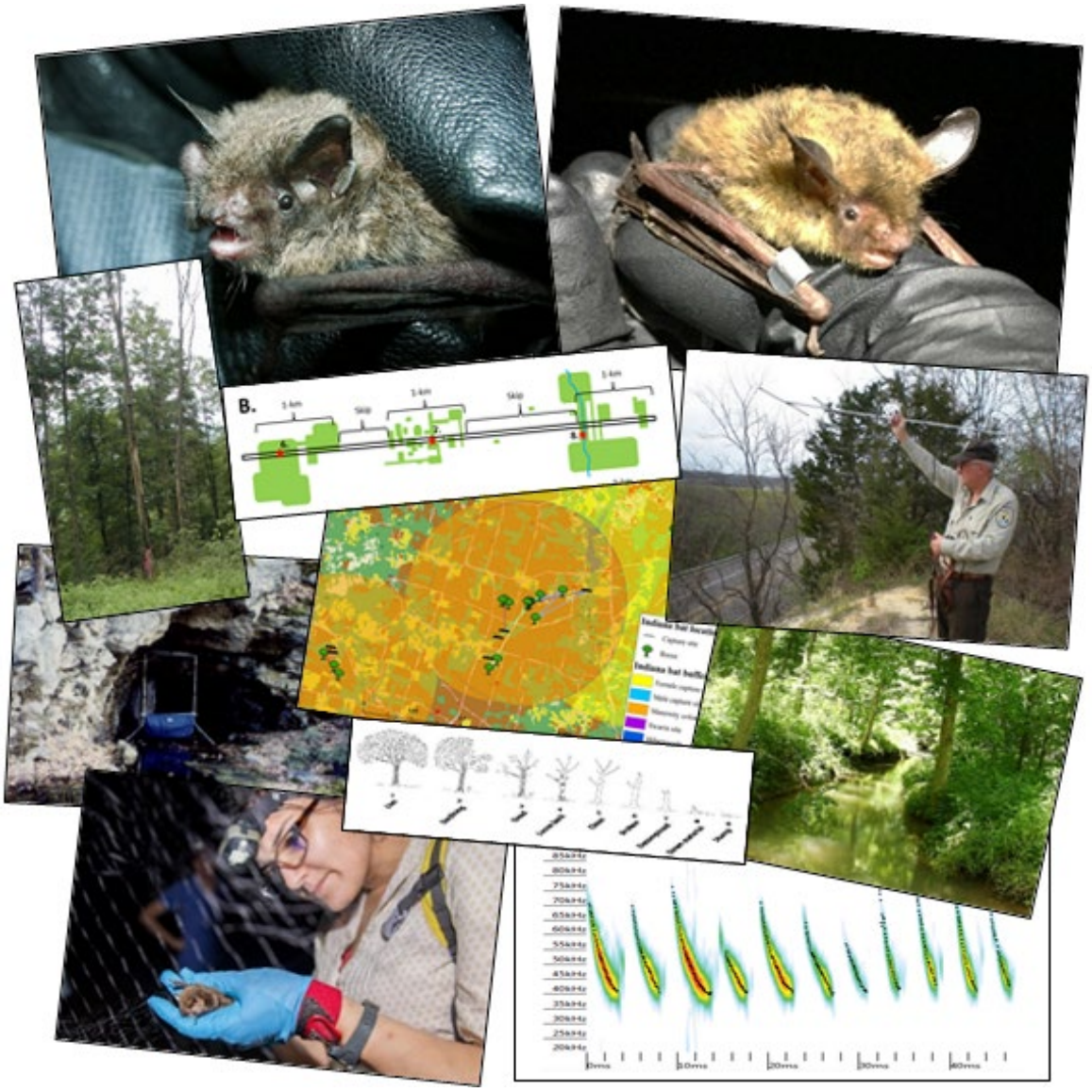
U.S. Fish and Wildlife Service

# RANGE-WIDE INDIANA BAT & NORTHERN LONG-EARED BAT SURVEY GUIDELINES



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# RANGE-WIDE INDIANA BAT & NORTHERN LONG-EARED BAT SURVEY GUIDELINES

(modifications from the previous guidelines are in **blue**)

# INTRODUCTION

The Indiana bat (IBAT) (*Myotis sodalis*) was originally listed as being in danger of extinction under the Endangered Species Preservation Act of 1966 (32 FR 4001, March 11, 1967), and is currently listed as endangered under the Endangered Species Act (ESA) of 1973, as amended. The northern long-eared bat (NLEB) (*Myotis septentrionalis*) was listed as threatened under the ESA on April 2, 2015 and recently reclassified to endangered on March 31, 2023. This survey protocol provides the U.S. Fish and Wildlife Service's (USFWS) recommended guidance on survey methods and outlines additional reporting requirements for surveyors.

The following guidance is designed to determine whether IBAT and/or NLEB are present[1] or probable absent (P/A)[2] at a given site during the summer/active season (see Appendices B, C, or J) and/or during the winter (see Appendix H) (also refer to Table 1). The phased-approach, which includes coordination with the USFWS[3], habitat assessments, acoustic, mist-net, and an assortment of survey guidance appendices, supersedes all prior survey guidance for these two species. Future changes to this document may occur and will be posted on the USFWS IBAT and NLEB survey guidance website by March 31st of each year. Before conducting surveys, please check this website to ensure use of the most current version of this document. All USFWS survey guidance documents can be found at https://www.fws.gov/library/collections/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines.

These protocols may be different from those designed for general bat monitoring as part of the North American Bat Monitoring Program (NABat)[4]. NABat surveys may be thought of as similar to breeding bird surveys and are not project-specific surveys in most cases. Information from NABat surveys can be considered as part of "best available" information when assessing whether there is already some existing information on presence of IBAT or NLEB in the vicinity of a given project.

NOTE: These protocols may also be used for tricolored bat (*Perimyotis subflavus*; TCB) presence/probable absence surveys using the NLEB level of effort (LOE) for the 2023 field season. The only differences are our definition of suitable summer habitat for tricolored bats (Appendix A), radio-tracking of TCB should prioritize identification of the immediate roosting area of the transmittered bat given the difficulty in locating the bats exact roosting location (Appendix D), emergence surveys for TCB is not a viable option given the variability in roosting locations (Appendix E), use of a 3-mile conservation buffer around TCB capture/detections and

[1] The guidance is not intended to be rigorous enough to provide sufficient data to fully determine population size or structure.
[2] Recognizing protocols are not 100% likely to detect IBAT and NLEB when present and identification errors may occur.
[3] Coordinate with the appropriate state natural resource agencies and any involved federal agency(ies) whenever "USFWS" coordination is listed. USFWS FO(s) may direct project sponsors to state agencies for existing occurrence information. Coordinate with your local USFWS FO(s) to understand the process for their area of jurisdiction.
[4] Loeb et al. 2015 available at https://www.nabatmonitoring.org

1.5-mile buffer around TCB roost trees/areas for applying the Outer-tier Guidance (Appendix G), and internal surveys of potentially suitable hibernacula may be completed for TCB (Appendix H).

# OBJECTIVES

The objectives of IBAT and NLEB survey guidelines are to: (1) standardize range-wide survey procedures; (2) maximize the potential for detection/capture of IBAT and NLEB at a minimum acceptable level of effort (LOE); (3) make accurate presence/probable absence determinations; and (4) aid in conservation efforts for the species' by identifying areas where they are present.

# BACKGROUND

In 2011, the USFWS developed a multi-agency team to determine whether improvements could be made to the 2007 IBAT Mist-Net Protocols (USFWS 2007). The team included members from each of the four USFWS regions (Midwest, Northeast, Southeast, and Southwest) where IBATs are known to occur, representatives of state natural resource agencies from three of those four regions (Midwest, Northeast, and Southeast), and representatives from three federal agencies (U.S. Geological Survey (USGS), Department of Defense, and U.S. Forest Service). This initial team obtained informal peer review of the draft guidelines in February 2012, gathered additional information in 2012, and made a revised version available for public comment in 2013 [78 FR 1879, January 9, 2013, and 78 FR 9409, February 8, 2013]. The USFWS implemented the revised guidance in 2014. Since then, a smaller USFWS team with support from USGS has made any necessary revisions to the guidelines each year. The USGS conducted initial independent testing of automated acoustic software programs during the winter of 2014-15 and continues to test new versions of available software using software-testing procedures updated in January 2019[5].

We considered the best available information for all aspects of the guidance. For example, see our white paper[6] and 2018 addendum outlining the methods used to determine the minimum IBAT LOE. Our 2022 addendum provided the rationale for the NLEB minimum LOE for acoustic and mist-net surveys (previously we deferred to LOE used for IBAT) as well as updating the IBAT acoustic LOE. The 2023 addendum utilizes new data to provide updated mist-netting LOE recommendations for IBAT and NLEB and year-round active LOE recommendations for NLEB. As we receive additional information, we may incorporate additional survey recommendations for the IBAT, NLEB, and/or other bat species. The USFWS continues to partner with local, State, and Federal biologists; scientific and academic institutions; commercial organizations; and other interested parties to collect additional data on the distribution, ecology, and biology of the IBAT and NLEB, as well as other at-risk bat species, and looks forward to receiving any additional pertinent information from partners.

