanist (i.e., NatureServe botanist). Due to a series of events, a “professional” botanist was not

available for the last plot at Cumberland Gap NHP. As a result, the protocol lead performed the botanist role. The plot in question was not overly diverse and data collection went smoothly. However, it is worth mentioning as this is a “deviation” from all plot work up to this point.

SOP#1: Field Season Prep

1. Selecting parks where QA/QC plots would be conducted:
 - a. 2011–2021: Selection of parks where QA/QC would be conducted during the field season was made largely with logistical considerations in mind. Specifically, parks were selected based on ease and cost of getting a second crew to the park to conduct the QA/QC plots. This resulted in the same parks being selected in most years.
 - b. 2022 and later: With encouragement from regional staff, selection of QA/QC parks will be randomly selected by the network program manager. In years where multiple parks are selected, at least one will occur in the early part of the field season (i.e., May and June) and at least one will occur in the latter part of the field season. QA/QC will not be conducted at back-to-back parks in the sampling schedule.

SOP#2: Using GPS

No major changes or deviations

SOP#3: Site Selection and Plot Establishment

1. 2011: (Deviation from SOP—Plot established out of sequence) LOOK001 at Chickamauga and Chattanooga NMP was not established in 2011 because of its perceived location being in Lookout Creek based upon an aerial map. In 2012 a field team visited the actual location and determined the randomized plot location was a sufficient distance from the creek and established the plot in 2012.
2. 2011: (Deviation from SOP—Plot established out of sequence) CUGA002 at Cumberland Gap NHP was not established in 2011 due to inaccessibility in 2011. It was established in 2012.
3. 2011: (Deviation from SOP—Plot established out of sequence) STRI015 at Stones River NB field was not established in 2011 due to a misunderstanding in canopy cover cutoff restrictions. It was established in 2012 (see below).
4. 2012 and later: SOP was updated to specify less than 10% tree cover as a justification for excluding potential plot locations in the field. Not coincidentally, this cut-off corresponds to the USNVC (U.S. National Vegetation Classification System) lower bound for Forest and Woodland. Original SOP did not explicitly give a cutoff percentage of tree cover as a reason to not establish a plot in the field though this exclusion was in the protocol narrative.
5. 2011 and 2012: (Deviation from SOP—Declination not used in plot establishment) Based on revisits, declination appears to have not been used when establishing plots on some Piedmont

parks in 2011 and 2012 (11 plots across four parks). Notes about these possible discrepancies were made on the revisit field forms and captured in the protocol database for the benefit of future field teams.

6. 2013: (Deviation from SOP—Plot established out of sequence) In 2013, LOOK010 at Chickamauga and Chattanooga NMP was sampled at the incorrect location (likely GPS or operator error). This plot was “re-established” in the correct location in 2014. LOOK010 was resampled in 2018 (only four years later), which was necessary to keep it on the correct five-year rotation.
7. 2016: CARL001—A portion of the plot in Carl Sandburg Home NHS was established outside the park boundary (2011). This was discovered by the revisit field team (2016). Park staff were consulted and a decision was made (based on park input) to continue sampling the two modules (2 and 3) clearly within the park boundary and to exclude from continued monitoring the two modules (1 and 4) that appeared outside boundary based on recent markings. In short, this resulted in a 10 × 20 meter (32.8 × 65.6 feet [ft]) modified plot size.
8. 2019: MACA034 – A portion of the plot in Mammoth Cave NP had eroded into the river due to substantial river erosion since plot establishment, thus resulting in one 10 square meter (107.6 square feet [ft²]) corner not being sampled.
9. Recording of disturbance codes:
 - a. 2011–2020: Both recent and historic (e.g., signs of old homesite) were recorded during each sampling event.
 - b. 2021 and later: Only record signs of disturbance that appear to have occurred since the last sampling event or within the past year (fire); note that “open grown canopy tree in or near plot” remains as a disturbance sign.
 - c. 2021 and later: “Wind damage” added as a disturbance code.

