

Cumberland Piedmont Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure 10

Revising the Protocol and Documentation of Deviations and Major Changes—Version 2.0

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Summary

This standard operating procedure (SOP) explains how to make changes to the cave bats monitoring protocol narrative for the Cumberland Piedmont Network (CUPN) and accompanying SOPs, and how to track these changes. Any changes in the cave bats monitoring protocol will adhere to the guidelines contained in this SOP. Those tasked with editing the protocol narrative or any one of the SOPs need to follow this procedure in order to eliminate confusion in how data are collected and analyzed. This SOP also documents any known deviations from the narrative and SOPs, as well as formalized changes to the protocol narrative and SOPs that have been made over time. The project leader and field crew leaders must be familiar with this SOP in order to identify and use the most current methodologies and also need to refer to the revision history log attached to the protocol narrative and each SOP.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
December 2015	Steven Thomas	Minor edits following external peer review		1.1
June 2021	Steven Thomas	Text in the protocol revision section was replaced with updated text from another network's protocol; then edited as necessary to fit this protocol. Also, a section was added that discusses major changes and deviations to the protocol.	The protocol revision section was updated because version 1.1 text was generally outdated. Version 1.1 did not include a section wherein changes and deviations to the protocol could be documented. So, that was added here to be more in line with what other networks are doing.	2.0

Revising the Protocol

SOP Source and How It Was Modified

The protocol revision section of this SOP is an adaptation of *SOP—VEG11: Protocol and Database Revision—Version 1.0* of the *Monitoring Terrestrial Vegetation in Gulf Coast Network Parks Protocol Implementation Plan* (Carlson and Segura 2018).

For a general explanation of how the Gulf Coast Network (GULN) modified the Northeast Temperate Network's (NETN) protocol and its SOPs (Tierney et al. 2016), see the protocol implementation plan document (Carlson et al. 2018). For this specific SOP, the Gulf Coast Network added some information to make it consistent with their other vital signs protocols. Much of that additional information comes from SOP 9—*Revising the Protocol* in the Northeast Coastal and Barrier Network (NCBN) geomorphological monitoring protocol (Psuty et al. 2012).

The version presented here is a modification of the GULN version of the SOP. The Cumberland Piedmont Network has modified where necessary to fit its cave bats monitoring activities. Much of the text within this document is unchanged from that found in the GULN SOP.

Scope and Applicability

All changes to the CUPN cave bats monitoring protocol and SOPs require careful documentation and record keeping. This is completed in two ways: (1) summarizing and recording revisions at the start of each document in a Revision Log and conglomerated in a single location, at the end of this SOP, and (2) retaining a library of previous versions. Completing these steps enables the Cumberland Piedmont Network to maintain consistency in the collection, summary, analysis, and reporting of data.

Instructions for the Revision Process

Review Panel

The recommended approach to revising the cave bats monitoring SOPs, protocol narrative and database is to first discuss changes at an annual protocol operational review. A review panel consisting of CUPN staff and participants meets within a few months following the completion of the field season. Several weeks prior to the review panel, the protocol leader distributes an email to all participants with a set of questions to consider, and requests feedback before the meeting. The protocol leader compiles the comments and distributes a draft version to panel members no later than the day before the review. These draft responses serve as the framework for the discussion during the meeting. Discussion topics cover, for example, protocol deviations, equipment changes, methods or safety improvements, lessons learned during the field season, field crew feedback, and potential SOP and database changes that came up during the field season or at other times.

After the review, the protocol leader makes revisions based on the review discussions. In instances where the database may be affected, the network data manager's input is solicited as well, to ensure that they can make necessary modifications to the database.

After all document revisions are made, the protocol leader changes the date and version number on the title page of each master document (and elsewhere in other documents, as needed) and updates the revision log. Each draft revised document is then sent to selected CUPN staff, including the Network Program Manager, for review. Finally, every revised document, along with operational review meeting documentation, is sent to the Regional Inventory and Monitoring (I&M) Division Chief for final approval. Generally, the protocol leader revises each document in a “tracked changes” format, checks for internal review, and then sends all documents to the regional chief for final review and approval. The data manager revises the database, which is sent to the protocol lead for review.

After regional chief approval is obtained, revised protocol narratives are assigned new report numbers by the National I&M Program Publication Manager. The new versions of the protocol narrative and SOP documents are then posted to the National Park Service’s Integrated Resource Management Applications (IRMA) Data Store, as well as archived in the appropriate CUPN vital signs protocol folder on the CUPN network drive.