# GENERAL PROCESS

Indiana and/or NLEB surveys for some proposed projects will require modification (or clarification) of this guidance through coordination with the USFWS Ecological Services Field Office(s) (FOs)

[5] Revised USFWS Software Testing Procedures are available on the USFWS website provided in the intro.
[6] The white paper, 2018, 2022 and 2023 addenda are available on the USFWS website provided in the intro.

responsible for the state(s) in which the project occurs[7]. Before coordinating with the USFWS FO(s) on survey plan development, project proponents should submit their project through the Information for Planning and Consultation (IPaC) website (https://ipac.ecosphere.fws.gov/). If not already required by federal permit, federal action agencies and surveyors should develop a proposed survey study plan in coordination with the USFWS FO(s) so that all parties fully understand which methods will be deployed, what assumptions will be made, and what the various outcomes would be based on the results of each step. Although optional, we encourage the use of the new fillable USFWS Study Plan Form for Bat Surveys and Monitoring as it will ensure all the information necessary is provided to the USFWS FO and expedite review and approval of your study plan. Project proponents are encouraged to coordinate with the USFWS FO(s) regarding when they may stop survey work at any point once an assumption or documentation of their targeted species presence occurs. Pre-survey coordination typically will preclude the need for subsequent reviews of intermediate steps by USFWS FO(s) during the busy field season. An online directory of USFWS FO(s) is available on the USFWS website (https://www.fws.gov/our-facilities). Unless otherwise agreed to by the USFWS, negative P/A survey results obtained using this guidance are valid for a minimum of five years[8] from their completion unless new information (e.g., other nearby surveys) suggest otherwise. If survey results are older than 5 years, coordinate with the USFWS FO(s) to discuss if additional surveys are needed. If not already required by federal permit, submit all results (negative or positive) from any phase to the USFWS FO(s) you have been in coordination with. We strongly encourage this coordination as it improves the USFWS' understanding of (1) the level of survey effort underway and (2) the distribution of the species. A single report can be submitted at the end of all phases conducted for a given project.

USFWS FO-level coordination is also important during the survey planning process. USFWS Section 10 permits require FO approval for each individual survey study plan in order to be in compliance. Field Offices have the authority to deny a proposed survey if it is determined that the study plan is insufficient for Section 7 consultation requirements of the ESA. For example, radio-tracking of captured IBAT and/or NLEB may be required by individual FOs and should be discussed as part of the study plan and pre-survey coordination. The guidelines that are described in this document are designed to be implemented in typical habitats that are conducive to the standard survey techniques described herein. However, the USFWS recognizes that occasionally there may be some site-specific conditions in summer habitats or at potential hibernacula sites that do not lend themselves to being surveyed using the standard survey options (e.g., mist nets, acoustic detectors, or harp traps) even though a site may otherwise meet the definition of suitable IBAT and/or NLEB habitat. Therefore, we strongly encourage coordination with the FO(s) prior to using methods that may not be appropriate for site-specific habitat conditions.

Because surveys that result in the capture of IBAT and/or NLEB result in take, such surveys should only be conducted by a qualified biologist[9]. Generally, a recovery permit for the IBAT and NLEB

[7] For example, project sponsors for large acreage and/or landscape-scale projects that do not result in permanent habitat loss and would not pose an ongoing threat of lethal take, especially those proposed by land management agencies, may work with local USFWS FOs to apply different scales of surveys (broad vs. project-level) or different types of surveys, such as long-term monitoring results (e.g., forest-wide acoustic transect data) and/or targeted survey efforts (e.g., sub-sampling of large project areas), to address P/A concerns.

[8] The timeframe may be reduced if significant habitat changes have occurred in the area or increased based on local information.

[9] A qualified biologist is an individual who holds a USFWS Recovery Permit (Federal Fish and Wildlife Permit) for IBAT and/or NLEB in the state/region in which they are surveying and/or has been authorized by the appropriate state agency to

authorizes the capture of bats for identification, and handling of bats for measurements, photography, banding, and radio transmitter attachment; some (but not all) may also authorize entry into potential hibernacula to conduct internal surveys and other study-specific collection. Following this survey guidance will meet standard USFWS Section 10 recovery permit requirements; however, surveyors also need to ensure they meet all applicable state permitting and reporting requirements. Failure to follow the survey guidance, as written, and/or failure to follow a study plan which has received concurrence from the local USFWS FO(s), may result in a USFWS FO requesting additional survey effort.

The following provides a step-by-step outline of how IBAT and/or NLEB summer surveys and/or potential hibernacula surveys should be conducted. Some of these steps can occur concurrently.

**NOTE:** If surveys are specifically targeting both the IBAT and NLEB, **make sure to use the higher minimum LOE for chosen survey methods (e.g., NLEB range-wide acoustic or mist-netting LOE, also see 2022 and 2023 Addendum)** to ensure it meets the needs for both species.

## PHASE 1 – INITIAL PROJECT SCREENING

**Step 1. Determine if your project is within the range of IBAT and/or NLEB through the U.S. Fish and Wildlife Service's Information for Planning and Consultation website (https://ipac.ecosphere.fws.gov/). Once completed, coordinate with the U.S. Fish and Wildlife Service Field Office(s)[10] regarding existing IBAT and/or NLEB summer and/or winter occurrence information. [*Projects located within known IBAT and/or NLEB summer habitat and/or known hibernacula/spring-staging/fall swarming zones will not proceed to Phase 2 of this process unless the project meets the definition of an "outer-tier project" outlined in Appendix G.*]**

a) If a project (located within or outside of a known maternity colony home range or spring-staging/fall-swarming zone of a known hibernaculum) is already covered under an existing Endangered Species Act (ESA) incidental take authorization (e.g., HCP, BO), then no further summer and/or potential hibernacula surveys are needed, follow the procedures previously authorized by the USFWS FO(s).

b) If there are known IBAT or NLEB occurrences (e.g., known roost trees, capture locations, foraging locations or hibernacula) within the project action area[11]; **OR**

   if there are no known IBAT or NLEB summer or spring/fall/winter occurrences within the proposed project area itself, but the project area is located within a known maternity colony home range and/or the spring-staging and fall-swarming zone of a known

net and handle IBAT and/or NLEB. Several USFWS offices maintain lists of qualified bat surveyors, and if working in one of those states with authorizations in lieu of a Recovery Permits, the individual will either need to be on that list or submit qualifications to receive USFWS approval prior to conducting any field work.

[10] Coordinate with the appropriate state natural resource agencies and any involved Federal Action agencies whenever "USFWS" coordination is listed. USFWS FO(s) may direct project sponsors to state agencies for existing occurrence information. Coordinate with your local USFWS FO(s) to understand the process for their area of jurisdiction.

[11] The "action area" is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. [50 CFR Section 402.02]

hibernaculum[12]; **OR**

if the project is located outside a known maternity colony home range and/or spring-staging and fall-swarming zone of a hibernaculum but is within the range of the IBAT and/or NLEB (note this can change over time), then proceed to Step 2.

**Step 2. Conduct Habitat Assessment (Desktop or Field-based; see Appendix A and Appendix H).**

a) If suitable summer habitat and/or a potential hibernaculum (a) is present within the action area, then proceed to Step 3.

b) If both suitable summer and winter habitat (i.e., potential hibernaculum) are absent within the action area, then no further P/A surveys are recommended; however, additional coordination with the USFWS FO(s) may be recommended if IBAT and/or NLEB may be present in an action area during other seasons (e.g., spring and fall migration) and may be affected by the proposed project.

**Step 3. Assess potential for adverse effects to IBAT and/or NLEBs**

a) If the project is not anticipated to result in adverse effects to IBAT and/or NLEB (as proposed), then no further summer and/or potential hibernacula surveys are recommended, coordinate with the USFWS FO(s).

b) If the project may result in adverse effects to IBAT and/or NLEB, but impacts can be adequately assessed and conservation measures can be designed to minimize those effects without additional P/A information (this includes **all** proposed projects within known summer maternity colony home ranges and /or at known hibernacula and their surrounding spring-staging and fall-swarming zones, but may include other areas as well), then no further surveys are recommended. Coordinate with the USFWS FO(s) regarding an assessment of the project's potential effects, development of conservation measures, determination of the need for any ESA incidental take authorization, and discussion of value of additional surveys.

c) If the project does not meet the conditions of 3a or 3b, then proceed to **Phase 2** and/or **Phase 5**.

## PHASE 2 – SUMMER/ACTIVE SEASON P/A SURVEYS (NETTING OR ACOUSTIC)[13]

Presence/probable absence (P/A) of IBAT and/or NLEB may be determined by conducting either

[12] See USFWS IBAT Section 7 and Section 10 Guidance for Wind Energy Projects (Questions 4 & 5) on the USFWS website provided in the introduction.

[13] NOTE: acoustic and/or mist-net surveys should be conducted in the best suitable habitat possible for each survey type to increase the likelihood of detecting/capturing IBAT and/or NLEB. In some cases, the most suitable habitat for effectively conducting surveys may occur outside a project site boundary and may be sampled if landowner permission is granted. For projects with multiple survey areas (e.g., >123 acres or >1 km), survey methods may be interchanged. For example, acoustics could be used for one 123-acre survey area and netting could be used for another 123-acre area.