SOP#4: Plot Photopoints

1. (Deviation from SOP—direction of tree tags) SOP has always stated that tree tags should face the direction from which teams access plot or upslope. In practice, however, crews have found that tags facing plot center are more useful and have thus followed this practice unless circumstances dictate otherwise (e.g., tree tags should be oriented such that they are not visible from public trails and roadways).
2. (Deviation from SOP—annotating plot datasheets with photopoint file names) SOP has always stated to annotate plot data sheets with the correct name of each photograph after downloading images and changing file names. We’ve never annotated plot data sheets with file name as this is standardized and can easily be derived from images found based on information already on the datasheet. So, this language will be removed from the SOP.

SOP#5: Canopy Closure and Stand Height Measures

1. 2015 and later: It was determined that stand height measurement was inadvertently left out of prior field methods and was added to field methods beginning in 2015. Based on formula in SOP 13 *Analysis and Reporting—Version 1.1* (CUPN 2023) stand height was/is needed to calculate coarse woody debris volume as a percentage of live tree volume for a plot.
2. 2022: Tree height was not recorded at both QA/QC plots at Guilford Courthouse NMP.

SOP#6: Tree Measurements

1. 2011 and later: (Deviation from SOP—Incorrect methodology in measuring tree diameters) Protocol states that tree diameters should be measured under vines growing up bole. Some crew members measured over vines. Some crew members attempted to use Biltmore stick. While these were the exception and efforts have been made to correct measurements on revisits this has created some limited ambiguity for some parks for measures relying on DBH (diameter at breast height).
2. 2011 and later: (Deviation from SOP) Original protocol stated in one location that trees forking below breast height should be measured 1 meter (3.3 ft) above the fork, but this was not practiced. Trees forking below breast height have been measured at breast height unless there is some other reason such as swelling or abnormality to cause change in measurement location and the change in location is documented in Tree Notes. This wording was clarified in the protocol in 2018.
3. 2011 and 2012: (Deviation from SOP) In 2011 and 2012, some field crew members were not recording tree measurements for tree forks. These missed stems were measured in 2016 and 2017 revisits resulting in a false increase in the number of trees and overall basal area.
4. 2011 to 2016: Only trees 20 centimeters (7.9 in) in DBH or greater were mapped in the field on tree map diagrams.
5. 2017 and later: All trees (≥ 10 centimeters [3.9 in]) are mapped in the field on tree map diagrams. This wording was changed in the SOP prior to the 2018 field season.
6. 2011 to 2015: QA/QC teams were not provided a copy of the primary sampling team's tree map. As a result, tree numbers do not align in the database between the two sampling events and should not be relied upon as a key field when making comparisons between the two sampling events.
7. 2016 and later: A copy of the primary sampling team's tree map is provided to the QA/QC sampling team to ensure tree numbers agree (i.e., tree 1 for the primary sampling event and QA/QC event are the same stem). However, it appears MACA058Q (2016), LOOK006Q (2017), MACA061Q (2017) and CHIC010Q (2018) forgot or failed to fully utilize the primary field team's tree map. During 2022 data validation, MACA058Q (2016) and MACA061Q (2017) tree data were reconciled to agree with primary sampling event tree data.

8. 2018: (Deviation from SOP) Summer interns were relied upon to complete tree measurements on plots selected for follow-up QA/QC at Carl Sandburg Home NHS. When experienced field crew members conducted the follow-up QA/QC it was discovered that several errors were made including: substantive errors in mapping location, tree data were reversed and in some cases, trees were not mapped at all. This pointed out the need for greater oversight and training for interns.
9. 2012 and later: (Deviation from SOP) Original 2011 protocol and initial field implementation had field crews recording all vines which were at least DBH height on bole or in canopy. Sometime during the plot establishment phase (2011–2015) the decision was made to only record vines if in canopy. Unfortunately, we're not sure exactly which year (as early as 2011 but possibly as late as 2013).
10. 2021: Removed the following Tree Condition Damage Codes: BROM, CROK, FORK, FRST, LEAN, OZON, ROTT, SPAR, because they were too subjective or damage could be categorized via another code (e.g., sparse foliage addressed by foliage condition codes).