Revision Timeframe

Most revisions are made once per year, following the annual review procedure explained above. As minor changes are noted throughout the year, each user is expected to maintain a list for the annual review, or they can send potential changes as they arise to the protocol leader, who organizes and compiles them once a year for that review.

Revision Log Table

The revision log found at the beginning of each protocol document lists a summary of all edits to each version of that document since the original publication date. Information entered in these logs should be complete and concise. The logs track the following information: (1) the date of revision, (2) author(s) of revision, (3) description of change, (4) why the change was made; and (5) the new version number. Author information will consist of full name.

Minor Revisions

Minor revisions are those that do not represent a change in the underlying methods or procedures used to generate data values for the protocol’s existing data set. Minor revisions include small changes in, or clarification of, procedures. Version numbers for minor revisions increase incrementally by tenths (e.g., 1.1, 1.2, 1.3...).

Major Revisions

Major revisions are designated with the next whole number in the sequence (e.g., 2.0, 3.0, 4.0...). A revision is considered “major” if there were changes in methodology that could influence the resulting data values and thereby limit the ability to compare newly-collected data with data collected using a previous version. Examples of this type of revision include:

- addition of monitoring objectives
- changes to the sampling design
- changes to reporting requirements

- addition of new variables
- deletion of variables

Communicating Changes to Investigators and Users

Once changes have been made, an updated protocol document is posted on the IRMA portal under the “[Cumberland Piedmont Network Cave Bats Monitoring](#)” assemblage. The narrative and each SOP are contained in their own digital file. Each time an SOP is revised, the protocol leader ensures that all known users obtain a current copy of the SOP and receive the necessary briefing material or training to understand and incorporate the change(s). Anyone completing tasks under this protocol is encouraged to contact the protocol leader beforehand to check for updates to the protocol narrative or associated SOPs.

Archive of Previous Versions

All published versions of the cave bats protocol are made available under the “[Cumberland Piedmont Network Cave Bats Monitoring](#)” assemblage on IRMA. This online bundle of records begins with version “2.0” of the protocol narrative and various versions of each associated SOP. All current and previous versions of the protocol are maintained on the CUPN server, in the following location: \\INPMACAFS\CUPN-MACA IM Projects\Vital_Signs\Vital_Signs_Prj\Cave_Bats\Docs\Protocols.

Summary of Deviations from and Changes to the Protocol

Acknowledgements

This section of the SOP borrowed extensively from Tierney et al. (2018).

Section Overview

This section 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, the small amount of data lost by the protocol change may not be worth the cost of overlapping methods.

Known Deviations and Major Changes

This section of the 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 section 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 biosite deviations, such as field data forms missing

data, or sampling at a site not completed due to safety concerns, lack of personnel or equipment issues, are generally not recorded within this section of the SOP. These and similar individual biosite deviations are noted in the database. As such, data users need to consult the protocol database for anomalies in the dataset in addition to reviewing this SOP.

Overall Protocol Changes and Data Issues

Narrative

1. 2016: Finished addressing external peer review comments and database development. Added reference to having relied heavily upon a chapter on colony counts from a program plan for the North American Bat Population Monitoring Program (Loeb et al. 2015). Analytical approach for summer data changed from abundance based on net number of bats counted to use of multiple-measures data (at least two independent sampling methods required) to allow the use of hierarchical models and estimation of detectability to obtain abundance estimates. Winter bat data will use time series trend analysis using additive models to produce population trajectories. Emphasized importance of minimizing the differences in the number/type of methods and specific observers used for each sampling event at a cave entrance—both within- and between- sampling years to minimize intra- and inter-annual variation. Annual Summary Reports and Trend Analysis Reports will be submitted for publication in the NPS's Natural Resource Publications Management series.

SOP 1: Training Sampling Crew

No major changes or deviations.