Step 4 (mist-netting; see Appendix B or Appendix J) or Step 5 (acoustics; see Appendix C or Appendix J) as outlined below. If the project area contains habitat that is appropriate to conduct either survey method, it is the project proponent's choice as to which option to use, for each survey area unit (i.e., ≤123-acre area or 1-km section of linear project). A combined mist-netting and acoustic approach is acceptable (see "pilot" Appendix I). Under no scenario can a project proponent use either mist-netting or acoustic Phase 2 surveys to challenge the other methods results. The USFWS accepts the results of either option and has no preference for methods. The USFWS FO(s) can discuss pros and cons of different approaches depending on project sponsor needs and project-specific habitat conditions. For example, a project area may not have suitable conditions for a mist-net survey and an acoustic survey may be the only appropriate method for establishing P/A. It is up to the surveyor's professional judgment to determine whether the habitat on-site has the appropriate structure for the survey method chosen prior to the survey and to coordinate with the FO(s) if issues arise with the method chosen and need to be reconsidered.

However, acoustics at the Phase 2 level of effort (LOE) (or otherwise agreed to with the USFWS FO) may be used as a coarse screening tool for conducting subsequent mist-netting at the Phase 2 LOE. For example, if NO high frequency (HF) calls (≥35 kHz) are detected, then no netting is required within that 123-acre (non-linear) or 1-km (linear) survey area due to the probable IBAT and/or NLEB probable absence. If ANY HF calls are detected, then mist-net at the Phase 2 LOE. Any project study plan that includes use of both acoustics and netting needs to be written clearly to avoid potential misunderstandings between the project proponent and the USFWS FO.

Also, Phase 2 acoustic results should be used to inform whether, when, and where to conduct any optional Phase 3 mist-netting. In this case, acoustics is the P/A method and if probable presence is detected (HF screen, automated/MLE, or manual vetting), then IBAT and/or NLEB probable presence is established. Negative results from follow-up mist-netting (at any LOE) does not refute a previously established positive acoustic result. The goal of Phase 3 netting is simply to verify where IBAT and/or NLEB(s) are active and to capture and track individuals to document roost trees and population size to further inform consultation or coordination under the ESA.

The summer survey season for IBAT and the seasonal[14] NLEB range is from 15 May through 15 August[15], unless the survey is being conducted within the year-round active portion of the NLEB range where the survey season is from 1 March through 15 November (see Appendix J). All P/A surveys should be completed by August 15 unless otherwise indicated by USFWS FO[14]. The minimum prescribed survey level of effort for any given survey area unit (i.e., ≤123-acre area or 1-km section of linear project) **cannot** be completed in a single calendar night regardless of which survey method (netting or acoustic) is used (i.e., minimum survey effort must be spread over at least 2 calendar nights with suitable weather conditions). If netting is chosen as the preferred P/A method and an IBAT and/or NLEB is captured, then surveyors may immediately begin Phase 4/radio-tracking. Project proponents must decide whether they will proceed to Phase 4 in coordination with the USFWS FO before any mist-netting occurs. Submit Phase 2 study plans to USFWS FO prior to conducting surveys for their review and site-specific authorization.

[14] The seasonal NLEB range includes the portion of the range where the species hibernates in the winter, stages and swarms outside of hibernacula in the spring and fall, and migrates to summer home ranges.

[15] With prior USFWS FO approval, a survey may be completed after August 15 if it was initiated in time to be completed by August 15 and extenuating weather circumstances resulted in delaying completion. Delays as a result of not meeting the acceptable weather requirements are the ONLY valid justification for surveying after August 15. If tracking is proposed, surveys should be scheduled so that tracking is concluded prior to August 15.

**Step 4. Conduct Mist-Netting Surveys following IBAT and/or NLEB Protocols**[16]
**(See Figure 1, Table 2, and Appendix B)**

**Range-wide IBAT Mist-netting LOE:**

Linear projects: a minimum of 2 net nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

Non-linear projects: a minimum of 6 net nights per 123 acres (0.5 $km^2$) of suitable summer habitat.

a) If no capture of IBAT(s), then no further summer surveys are recommended[17].

a) If capture of IBAT(s), then stop or proceed to **Phase 4** as previously decided in coordination with the FO.

**Seasonal Range NLEB Mist-netting LOE:**

Linear projects: a minimum of 4 net nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

Non-linear projects: a minimum of 10 net nights per 123 acres (0.5 $km^2$) of suitable summer habitat.

a) If no capture of NLEB(s), then no further summer surveys are recommended.

b) If capture of NLEB(s), then stop or proceed to **Phase 4** as previously decided in coordination with the FO.

**OR**

**Step 5. Conduct Acoustic Surveys**[18] **(see Figure 1, Table 2, and Appendix C)**

**IBAT Acoustic LOE (Range-wide)**

Linear projects: a minimum of 4 detector nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

[16] We have no recommendations for reducing the minimum level of effort required to demonstrate probable absence for projects <123 acres in size. Level of effort is based on detection probabilities and occupancy estimates that were derived from past survey efforts that used the same acreage threshold. Level of effort for mist-netting is designed to reach 90% confidence in negative survey results (see Niver et al. 2014; Armstrong et al. 2023).

[17] NOTE: For Phase 2 P/A Surveys, wherever the phrase "no further summer surveys are recommended" occurs within this document, the USFWS FO(s) is in affect assuming probable absence of IBAT and/or NLEB.

[18] Acoustic surveys are available as a P/A option throughout the ranges of both species. We have no recommendations for reducing the minimum level of effort required to demonstrate probable absence for projects <123 acres in size. Level of effort is based on detection probabilities and occupancy estimates that were derived from past survey efforts that used the same acreage threshold. Level of effort for acoustics is designed to reach 90% confidence in negative survey results (see Niver et al. 2014; Armstrong et al. 2022).

Non-linear projects: a minimum of 10 detector nights per 123 acres (0.5 $km^2$) of suitable summer habitat.

**NLEB Acoustic LOE (Range-wide)**

Linear projects: a minimum of 4 detector nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

Non-linear projects: a minimum of 14 detector nights per 123 acres (0.5 $km^2$) of suitable summer habitat.

**NOTE:** Optional coarse screening - for high frequency (HF) or myotid calls (depending on available H/L frequency filters) or Proceed to Step 6

i) If no positive detection of HF calls[19] (≥35 kHz) or myotid calls, no further summer surveys recommended.

ii) If positive detection of HF or myotid calls, then
   (a) proceed to Step 6 for further acoustic analysis; **OR**
   (b) assume presence of IBAT and/or NLEB and coordinate with the USFWS FO(s); **OR**
   (c) assume presence and proceed to **Phase 3**.

**Step 6. Conduct Automated Acoustic Analyses for each site that had HF or Myotid calls from Step 5 or ALL sites and ALL calls if Step 5 was not conducted.**

**(NOTE: cannot skip this step and proceed directly to Step 7)**

Use **one or more** of the currently available 'approved' acoustic bat ID programs[20] (use most current approved software versions available and manufacturer's recommended settings for IBAT and/or NLEB P/A surveys). 'Candidate' programs are not yet approved by USFWS for stand-alone use for P/A surveys but may be used in conjunction with one or more of the approved programs. At this time, no acoustic bat ID programs are 'approved' for many western states (Figure 2 in Appendix C). Two or more of the currently available 'candidate' programs must be used for surveys conducted in these locations (always use most recent versions of software programs).

Include your plans for which specific software program(s) you will use in your survey study plan and submit for USFWS FO(s) review prior to conducting surveys. Beginning with acoustic data from night one at each acoustic site, run each night's data for each site through your chosen ID program(s). Review results by site by night from each acoustic ID program used[21].

[19] HF calls are defined as individual call pulses whose minimum frequency is ≥35 kHz.

[20] Approved and candidate programs are listed on the USFWS website provided in the introduction; note all programs are considered 'candidate' for States/Region identified in Figure 2 (see Appendix C).

[21] The approved acoustic identification programs all have implemented a maximum likelihood estimator (MLE) at this time. If the analysis of collected calls at a given site on a given night results in the probable presence of IBAT or NLEB with high levels of certainty ($P<0.05$), then select one of the options available in Step 6b.

a) If IBAT and NLEB presence is considered unlikely by all the approved and candidate program(s) used in analysis, then no further summer surveys recommended.

b) If IBAT and/or NLEB presence is considered likely at one or more sites on one or more nights by any approved or candidate program(s) used in analysis, then

i) proceed to Step 7 for qualitative ID; **OR**
ii) assume presence of IBAT and/or NLEB and coordinate with the USFWS FO(s); **OR**
iii) assume presence and proceed to **Phase 3**.

**Step 7. Conduct Qualitative Analysis of Calls.**

At a minimum, for each detector site/night a program identified IBAT and/or NLEB presence likely (i.e., P<0.05), review all HF (i.e., ≥35 kHz) call files (regardless of MLE value and including no ID files) from that site/night. Qualitative analysis[22] (i.e., manual vetting) must also include a comparison of the results of each acoustic ID program by site and night (see Reporting Requirements in Appendix C).

a) If no visual confirmation of probable IBAT and NLEB, then no further summer surveys recommended[23].

b) If visual confirmation of probable IBAT and/or NLEB, then

i) assume presence of IBAT and/or NLEB and coordinate with the USFWS FO(s); **OR**
ii) assume presence and proceed to **Phase 3**.

