

Acoustic surveillance of bat populations in multiple Midwest parks

Research on the Ecology of Carnivores and their Prey Laboratory
National Park Service



Principal Investigator:
Robert Montgomery PhD

Project Manager:
Claire Hoffmann

Project Members:
Jacalyn Beck
David Heit

Prepared By:
David Heit

Disclaimer: This protocol was adapted from the *Mobile Bat Survey Protocol* developed by the U.S. Fish and Wildlife Service, and *A Plan for the North American Bat Monitoring Program (NABat)* Produced by the USDA.

Objectives:

Purpose: Conduct acoustic surveys of bat species in 13 National Park Service (*hereafter* NPS) properties in the Midwest and Southeast using stationary acoustic monitors.

Project Objective: The primary objective is to perform a baseline inventory of bat species in NPS properties across the Midwestern region. This will provide presence/absence data sets and be the foundation for long term monitoring of bat populations. This project will inform what species are present, where they are present, and may be the initial step towards determining whether these species need to be listed. Specific objectives of the project are:

1. Determine baseline occurrence of bat species in NPS properties during the breeding season.
 2. Index bat populations on a species by species basis to monitor population trends at the refuge, landscape and regional level using standardized protocol using acoustic detection data loggers.
 3. Examine bat species occurrence based on habitat type classification.
-

Study Locations and Species Information:

National Park Units:

Northern Sector:

Iowa:

1. Effigy Mounds National Monument, Harpers Ferry, IA
2. Herbert Hoover National Monument, West Branch, IA

Kansas:

1. Tallgrass National Prairie, Strong City, KS
2. Fort Larned National Historic Site, Larned, KS

Minnesota:

1. Pipestone National Monument, Pipestone, MN

Nebraska:

1. Homestead National Monument, Beatrice, NE

Southern Sector:

Arkansas:

1. Pea Ridge National Military Park, Garfield, AR
2. Arkansas Post National Monument, Gillet, AR

3. Buffalo National River, Ponca Township, AR
4. Hot Springs National Park, Hot Springs, AR

Missouri:

1. George Washington Carver National Monument, Diamond, MO
2. Wilson's Creek National Battlefield, Republic, MO
3. Ozark National Scenic Riverways, Alley Spring, MO

Bat Occurrence in Study Area:

Bat Species:

1. Little Brown Myotis (MYLU)
2. Big Brown Bat (EPFU)
3. Northern Long-eared Bat (MYSE)
4. Tri-colored Bat (PESU)
5. Silver-haired Bat (LANO)
6. Eastern Red Bat (LABO)
7. Hoary Bat (LACI)
8. Evening Bat (NYHU)
9. **Indiana Bat (MYSO)**
10. Brazilian Free-tailed Bat (TABR)
11. Cave Myotis (MYVE)
12. **Gray Myotis (MYGR)**
13. Western Small-footed Myotis (MYCL)
14. Pallid Bat (ANPA)
15. Eastern Small-footed Myotis (MYLE)
16. Townsend's Big-eared Bat (COTO)
17. Rafinesque's Big-eared Bat (CORA)

Bold - Endangered Species

State	MYLU	EPFU	MYSE	PESU	LANO	LABO	LACI	NYHU	MYSO	TABR	MYGR	MYCL	ANPA	MYLE	COTO	CORA
MN																
IA										*						
NE	*									*						
KS	*									*						
MO									*						*	
AR															*	

Figure 1. Bat species presence by state. Orange signifies cave-roosting species while green signifies tree-roosting species. Squares with an asterisk (*) signifies rare occurrences. Bold (**bold**) signifies endangered species.

Materials and Methods:

Acoustic bat monitors: We will use the **Anabat Express Bat Detector** from Titley Scientific®. This frequency division detector can isolate species, allowing for the collection of presence/absence data at the species level. We will use the internal directional microphone already present in the Anabat Express data recorder.

NABat compliance: This project will work to add to the North American Bat Monitoring Database (NABat) developed by the USDA. The goal of this database is to compile continent-wide data on bats to aid in their conservation and management. We will structure our protocol and data analysis to be consistent with the desired structures of this database.

Dynamic survey: Many of the survey sites, especially those in our northern sector, are smaller than 1 km² in area. Deploying more than one detector in sites of this size will potentially result in a double-count of some individuals. Thus, only one data recorder will be used in locations in which there are not suitable placement locations spaced at least 2.5 km apart. Should we have additional data recorders available, we will set up data recorders at multiple small sites simultaneously.

Establishing survey locations: The proper selection of Anabat locations is important because many of the parameters associated with location selection can have substantial impacts on data quality and reproducibility. As we only have access to 1-4 detectors at any given time, random location selection is not cost-effective. Thus, placement locations will be chosen according to bat ecology to maximize the efficiency of data collection.

Acoustic survey methodology: Locations will conform to the following characterizations where possible

1. Located in representative habitat
 - a. Encompass likely bat travel corridors
 - b. Not located in dense vegetation
2. Reduced risk of acoustic “clutter” or density of obstacles in the flight environment (e.g tree branches)
 - a. Three to five meters away from forest edges or other reflective surfaces
 - b. At least 1.4 meters above the ground
3. If multiple data recorders are used, they will be spaced no closer than 2.5 km
4. Repeatable over future years (i.e. in a location that will be available in the subsequent years)

Equipment setup: The microphone will be oriented to face a likely bat travel corridor or open area. The microphone will not be directed at any solid reflective material such as large bodies of water or buildings, as this can influence the collection of acoustic data. Directional microphones will be placed at least 1.5 meters above the ground and angled approximately 45° upwards.

Habitat covariates: Data regarding habitat features and conditions can be very helpful in elucidating effects on bat abundance and diversity. For each survey, the following information will also be collected: lunar phase, habitat classification, beginning and end time, time of moonrise and moonset, time of sunrise and sunset, nightly temperature (high, low, and mean), nightly relative humidity (high, low, and mean), nightly wind speed (high, low, and mean), and distance to nearest source of clutter.

Survey period: The optimal survey period for this type of acoustic monitoring is while only resident bats are present and after young have begun to fly, to avoid biased detection of volant young. For the northern sector of sampling locations we define this as **June 15th to July 30th** and in the southern sector we define this as **June 1st to July 15th**. This classification is based on estimated spring emergence times in each sector.

Weather considerations: Weather conditions can greatly affect the activity of bat species. Thus, surveys will only be conducted when there is no rain or fog, and wind speeds are below 15 mph. If winds begin to exceed 15 mph, fog develops over large portions of the study area, or rain lasting more than 10 minutes forms, the survey will be terminated and restarted on a subsequent day.

Data downloads: During sampling, the Anabat detector will pick up a variety of noises, only a portion of which are actual bat echolocations. For analysis, this data must be separated into: *i*) raw data, *ii*) GPS data, and *iii*) individual call files. This will be done using the **CFC Read** software. The software will be set up to separate echolocations using the parameters: smooth-50, min line length-5, and MaxTBC-1. This will generate all files that are potentially bat echolocations. Further filters will be applied in the software to isolate true echolocations and divide the set into species.

Outputs

This study will provide an updated knowledge of bat populations across the Midwestern United States. This information will be shared with managers across the region and park personnel at the included research sites. This knowledge will aid in developing outreach materials for each park, and maintaining up-to-date protocols for management of bat populations across the region.