SOP 2: Pre-field Sampling and Safety

1. 2016: Added steps in the process used to create a Cave Section Map. Added synchronization of internal clock of NV video camera with time mechanism used to determine bat exit count start and end times. The same sampling start and end time set for all caves (Central Time Zone Parks [MACA and RUCA] start at 19:45:00 [7:45:00 p.m.] and end at 21:00:00 [9:00:00 p.m.], Eastern Time Zone Parks [CHCH and CUGA] start at 20:45:00 [8:45:00 p.m.] and end at 22:00:00 [10:00:00 p.m.]).
2. 2017: (Deviation from SOP)—Hemlock Cave and Stacked Rock Cave at Mammoth Cave National Park were scheduled to be sampled in summer 2017 but were not sampled—these three caves (each done once every four years) were sampled in 2018.
3. 2018: (Deviation from SOP)—Anarchy Shelter, Hemlock Cave and Stacked Rock Cave at Mammoth Cave NP were scheduled to be sampled in summer 2017 (see previous item) but were sampled in 2018 instead. Also, Lapp Hole cave at Chickamauga and Chattanooga NMP was sampled for the first time this summer in its once-every-four years-rotation, although it wasn't formally added to the schedule until 2020.
4. 2018: The sampling dates for summer cave bats monitoring at Cumberland Gap National Historical Park were moved from the last half of June to the first half of July while sampling dates at Chickamauga and Chattanooga National Military Park and Russell Cave National

Monument made the opposite switch. The change was primarily based on recommendations from a 2016 study at these parks (Wilcox 2017, Table 4). Sampling at Cumberland Gap NHP was moved closer to the post-lactation period recommended by Wilcox (2017). According to Wilcox (2017), there was no difference among sampling periods at Russell Cave NM, and late June and early July are equidistant between the recommended sampling periods at Chickamauga and Chattanooga NMP. Logistics also played a role in the decision since it is more efficient to sample Chickamauga and Chattanooga NMP and Russell Cave NM during the same timeframe because they are geographically close, and it is not feasible to sample Cumberland Gap NHP during the post-lactation period in late July due to long-term sampling a four MACA caves at that time. Note, this change of sampling dates is within one biological season (lactation).

5. 2019: (Deviation from SOP) – No caves were sampled during the summer at Chickamauga and Chattanooga NMP, Cumberland Gap NHP and Russell Cave NM due to an approved hiatus from sampling to focus on data analysis and reporting.

SOP 3: Summer Cave Roost Sampling

1. 2014: (Deviation from SOP) – Only one sampling event instead of at least two was conducted at 27 Spiders Cave at Chickamauga and Chattanooga NMP and at Packrat Entrance of Gap Cave at Cumberland Gap NHP.
2. 2015: (Deviation from SOP) – Count interval and time count started changed during middle of field season. Sampling at last nine caves starting on 5 June 2015 changed from “10 mins or so” to 5-minute intervals, and time count started changed—not linked to bats emerging but varied among sites and was recorded now on data forms.
3. 2016: Multiple visit (≥ 2 per sampling window) and multiple observer methods (≥ 2 independent observers or ≥ 2 independent methods) will be employed to collect summer bat (“multiple-measures”) data—this will allow the use of hierarchical models and estimation of detectability. Emphasized importance of minimizing the differences in the number/type of methods and specific observers used for each sampling event at a cave entrance—both within- and between- sampling years to minimize intra- and inter-annual variation. Added synchronization of internal clock of NV video camera with time mechanism used to determine bat exit count start and end times. The same sampling start and end time set for all caves (Central Time Zone Parks [MACA and RUCA] start at 19:45:00 [7:45:00 p.m.] and end at 21:00:00 [9:00:00 p.m., Eastern Time Zone Parks [CHCH and CUGA] start at 20:45:00 [8:45:00 p.m.] and end at 22:00:00 [10:00:00 p.m.]). Start and end time of each 5-minute interval synchronized for all independent sampling methods during each event. If any sampling method started late, ended early or had an interruption, observer will skip to the start of the next interval and put an “NA” on the data form for the interval(s) missed (instead of starting/ending part-way through an interval). Zero exits or entries during each time interval is recorded on the data form instead of leaving blanks. Video camera recording “Start Time (hhmmss)”, as well as name of NV goggles observer in the field and name of the person who later counted bats in the office via computer are all now recorded on data forms.

Added the “3-seconds rule” to determine whether to count an exiting/entering bat (i.e., bat must remain inside or outside of cave for at least 3 seconds in order to count it).