## PHASE 3. CONDUCT MIST-NETTING SURVEYS TO CAPTURE INDIANA and/or NORTHERN LONG-EARED BATS.

If mist-netting was not conducted as the P/A method, then mist-netting may be conducted in Phase 3 to capture and characterize (e.g., sex, age, reproductive condition) the IBAT and/or NLEB that are present in an area and to facilitate Phase 4 efforts. We encourage working with the FOs to develop Phase 3 netting plans based on best available information (e.g., positive acoustic locations). There are no minimum requirements for this phase as this is not a P/A phase.

a) If no IBAT and/or NLEB are captured, then coordinate with the USFWS FO.

b) If IBAT and/or NLEB are captured, then proceed to **Phase 4**.

[22] Qualitative analysis of each acoustic site and night with probable detections of IBAT or NLEB during Step 6 must include the entire night's high-frequency call data and not just those files making it through the acoustic analysis tools as probable IBAT or NLEB.
[23] If you identify any suspected mis-identifications from programs, the Service will share those results with the software manufacturer(s) and the USGS to assist with future improvements and testing of software.

**PHASE 4. CONDUCT RADIO-TRACKING AND EMERGENCE SURVEYS** (See Appendices D and E).

**PHASE 5. CONDUCT POTENTIAL HIBERNACULA SURVEYS**
(See Appendix H)

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**TABLE 1.** Standard survey seasons for conducting P/A surveys for IBAT and/or NLEB.

| IBAT & NLEB SURVEY SEASONS | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **IBat Internal Winter Hibernacula Surveys**[1,2] | | | | | | | | | | | | |
| Acceptable survey window (1 Jan. - 28 Feb.) | | | | | | | | | | | | |
| Traditional survey window of known sites (15 Jan. - 15 Feb.) | | | | | | | | | | | | |
| **IBat & NLEB Spring & Fall Surveys at Entrances of Potential Hibernacula** [3,4] | | | | | | | | | | | | |
| Acceptable survey window (1 - 21 Apr. & 15 Sep. - 31 Oct.) | | | | | | | | | | | | |
| **IBat & NLEB Summer Surveys of Suitable Summer Habitat** [5] | | | | | | | | | | | | |
| Acceptable survey window (15 May - 15 Aug.) | | | | | | | | | | | | |
| Optimal survey window (1 Jun. - 31 Jul.) [6] | | | | | | | | | | | | |
| **NLEB Surveys of Suitable Habitat in Year-round Active Range** | | | | | | | | | | | | |
| Acceptable survey window - (1 Mar. - 15 Nov.) | | | | | | | | | | | | |
| Optimal survey window (1 May - 30 Sep.) [6] | | | | | | | | | | | | |

[1] visual and photographic surveys conducted within known and/or potential hibernacula (if deemed safe to enter).

[2] internal winter hibernacula surveys are seldom appropriate for NLEB as they typically fail to reliably detect and accurately enumerate the species when present.

[3] conducted using harp traps or mist nets at cave/mine entrances.

[4] if State/USFWS FO approve, spring and fall survey windows can "drift" a bit earliler or later to better accommodate prevailing weather patterns and/or climate conditions in the location of the proposed survey. For example, the fall survey window in nothern portions of the IBAT or NLEB range may begin on or after 1 Sep. and end prior to 31 Oct. pending local State and FO approval. Likewise, if agencies approve, spring surveys of potential hibernacula may be pushed back/extended a few days or longer due to an extended period of unseasonably cold spring weather.

[5] conducted using mist nets or acoustic detectors deployed within suitable flight corridors and foraging areas.

[6] the middle of the maternity season is considered by many to the best or "optimal" time to capture resident bats.

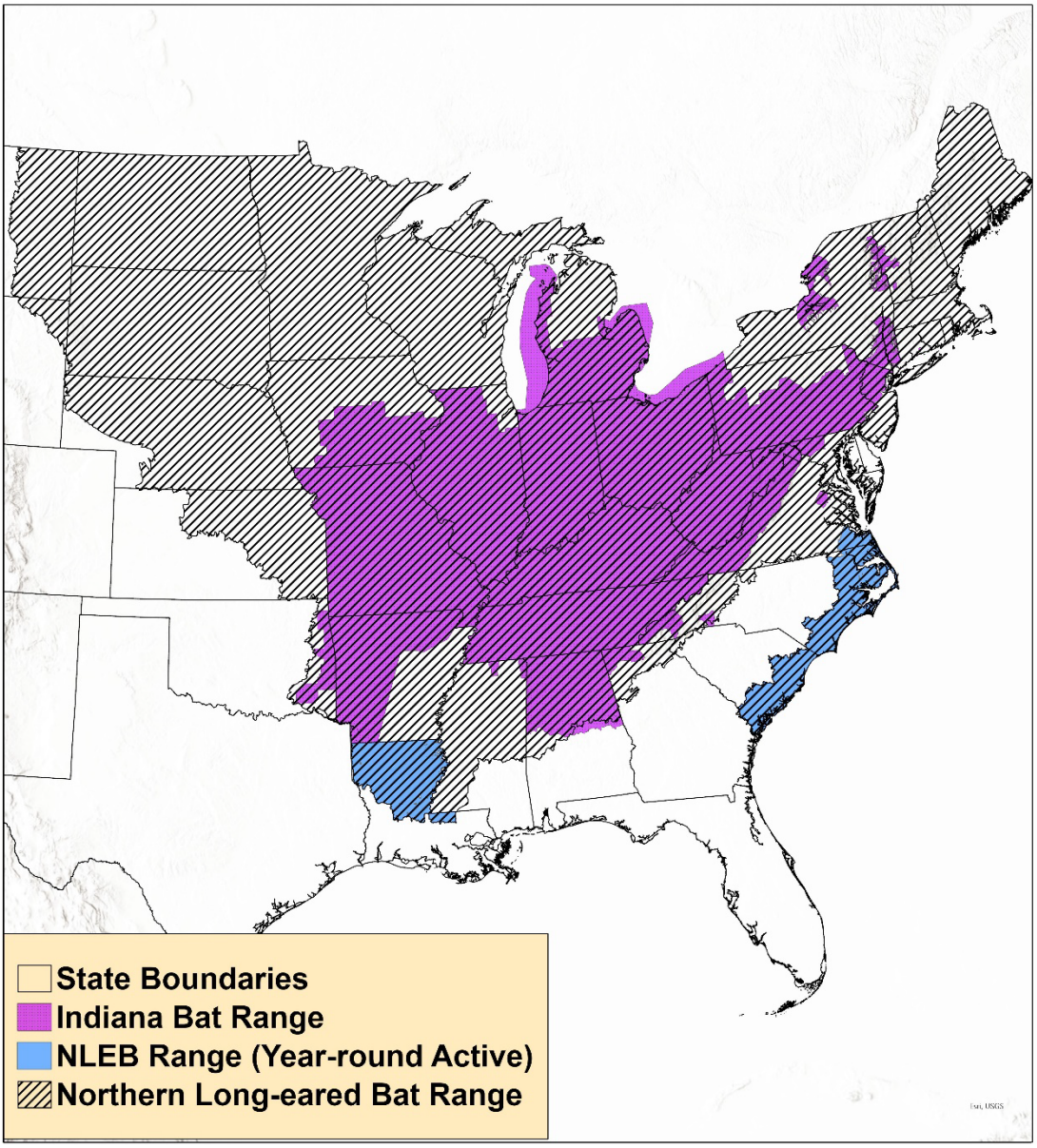


**FIGURE 1.** IBAT and NLEB ranges as defined for use in presence/ probable absence surveys (also see Table 2).

**TABLE 2.** Summary of current survey LOEs for IBAT and NLEB.

| | | MIST-NETTING (net nights) | | ACOUSTICS (detector nights) | |
|---|---|---|---|---|---|
| **Species** | **Region** | **Linear** (per km) | **Non-Linear** (per 123 ac.) | **Linear** (per km) | **Non-Linear** (per 123 ac.) |
| IBAT | Range-wide | 2 | 6 | 4 | 10 |
| NLEB | Seasonal Range (non-coastal areas) | 4 | 10 | 4 | 14 |
| | Non-seasonal Range (year-round active / coastal areas) | 2 | 6 | | |

# APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

Summer habitat and potential hibernacula assessments are Step 2 of Phase 1- Initial Project Screening. The information below is provided to assist applicants, consultants, and/or project proponents (hereinafter termed the "applicant") in establishing whether surveys for IBAT and/or NLEB should be conducted. As a reminder, the first steps for determining presence of IBAT and/or NLEB at a given site is to 1) use the USFWS's Information for Planning and Consultation (IPaC) website (https://ipac.ecosphere.fws.gov/), and 2) determine whether there is any existing occurrence data available for the vicinity of the project from the local USFWS FO. This step can be conducted remotely via a desktop analysis (e.g., use of aerial photography to assess the potential presence of suitable summer habitat). The applicant is responsible for developing and providing sufficient information as to whether suitable summer habitat and/or potential hibernacula exist within a proposed project area. If suitable habitat is present, the applicant should calculate the amount and submit this to the USFWS FO(s) and determine the need for any P/A surveys (Phase 2).