SOP#7: Species Diversity and Tree Regeneration Measurements

1. Changes to tree seedling height classes
 - a. 2011 and 2012: Seedling height classes were measured in 5–50 centimeters (2–19.7 in) tall and 50–137 centimeters (19.7–53.9 in) tall categories (i.e., two height classes).
 - b. 2013 and later: Seedling height classes are measured in 5–15, 15–30, 30–50, and 50–137 centimeters (2–5.9, 5.9–11.8, 11.8–19.7, 19.7–53.9 in) tall categories (i.e., four height classes). This was changed to align with other network and FIA (Forest Inventory and Analysis) measurement categories.

SOP#8: Coarse Woody Debris Measurements

1. 2012 and later: added DBH tape as an acceptable method for measuring diameter.

SOP#9: U. S. National Vegetation Classification Measure

No major changes or deviations.

SOP#10: Soil Measurements

1. This SOP has not been implemented.

SOP#11: Data QA/QC

1. 2022: Data performance standards (a.k.a. measurement quality objectives) approved by regional IMD coordinator and added to SOP.

SOP#12: Data Management

2. 2011–2017: After fieldwork at each park, original field datasheets were retained by the botanist from the field team to aid in completing plant specimen identification and were sent back to the Cumberland Piedmont Network once all specimens were identified.

3. 2018 and later: Original datasheets now stay with the network instead of the botanist and the botanist communicates with the network on species that still need to be identified and can request digital scans of datasheets if needed. This has been updated in the SOP.
4. 2011–2017: Plot and tree diagrams for each plot were extracted directly from scanned field datasheets and saved as images.
5. 2018 and later: Plot and tree diagrams for each plot are created digitally using Microsoft Paint and saved as images to maintain high file resolution quality. This has been updated in the SOP.

SOP#13: Data Analysis and Reporting

1. 2019: As part of a long-term cooperative agreement that ended in June 2019, NatureServe submitted to the Cumberland Piedmont Network an updated but un-reviewed draft of this SOP. The cooperative agreement ended before review and revision were completed. In early 2020, the network worked with the protocol's lead author to further its development but failed to make much progress.

SOP#14: Recording Species Nomenclature and Data Field Descriptions

1. 2019: Updated nomenclature standard from ITIS to Weakley (2019) starting with the 2019 field season. Taxonomy was updated in the CUPN database in April 2019 days before fieldwork was scheduled to commence. These updates were facilitated through the cooperative agreement with NatureServe. Review and cleanup of issues are currently underway through a cooperative agreement with UNC (2019–2020).

SOP#15: Deviations and Summary of Major Changes

1. 2018: A deviations and major changes SOP (this SOP) was added to the protocol (approach derived from Northeast Temperate Network protocol) to capture changes made over the course of protocol implementation, where changes include those that impact analysis and interpretation of data.

Literature Cited

Cumberland Piedmont Network. 2023. Analysis and reporting—Version 1.1. Cumberland Piedmont Network Standard Operating Procedure NPS/CUPN/SOP—13. Cumberland Piedmont Network, Mammoth Cave, Kentucky. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2301183> (last accessed November 2023).

Revision Log

Revision History Log.

Version #	Date	Revised by	Changes
1.0	Feb 2018	C. Bledsoe	Initial effort to begin tracking substantive changes and deviations in one place (based on example from NETN)
1.15	3/30/2020	C. Bledsoe, B. Moore, and T. Leibfreid	Previous version was a good first effort but also somewhat incomplete. As a result, this was a group effort to ensure all substantive deviations and changes that have occurred over the years are listed in this SOP.
1.20	8/22/2022	B. Moore	Added an acknowledgement that NatureServe's long term partnership in the development and implementation of this protocol ended at the conclusion of the 2019 field season. Added 2020 deviation from sampling rotation resulting from Covid-19 safety protocols. Added change in how QA/QC parks will be selected beginning with the 2022 season. Added that historic disturbance codes would no longer be recorded beginning in the 2021 season. Added removal of certain tree damage codes beginning with the 2021 season.
1.22	8/30/23	B. Moore and C. Bledsoe	Additions and edits to Overall Protocol Changes and Data Issues section. Additions to SOP 3, 4, 5 and 11. Formatted by editor to regional I&M publication standards.