Recommended using a smartphone application or count-down timer that automatically resets and restarts when the alarm sounds at end of 5-minute interval without any time delay. A one-year (only) special research project was done by Dr. Emma Wilcox (University of Tennessee, Knoxville) and technicians wherein extra counts were done at a subset of caves (n=8)/entrances (n=12) on all four parks. These are: Chambliss Cave and Neeld’s Well Cave (CHCH), Gap Cave (4 entrances) and Olde Formation Pit (CUGA), Historic Entrance, Long Cave and Luna Cave (MACA), and Picnic Entrance (2 entrances) at Russell Cave NM. At each of the 12 entrances, counts were conducted for three to five nights during one week in each of three sampling periods: Sampling Period 1: Mid-May to mid-June, Sampling Period 2: Mid-June to mid-July, and Sampling Period 3: Mid-July to mid-August. Sampling methods for this special project were identical to our regular monitoring.

4. 2017: (Deviation from SOP) – Only one sampling event instead of at least two was conducted at Anarchy Shelter at Mammoth Cave NP.

SOP 4: Winter Cave Roost Sampling

1. 2015: Added check boxes to field data form and instructions to indicate if “No bats present” in a section or if “Survey not attempted” in a section.
2. 2016: Added photograph of any size cluster roosting at a distance of roughly greater than 30 feet (9.1 meters), instead of only clusters large enough that an accurate count is difficult.

SOP 5: Cave Meteorological Sampling

1. 2014: Changed siting variable from “height” to “inclination” (from a disto or clinometer) to obtain measurement from landmark to data logger location. Distance and inclination are now measured from landmark directly to data logger location, rather than to a point directly below the data logger location.
2. 2015: Made many changes to the field data form (20150521) and instructions, including adding “Office Use Only” section, “Cave Section Number” field, and change “check one” action to “check all that apply.”
3. 2016: Added step of re-launching data shuttle in office prior to field work in order to update the shuttle’s date and time that is set to local time (CHCH and CUGA are in eastern time zone, MACA and RUCA are in central time zone).

SOP 6: Post-field sampling

1. 2016. Added step-by-step procedures for conducting digital photo image analysis using Microsoft Paint as an optional alternative to using GIS software. Added step-by-step instructions for performing digital video analysis—both night vision video and thermal infrared video files. Expanded upon and added several steps for processing cave meteorological data files, including the use of SigmaPlot for post-processing and validation.

SOP 7: Data Management

1. 2016: Major updates related to completion in late 2015 of a database developed by Michael Lee (University of North Carolina, Chapel Hill)—previous versions of this SOP were based on a “conceptual” database design.

SOP 8: Data Analysis

1. 2016: Significant modifications made to standardize how data are analyzed in response to external peer review comments. Changed analytical approach for addressing monitoring objective 1 (summer cave bat abundance) from using “a combination of summary and descriptive statistics, and graphic analysis” to using hierarchical models, such as N-mixture, in the R library called unmarked, along with the maximum emergence statistic (to control for double-counting individual bats) to obtain abundance estimates. Multiple visit (>2 per sampling window) and multiple observer methods (>2 independent observers or >2 independent methods) will be employed to collect summer bat emergence (“multiple-measures”) data—this will allow the use of hierarchical models, estimation of detectability, and will greatly increase the utility and longevity of the data (Loeb et al. 2015). Added an example of proper format for a dataframe for summer bat count data to be read by R - software, and an example of a summer bat roost monitoring data summary table with results of model-based abundance estimates via maximum emergence and N-mixture from seven MACA caves. Modified analytical approach for addressing trend analysis for monitoring objective 2 (winter cave bat abundance) and objective 3 (cave air temperature and relative humidity) from using basic linear regressions to additive models, because they enable modeling of a non-linear population trajectory rather than assuming a linear population trend (Ingersoll et al. 2013). Some examples of population trajectories from winter bat roost monitoring and generalized additive models with hibernating bat abundance trajectories in relation to habitat parameters (temperature and relative humidity) were added.

SOP 9: Reporting

1. 2016: Added that a Trend Analysis Report may be produced every 5 years that includes only the sites in the panel where summer cave roost sampling occurs annually.

SOP 10: Revising the Protocol and Documentation of Deviations and Major Changes

1. 2020: A deviations and major changes section was added to this SOP in the protocol (approach derived from NETN protocol [Tierney et al. 2016]) in an attempt to capture changes and deviations made over the course of protocol implementation, where changes include those that impact analysis and interpretation of data. Much of the descriptive text for this SOP was borrowed from the NETN protocol, as well as those edits that were written by the authors of CUPN’s vegetation monitoring protocol (unpublished).

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