**NOTE**: If IBAT and/or NLEB are present or assumed to be present during any phase, more detailed habitat information may be necessary to adequately assess the potential for impacts (see attached example Bat Habitat Assessment Datasheet). If no suitable habitat is present or it is determined through discussions with USFWS FO(s) that no adverse effects are anticipated from the proposed project, no surveys are recommended to assess risk during the summer. Habitat assessments for IBAT and/or NLEB can be completed any time of year and applicants are encouraged to submit results and proposed Phase 2 study plans well in advance of the summer survey season.

## PERSONNEL

Habitat assessments should be completed by individuals with a natural resource degree or equivalent work experience demonstrating skills and knowledge in area-specific ecoregions, landscapes, habitats, and ecosystems.

## DEFINITION FOR POTENTIALLY SUITABLE INDIANA BAT SUMMER HABITAT

Suitable summer habitat for IBAT consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats[24] such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥5 inches dbh[25] (12.7 centimeter) that have exfoliating bark, cracks, crevices, and/or hollows), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be

[24] Non-forested habitats typically should be excluded from acreages used to establish a minimum level of survey effort for Phase 2 surveys.

[25] While trees <5 inches (<12.7 cm) dbh that have exfoliating bark, cracks, crevices, and/or hollows may have some potential to be male IBAT summer roosting habitat, the USFWS does not consider early successional, even-aged stands of trees <5 inches dbh to be suitable roosting habitat for the purposes of this guidance. Suitable *roosting* habitat is defined as forest patches with trees of 5-inch (12.7 cm) dbh or larger. However, early successional habitat with small diameter trees may be used as foraging habitat by IBATs. Therefore, a project that would remove or otherwise adversely affect ≥20 acres of early successional habitat containing trees between 3 and 5 inches (7.6-12.7 cm) dbh would require coordination/consultation with the USFWS FO to ensure that associated impacts would not rise to the level of take. The USFWS may request P/A surveys if >20 acres of early successional habitat were proposed for removal.

considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of other forested/wooded habitat.

Indiana bats have also been observed roosting in human-made structures, such as bridges and bat houses (artificial roost structures); therefore, these structures should also be considered potential summer habitat[26]. We recommend that project proponents or their representatives coordinate with the appropriate USFWS Field Office (FO) to define suitable habitat more clearly for their region as some differences in state/regional suitability criteria may be warranted (e.g., high-elevation areas may be excluded as suitable habitat in some states).

Examples of unsuitable habitat:

- Individual trees that are greater than 1,000 feet from forested/wooded areas;
- Trees found in highly developed urban areas (e.g., street trees, downtown areas); and
- A pure stand of less than 3-inch dbh[27] trees that are not mixed with larger trees.

## DEFINITION FOR POTENTIALLY SUITABLE NORTHERN LONG-EARED BAT SUMMER HABITAT

Suitable summer habitat for the NLEB consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥3 inches dbh that have exfoliating bark, cracks, crevices, and/or cavities), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. NLEBs are nocturnal foragers and use hawking (catching insects in flight) and gleaning (picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, p. 88; Ratcliffe and Dawson 2003, p. 851). NLEB seem to prefer intact mixed-type forests with small gaps (i.e., forest trails, small roads, or forest-covered creeks) in forest with sparse or medium vegetation for foraging and commuting rather than fragmented habitat or areas that have been clear cut (USFWS 2015, p. 17992). Individual trees may be considered suitable habitat when they exhibit characteristics of suitable roost trees and are within 1,000 feet of other forested/wooded habitat[28]. The NLEB has also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat[29].

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[26] If human-made structures are present within your project area and are proposed to be removed or modified, see Appendix E (Emergence Surveys) and then coordinate with the local USFWS FO(s) regarding how to determine P/A.

[27] Suitable *roosting* habitat is defined as forest patches with trees of 5-inch (12.7 cm) dbh or larger. However, early successional habitat with small diameter trees may be used as foraging habitat by IBAT. Therefore, a project that would remove or otherwise adversely affect ≥20 acres of early successional habitat containing trees between 3 and 5 inches (7.6-12.7 cm) dbh would require coordination/consultation with the USFWS FO to ensure that associated impacts would not rise to the level of take. The USFWS may request P/A surveys if >20 acres of early successional habitat were proposed for removal.

[28] This number is based on observations of bat behavior indicating that such an isolated tree (i.e., ≥1000 feet) would be extremely unlikely to be used as a roost. This distance has also been evaluated and vetted for use for the NLEB. See the "Indiana bat Section 7 and Section 10 Guidance for wind Energy Projects," question 33, found on the USFWS website provided in the intro.

[29] Trees found in highly-developed urban areas (e.g., street trees, downtown areas) are extremely unlikely to be suitable habitat.

NLEBs typically occupy their summer habitat from mid-May through mid-August each year[30] and the species may arrive or leave some time before or after this period. In most areas, roosting habitat is considered suitable summer habitat because NLEBs are only present in forested habitat during the summer active months. In some areas of the southern U.S., NLEBs are present in potential roosting habitat year-round. In these areas (see Figure 1 and Figure 3 in Appendix J), habits and habitat use differ significantly from the rest of the species' range.

Examples of unsuitable habitat:

- Individual trees that are greater than 1,000 feet from forested/wooded areas;
- Trees found in highly developed urban areas (e.g., street trees, downtown areas); and
- A pure stand of less than 3-inch dbh trees that are not mixed with larger trees.

## DEFINITION FOR POTENTIALLY SUITABLE TRICOLORED BAT SUMMER HABITAT

Suitable TCB summer habitat consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures. This includes forests and woodlots containing trees with potential roost substrate (i.e., live and dead leaf clusters of live and recently dead deciduous trees, Spanish moss [*Tillandsia usneoides*], and beard lichen [*Usnea trichodea*])[31], as well as linear features such as fencerows, riparian forests, and other wooded corridors. TCBs will roost in a variety of tree species, especially oaks (*Quercus spp.*), and often select roosts in tall, large diameter trees, but will roost in smaller diameter trees when potential roost substrate is present (e.g., 4-inch [10-centimeter]; Leput 2004). TCBs commonly roost in the mid to upper canopy of trees although males will occasionally roost in dead leaves at lower heights (e.g., < 16 feet [5 meters] from the ground; Perry and Thill 2007) and females will occasionally roost in Spanish moss of understory trees (Menzel et al. 1999). TCBs seem to prefer foraging along forested edges of larger forest openings, along edges of riparian areas, and over water and avoid foraging in dense, unbroken forests, and narrow road cuts through forests (Davis and Mumford 1962; Kurta 1995; Lacki and Hutchinson 1999; Ford et al. 2005; Menzel et al. 2005; Thames 2020). TCBs also roost in human-made structures, such as bridges and culverts, and occasionally in barns or the underside of open-sided shelters (e.g., porches, pavilions); therefore, these structures should also be considered potential summer habitat. TCBs occupy similar forest habitats in the spring, summer, and fall (i.e., non-hibernating seasons) but in the southern portion of the range, where TCBs exhibit shorter torpor bouts and remain active and feed year-round, they may roost in culverts, bridges, cavities in live trees, live and dead leaf clusters, and/or Spanish moss during the winter (Sandel et al. 2001; Newman et al. 2021). TCBs may roost and forage in forested areas near anthropogenic structures and buildings (e.g., suburban neighborhoods, parks, etc.) (Helms 2010; Shute et al. 2021). However, highly developed urbanized areas generally devoid of native vegetation (including isolated trees surrounded by expansive anthropogenic development) are considered unsuitable habitat (e.g., parking lots, industrial buildings, shopping centers).

[30] Exact dates vary by location., with NLEBs typically being found earlier in spring at lower latitudes. Also, NLEBs in the year-round active portion of the range are an exception as they utilize the same habitat in summer as they do in winter.

[31] Occasional summer roosts also include clusters of dead pine needles of large live pines (*Pinus echinata*), live branches of Norway spruce (*Picea abies*), eastern red cedar (*Juniperus virginiana*), abandoned gray squirrel (*Sciurus carolinensis*) nests, and under exfoliating birch (*Betula spp.*) bark (Veilleux et al. 2003; Perry and Thill 2007; WDNR 2016; WDNR 2017a; WDNR 2017b; WDNR 2018; Thames 2020; Hammesfahr et al. 2022).

## SUBMISSION OF PHASE 1 HABITAT ASSESSMENT & PHASE 2 AND/OR PHASE 5 STUDY PLAN (IF NEEDED)

If a proposed project may affect (positively or negatively) IBAT and/or NLEB and the conditions outlined in Step 3 a or b are not met, a habitat assessment report should be submitted to the appropriate USFWS FO(s) (and/or to the lead Federal Action Agency as appropriate) along with a draft study plan for the Phase 2 (acoustic or netting) and/or Phase 5 (potential hibernaculum) survey(s) (if suitable habitat(s) is present). Although optional, we encourage the use of the new fillable USFWS Study Plan Form for Bat Surveys and Monitoring as it will ensure all the information necessary is provided to the USFWS FO and expedite review and approval of your study plan. Complete Phase 1 reports will include the following:

1. Full names and relevant titles/qualifications of individuals (e.g., John E. Smith, Biologist II, State University, B.S. Wildlife Science 2007) completing the habitat assessment and when the assessment was conducted
2. A map and latitude/longitude or UTM clearly identifying the project location (or approximate center point) and boundaries
3. A detailed project description (if available)
4. Documentation of any known/occupied spring staging, summer, fall swarming, and/or winter habitat for IBAT and/or NLEB within or near the project area
5. A description of methods used during the habitat assessment
6. A summary of the assessment findings and a completed Bat Summer Habitat Assessment Datasheet (see example below; use of this datasheet is optional)
7. Other information that may have a bearing on use of the project area (e.g., presence of fall or winter habitat [caves, crevices, fissures, or sinkholes, or abandoned mines of any kind], bridges and other non-tree potential summer roosts.)
8. A Phase 1 Habitat Assessment on all potential hibernacula that could be affected by the proposed project (see Appendix H for additional instructions for completing this assessment and sample datasheet), if necessary
9. Any other information requested by the local USFWS FO(s) related to the project

In addition, Phase 2 Study Plans should contain the following:

1. A statement as to which type of P/A surveys will be conducted (i.e., mist-netting and/or acoustic surveys) and how the proposed survey level of effort (i.e., total # of net nights and/or detector nights) was calculated/determined;
2. A map depicting the proposed number of survey sites (mist netting and/or acoustic) and their tentative distribution throughout the project area; NOTE: If a site has never been visited or confirmed to have suitable mist netting habitat, it is the surveyor's responsibility to contact the USFWS FO(s), and come up with an alternative plan, such as conducting an acoustic survey. The USFWS FO may reject mist net surveys that lead to false negative results.
3. A tentative list of surveyor names and copies of relevant federal permits (if applicable);

4. A tentative survey schedule (e.g., start date, duration, end date);
5. For mist-netting surveys with planned Phase 4 radio-tracking: the approximate number and distribution of transmitters (e.g., prioritization of sex/age, maximum number per site) and a request that bats targeted for tracking may be held for up to 30 minutes[32] to allow for application of transmitters; and
6. For acoustic surveys: information on which specific program(s) will be used and what level of acoustic analyses will be conducted.

If **potential hibernacula** are identified, then Phase 5 Study Plans should contain the following:

1. A completed USFWS Project Proposal Form (see Appendix H);
2. A map depicting all potential hibernacula identified and their tentative distribution throughout the project area;
3. A written justification if an entrance(s) survey is proposed instead of an internal survey;
4. A written justification if mist-nets are proposed instead of harp traps; and
5. For surveys of entrances that are inter-connected and unfeasible to survey on the same night, a proposed modified method to complete the survey (see Phase 2, #5 in Appendix H).

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[32] Current standard federal Section 10 bat permit conditions require prior written approval from the Field Supervisor in the USFWS FO(s) if capture times may exceed 30 minutes.

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## BAT HABITAT ASSESSMENT DATASHEET

Project Name:_____ Date:_____

Township/Range/Section:_____

Lat Long/UTM/ Zone:_____ Surveyor:_____

**Brief Project Description**

| |
|---|
| |

**Project Area**

| | Total Acres | Forest Acres | Open Acres |
|---|---|---|---|
| **Project** | | | |

| | Completely cleared | Partially cleared (will leave trees) | Preserve acres- no clearing |
|---|---|---|---|
| **Proposed Tree Removal (ac)** | | | |

**Vegetation Cover Types**

| Pre-Project | Post-Project |
|---|---|
| | |

**Landscape within 5 mile radius**

| |
|---|
| **Flight corridors to other forested areas?** |
| **Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)** |

**Proximity to Public Land**

| |
|---|
| **What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?** |

Use additional sheets to assess discrete habitat types at multiple sites in a project area

*Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area*

*A single sheet can be used for multiple sample sites if habitat is the same*

| **Sample Site Description** |
|---|
| Sample Site No.(s): _____ |

| **Water Resources at Sample Site** | | | | |
|---|---|---|---|---|
| **Stream Type (# and length)** | Ephemeral | Intermittent | Perennial | Describe existing condition of water sources: |
| | | | | |
| **Pools/Ponds (# and size)** | | Open and accessible to bats? | | |
| | | | | |
| **Wetlands (approx. ac.)** | Permanent | Seasonal | | |
| | | | | |

| **Forest Resources at Sample Site** | | | | |
|---|---|---|---|---|
| **Closure/Density** | Canopy (> 50 ') | Midstory (20-50') | Understory (<20') | 1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100% |
| | | | | |
| **Dominant Species of Mature Trees** | | | | |
| **% Trees w/ Exfoliating Bark** | | | | |
| **Size Composition of Live Trees (%)** | Small (3-8 in) | Med (9-15 in) | Large (>15 in) | |
| | | | | |
| **No. of Suitable Snags** | | | | |

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

**IS THE HABITAT SUITABLE FOR INDIANA BATS?** _____

**IS THE HABITAT SUITABLE FOR NORTHERN LONG-EARED BATS?** _____

| **Additional Comments:** |
|---|
| |

**Attach aerial photo of project site with all forested areas labeled and a general description of the habitat**

**Photographic Documentation:** habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

# APPENDIX B: PHASE 2 OR PHASE 3 MIST–NETTING

Mist-netting can be used as a P/A method (Phase 2 surveys) or it can be conducted for the purpose of attempting to capture IBAT and/or NLEB after detection during acoustic P/A surveys (Phase 3 surveys). The same recommendations (e.g., season, personnel, equipment, net placement, checking nets) apply for either use of mist-netting surveys.

## SUMMER MIST-NETTING SEASON: May 15 – August 15[33]

Capture of reproductive adult females (i.e., pregnant, lactating, or post-lactating) and/or young of the year during May 15 – August 15 confirms the presence of a maternity colony in the area. Since adult males and non-reproductive females have commonly been found summering with maternity colonies, radio-tracking results will be relied upon to help determine the presence or probable absence of a maternity colony or large concentrations of bats in the area when only males and/or non-reproductive females are captured.

## PERSONNEL

A qualified biologist(s)[34] must (1) select/approve mist-net sets in areas that are most suitable for capturing IBAT and/or NLEB, (2) be physically present at each mist-net site[35] throughout the survey period, and (3) confirm all bat species identifications. This biologist may oversee other biological technicians and manage mist-net sets in close proximity to one another if the net-check timing (i.e., every 10 minutes) can be maintained while **walking** between net-sets[36]. A minimum of two (2) biologists (e.g., one qualified and one technician) must be on-site for every four (4) net-sets being operated. Exceptions to on-site minimum staffing levels may be allowed under extenuating circumstances, provided written justification is included in the proposed survey study plan and subsequently approved by the local USFWS FO(s).

## COORDINATION WITH USFWS FIELD OFFICES (FOs)

If not already required by federal permit, we recommend that applicants submit a draft study plan for all survey phases to the USFWS FO(s) for review and approval (See Appendix A for guidance on submitting a draft study plan).

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[33] With prior USFWS FO approval, a survey may be completed after August 15 if it was initiated in time to be completed by August 15 and extenuating weather circumstances resulted in delaying completion. Delays as a result of not meeting the acceptable weather requirements are the ONLY valid justification for surveying after August 15. If tracking is proposed, surveys should be scheduled so that tracking is concluded prior to August 15.

[34] A qualified biologist is an individual who holds a USFWS Recovery Permit (Federal Fish and Wildlife Permit) for IBAT and NLEB in the state/region in which they are surveying and/or has been authorized by the appropriate state agency to net and handle IBAT and/or NLEB. Several USFWS offices maintain lists of qualified bat surveyors, and if working in one of those states with authorizations in lieu of a Recovery Permits, the individual will either need to be on that list or submit qualifications to receive USFWS approval prior to conducting any field work.

[35] A Net Site is defined as one or more net sets that can be efficiently walked to and checked by a survey team (typically 2 people) within a 10-minute window from a central bat-processing location. For example, a single net "site" is often composed of 4 individual net sets (separated by at least 30 m apart) that are checked every 10 minutes by a 2-person team (each person checks 2 nets for each net check).

[36] A Net-Set is defined as one mist-net deployment consisting of two poles and typically from 1-3 affixed mist-nets stacked onto one another. A typical net set is at least 5 m to 9 m high consisting of two or more nets stacked on top of one another (without gaps) and from 6 m to 18 m wide.

## EQUIPMENT

Use the finest, lowest visibility mesh mist-nets commercially available, as practicable. Currently, the finest net on the market is 75 denier, 2 ply, denoted 75/2 (Arndt and Schaetz 2009); however, the 50 denier nets are still acceptable for use currently. The finest mesh size available is approximately 1½ inches (38 millimeters). No specific hardware is required. There are many suitable systems of ropes and/or poles to hold nets. The systems of Gardner et al. (1989) and Chenger's BCM triple high has been widely used. See NET PLACEMENT discussion below for minimum net heights, habitats, and other netting requirements that affect the choice of hardware.

To minimize potential for disease transmission, any equipment that comes in contact with bats should be kept clean and disinfected, following approved protocols; this is particularly a concern relative to white-nose syndrome (WNS). Disinfection of equipment to avoid disease transmission (e.g., WNS) is required; protocols are posted at http://www.whitenosesyndrome.org/. Federal and state permits may also have specific equipment restrictions and disinfection requirements.

## MINIMUM P/A MIST-NETTING LEVEL OF EFFORT (PHASE 2)

The level of netting survey effort required for a non-linear project will be dependent upon the overall acreage of suitable habitat that may be impacted by the action (directly or indirectly). To determine the survey effort, quantify the amount of suitable summer habitat within the project area.

**NOTE**: for projects where other impacts than tree removal are likely (e.g., collision), ensure that P/A surveys are designed to cover all suitable habitat within the entire project area (where exposure to any kind of impacts may be anticipated) and NOT just the locations where tree removal is planned. Additional guidance for linear projects is in Appendix F.

### Conduct Mist-Netting Surveys following IBAT and/or Seasonal NLEB Range Level-of-Effort Recommendations (See Figure 1 and Table 2)

#### Range-wide IBAT Mist-netting LOE:

Linear projects: a minimum of 2 net nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

Non-linear projects: a minimum of 6 net nights per 123 acres[37] (0.5 $km^2$) of suitable summer habitat.

After 2 consecutive nights of netting at the same location without capturing target species, you must change net locations or wait at least 2 calendar nights before resuming netting at the same location.

a) If no capture of IBAT(s), then no further summer surveys are

[37] We have no recommendations for reducing the minimum level of effort required to demonstrate probable absence for projects <123 acres in size. Detection probabilities and occupancy estimates were derived from past survey efforts that used the same acreage threshold (see Niver et al. 2014).

recommended[38].

b) If capture of IBAT(s), then stop or proceed to **Phase 4** as previously decided in coordination with the FO(s).

**Seasonal NLEB Range Mist-netting LOE:**

Linear projects: a minimum of 4 net nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

Non-linear projects: a minimum of 10 net nights per 123 acres (0.5 $km^2$) of suitable summer habitat.

After 2 consecutive nights of netting at the same location without capturing target species, you must change net locations or wait at least 2 calendar nights before resuming netting at the same location.

a) If no capture of NLEB(s), then no further summer surveys are recommended.

b) If capture of NLEB(s), then stop or proceed to **Phase 4** as previously decided in coordination with the FO.

## MIST-NETTING SURVEYS TO CAPTURE INDIANA AND/OR NORTHERN LONG-EARED BATS AFTER ACOUSTICS WERE USED AS P/A METHOD (PHASE 3)

If netting was not conducted as the P/A method, then netting may be conducted to capture and characterize (e.g., sex, age, reproductive condition) the IBAT and/or NLEB (documented through the Phase 2 acoustic P/A survey) present in an area and to facilitate radio-tracking (Phase 4) efforts. We encourage working with the FO(s) to develop Phase 3 netting plans based on best available information (e.g., positive acoustic locations). There are no minimum requirements for this phase as this is not a P/A phase.

a) If no IBAT and/or NLEB are captured, then coordinate with the USFWS FO.
b) If IBAT or NLEB are captured, then proceed to **Phase 4** as previously decided in coordination with the FO(s).

## NET PLACEMENT

Indiana and Northern long-eared bats typically forage in habitats that do not completely overlap (see species-specific habitat definitions in Appendix A) therefore, net placement should reflect these differences when targeting both species. Net placement along potential travel corridors (e.g., streams, logging trails, roads) as well as other edge habitats (e.g., other water sources, field edges) have traditionally been the most common habitats sampled due to their ease of access. However, non-traditional net placement in interior forest habitats may also be productive, especially for NLEB and

[38] NOTE: For Phase 2 P/A Surveys, wherever the phrase "no further summer surveys are recommended" occurs within this document, the USFWS FO(s) is in affect assuming probable absence of IBAT and/or NLEB during the summer.

IBAT (Carroll et al. 2002). Because the best survey sites for capturing bats may fall outside of a project footprint, the surveyor and project proponent should coordinate with the appropriate USFWS FO(s) to establish a project-specific maximum net placement distance from the centerline or project boundary prior to initiating surveys.

When sampling traditional travel corridors with defined edges, place net-sets approximately perpendicular to the edge and, ideally within bends or curves in the corridor that reduces bat reaction time to avoid capture. Net-sets should fill the corridor from side to side, extending beyond the corridor boundaries and into the interior forest to prevent bats from flying along the edges of the corridor and avoiding the nets, and from water (or ground) level up to the overhanging canopy. Surveyed corridors must have overhanging branches, most often within 9 m of the ground, that force bats to fly downward and into the nets. Net-sets of varying widths and heights may be used as the situation dictates. A typical net-set is at least 5 m to 9 m high consisting of two or more nets stacked on top one another (without gaps) and from 6 m to 18 m wide. If netting over water, ensure there is enough space between the net and the water so that captured bats will not get wet. Justification for placing net-sets perpendicular to a forest edge, or any net-set, without overhanging vegetation (i.e., no funneling effect) should be specifically provided in the survey report or ideally discussed with the FO(s) prior to sampling.

Because a) NLEB is a clutter-adapted gleaning species (see definition of suitable summer habitat in Appendix A) or b) a project area may not have well-defined travel corridors, surveyors may sample more non-traditional habitat types (e.g., small forest openings, ponds, interior forest). The typical equipment and placement described in the section above may be inadequate when netting for IBAT and NLEB in these non-traditional locations, where a travel corridor is less obvious. This would require innovation on the part of the surveyor (see Humphrey et al. 1968). For example, net placement in interior forests should be a minimum of 50 m from edge habitats and should represent a variety of understory cover and canopy closure (Carroll et al. 2002). Ponds and large water-filled road ruts can be productive places to net when other water sources are limited. See Kiser and MacGregor (2005) for additional discussion about net placement.

Mist-net sets should be spaced a minimum of 30 m apart, surveyors should attempt to evenly distribute net-sets throughout suitable habitat and not over-sample individual habitat features (e.g., three or more mist-net sets on a single travel corridor or stream). Surveyors must provide written justification in their report if net-sets were not distributed throughout suitable habitat (i.e., why were they clumped?). Surveys conducted for northern long-eared bat should include both traditional and non-traditional (as described above) net placements within suitable habitat when present. Net-sets can be repeatedly sampled throughout the project, but no more than 2 nights at a single location is recommended. In addition, changing locations within a project area may improve capture success (see Robbins et al. 2008; Winhold and Kurta 2008). Photo-document placement of net-sets.

## SURVEY PERIOD

The survey period for each net shall begin at sunset[39] and continue for at least 5 hours (longer survey periods may also improve success).

[39] Surveys may need to start a little earlier or later than official sunset times (i.e., at "dusk") in some settings such as a deep/dark forested valleys or ridge tops to avoid missing early flying bats or capturing late-flying birds, respectively. Sunset tables for the location of survey can be found at: https://sunrise-sunset.org.

## CHECKING NETS

Each net-set should be checked every 10 minutes (Gannon et al. 2007). If surveyors monitor nets continuously, take care to minimize noise, lights and movement near the nets. Monitoring the net-sets continuously with a bat detector (ideally using ear phones to avoid alerting bats) can be beneficial: (a) bats can be detected immediately when they are captured, (b) prompt removal from the net decreases stress on the bat and potential for the bat to escape (MacCarthy et al. 2006), and (c) monitoring with a bat detector also allows the biologist to assess the effectiveness of each net placement (i.e., if bats are active near the net set but avoiding capture), which may allow for adjustments that will increase netting success on subsequent nights. There should be no other disturbance near the nets, other than to check nets and remove bats. Biologists should be prepared to cut the net if a bat is severely entangled and cannot be safely extracted within 3 or 4 minutes (CCAC 2003; Kunz et al. 2009). Capture and handling are stressful for bats. Emphasis should be on minimizing handling and holding bats to as short a time as possible to achieve field study objectives. Indiana and/or northern long-eared bats should not be held for more than 30 minutes after capture, unless the individual is targeted for radio-tracking. Bats targeted for radio-tracking should be released as quickly as possible, but no longer than 30 minutes[40] after capture, or as allowed in federal and state permits. See Kunz and Kurta (1988) for general recommendations for holding bats.

## WEATHER, LIGHTING, AND OTHER ENVIRONMENTAL CONDITIONS

Severe weather adversely affects capture of bats. Some IBAT and NLEBs may remain active despite inclement weather and may still be captured while others in the same area become inactive. Therefore, negative surveys combined with any of the following weather conditions throughout all or most of a sampling period are likely to require an additional night of mist-netting[41]: (a) temperatures that fall below 50°F (10°C)[42]; (b) precipitation, including rain and/or heavy fog, that exceeds 30 minutes or continues intermittently during the survey period; and (c) sustained wind speeds greater than 9 miles/hour (4 meters/seconds; 3 on Beaufort scale) for 30 or more minutes.

**NOTE**: Provided that nets are not dripping wet, surveyors can resume netting to meet the minimum 5-hour requirement after short periods of adverse weather. If nets are under good cover, light rain may not alter bat behavior. However, if no bats are being captured during marginal weather, coordinate with the USFWS FO(s).

It is typically best to place net sets under the canopy where they are out of moonlight, particularly when the moon is half-full or greater. Net sets illuminated by artificial light sources should also be avoided. The shining of lights, and noise should be kept to a minimum with no smoking around the survey sites. In addition, the use of radios, campfires, running vehicles, punk sticks, citronella

[40] Current standard federal Section 10 bat permit conditions require prior written approval from the Field Supervisor in the USFWS FO(s) if capture times may exceed 30 minutes.
[41] With prior USFWS FO approval, a survey may be completed after August 15 if it was initiated in time to be completed by August 15 and extenuating weather circumstances resulted in delaying completion. Delays because of not meeting the acceptable weather requirements are the ONLY valid justification for surveying after August 15. If tracking is proposed, surveys should be scheduled so that tracking is concluded prior to August 15.
[42] Overnight survey temperatures may be lower in northern portions of the NLEB range, coordinate with the local USFWS FO in the northern portions of the range for any variation in temperature requirements.

candles and other disturbances will not be permitted within 300 feet of mist nets (or acoustic detectors) during surveys.

## DOCUMENTATION OF INDIANA AND/OR NORTHERN LONG-EARED BAT CAPTURES

If an IBAT and/or NLEB is captured during mist-netting, protocols for radio-tracking and emergence survey requirements, as provided in Appendix D and E, respectively, should be followed. In addition, the appropriate USFWS FO(s) must be notified of the capture within 48 hours (or in accordance with permit conditions), and the sex and reproductive condition of the bat and GPS coordinates of the capture site should be provided. Ensure GPS coordinates are recorded for each individual net set on datasheets.

Several species of bats from the genus *Myotis* share common features which can make identification difficult; IBATs and little brown bats (*Myotis lucifugus)* can be particularly difficult to distinguish. Photo documentation of all bats captured and identified as IBAT and/or NLEB and the first 10 little brown bats per project are requested to verify the identifications made in the field.

Photo documentation should include diagnostic characteristics:

- a ¾-view of face showing ear, tragus, and muzzle
- view of calcar showing presence/absence of keel
- a transverse view of toes showing extent of toe hairs

Consider taking short video clips of the bat and its diagnostic features, as videos may also be helpful to later confirm bat identification. If a bat from the genus *Myotis* is captured during mist-netting that cannot be readily identified to the species level, then species verification may be attempted through fecal DNA analysis. Collect one or more fecal pellets (i.e., guano) from the bat in question by placing it temporarily in a holding bag (15 minutes is usually sufficient, no more than 30 minutes is recommended). The pellet (or pellets) collected should be placed in a small vial (e.g., 1.5 ml) with silica gel desiccant; pellets from each individual bat should be stored in separate vials and out of direct light. Fees charged by independent laboratories for sequencing fecal DNA samples is generally inexpensive (approx. $50 per guano sample), however, it has been challenging to identify labs willing to consistently conduct these analyses. Any additional information and a list of available laboratories will be made available on the IBAT webpage on the USFWS's Region 3 website (http://www.fws.gov/species/Indiana-bat-myotis-sodalis).

## SUBMISSION OF MIST-NETTING RESULTS

Provide results of netting surveys to the appropriate USFWS FO(s) in accordance with previously agreed upon[43] timeframes and formats[44]. If IBAT and/or NLEB are captured, this report should also include the results of subsequent radio-tracking and emergence counts. Reports should include the following:

[43] As discussed in the Introduction, we encourage coordination with USFWS FO(s) prior to implementation of any surveys to ensure that all parties agree upon the need for surveys, the methods proposed, and the decisions from various survey results.

[44] In 2016, the USFWS implemented a new standardized approach for reporting of bat survey data. In addition to a traditional written report, federal permit holders are now required to submit their survey data using the standardized permit reporting spreadsheets available on the USFWS website provided in the intro.

1. Copy of prior phase reports (if not previously provided).
2. Explanation of any modifications from original survey plan (e.g., altered net locations).[45]
3. Description of net locations (including site diagrams), net sets (include net heights), survey dates, duration of surveys, weather conditions, and a summary of findings.
4. Map identifying netting site locations and information regarding net sets, including lat/long or UTM, individual net placement, net spacing (i.e., include mist-netting equipment in photographs of net locations), and adequate justification if net sets are not evenly distributed across suitable habitat within the project area.
5. Full names of mist-netting personnel attending each mist-net site during an operation, including the federally permitted/qualified biologist present at each mist-net site. Indicate on the field data sheet the full name of person who identified bats each night at each site.
6. Legible copies of all original mist-netting datasheets (see example datasheet below) and a summary table with information on all bats captured during the survey including, but not limited to: capture site, date of capture, time of capture, sex, reproductive condition, age, weight, right forearm measurement, band number and type (if applicable), and Reichard's wing damage index score (Reichard and Kunz. 2009).
7. Photographs of all net sets, as well as **all** IBAT and NLEB and the first 10 little brown bats captured from each project, so that the placement of netting equipment and identification of species can be verified. Photographs of bats should include all diagnostic characteristics that resulted in the identification of the bat to the species level.
8. Any other information requested by the local USFWS FO(s) related to the project.

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## Sample Data Sheets for Bat Surveys

| Site No. | | | | Project/Firm: | | | | | | | | Date: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location: | | | | | | | | | | | | |
| County: | | | | State: | | Quad: | | | | | | Quadrant: |
| Lat/Long (DMS): | | N | | W | | | | Zone: | | | | Surveyors: |

| # | Time | Species | Age | Sex | Repro. Cond.* | RFA (mm) | Mass (g) | Net/ Ht | Guano/ Hair | Wing Score | Band # Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
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| 29 | | | | | | | | | | | |
| 30 | | | | | | | | | | | |

| Moon Phase: | | % |
|---|---|---|
| | Rise | Set |
| Moon: | | |
| Sun: | | |

| Time | Temp | Sky | Wind | # Bats |
|---|---|---|---|---|
| | | | | |
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| | | | | |
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| | | | | |
| | | | | |
| Avg | | | | |

| Sky Code | |
|---|---|
| 0 | Clear |
| 1 | Few Clouds |
| 2 | Partly Cloudy |
| 3 | Cloudy or overcast |
| 4 | Smoke or fog |
| 5 | Drizzle or light rain |
| 6 | Thunderstorm |

| Beauford Wind Code | |
|---|---|
| 0 | Calm (0 mph) |
| 1 | Light wind (1-3 mph) |
| 2 | Light breeze (4-7 mph) |
| 3 | Gentle breeze (8-12 mph) |
| 4 | Moderate breeze (13-18 mph) |

*Repro. Cond (Reproductive Condition): (P) pregnant; (L) lactating; (PL) post-lactating; (NR) non-reproductive, (TD) testes descended

## Sample Data Sheets for Bat Surveys

| Net Site Diagram | Dominant Vegetation |
|---|---|
| | 1 |
| | 2 |
| | 3 |
| | 4 |
| | 5 |

| Net Site(s) by Habitat | | | | |
|---|---|---|---|---|
| Habitat | A | B | C | |
| River | | | | |
| Stream | | | | |
| Pond | | | | |
| Road Rut | | | | |
| Corridor | | | | |
| Cave/mine | | | | |
| | | | | |
| Total | | | | |

| No. of Poles X Net length | | | | |
|---|---|---|---|---|
| A | = | | X | |
| B | = | | X | |
| C | = | | X | |
| D | = | | X | |

| Other Species: |
|---|
| |

| Comments: |
|---|
| |
| |
| |

# APPENDIX C: PHASE 2 ACOUSTIC SURVEYS

**SUMMER ACOUSTIC SURVEY SEASON:** May 15 – August 15[46]

**PERSONNEL**[47]

**Overall:** Acoustic surveyors should have either completed one or more of the available bat acoustic courses/workshops put forth by various entities (e.g., Bat Conservation & Management, Bat Survey Solutions, Titley/AnaBat, Wildlife Acoustics, USFWS, Vesper Bat Detection Services) or be able to show similar on-the-job or academic experience.

**Detector Deployment:** Acoustic surveyors should have a working knowledge of the acoustic equipment and IBAT and/or NLEB ecology. Surveyors should be able to identify appropriate detector placement sites and establish those sites in the areas that are most suitable for recording high-quality IBAT and/or NLEB calls. Thus, it is highly recommended that all potential acoustic surveyors attend appropriate training and have experience in the proper placement of their field equipment.

**Acoustic Analysis:** Acoustic surveyors should have a working knowledge of the approved acoustic analysis programs, and any candidate acoustic analysis programs used for surveys. Thus, it is highly recommended that all potential acoustic surveyors attend appropriate training and have experience in the analysis of acoustic recordings.

**Qualitative Analysis:** Individuals qualified to conduct qualitative analysis of acoustic bat calls typically have experience: (1) gathering known calls as this provides a valuable resource in understanding how bat calls change and the variation present in them; (2) identifying bat calls recorded in numerous habitat types; (3) familiarity with the species likely to be encountered within the project area; and (4) individuals must have multiple years of experience and must have stayed current with qualitative ID skills. A resume (or similar documentation) must be submitted along with final acoustic survey reports for anyone making final qualitative identifications.

**COORDINATION WITH USFWS FIELD OFFICES (FOs)**

If not already required by federal permit, we recommend that applicants submit a draft study plan for all survey phases to the USFWS FO(s) for review and approval. Study plans should include a map/aerial photo identifying the proposed project area boundaries, suitable bat habitats and acreages within the project area, the proposed number and tentative locations of acoustic monitoring sites, and the identification of the approved (or candidate[48]) acoustic software program(s) (and version #) used for analysis of calls for the specific project. If a single software program is used for analysis, surveyors will not be allowed to switch programs from what was originally identified in their final study plan.

[46] With prior USFWS FO approval, a survey may be completed after August 15 if it was initiated in time to be completed by August 15 and extenuating weather circumstances resulted in delaying completion. Delays as a result of not meeting the acceptable weather requirements are the ONLY valid justification for surveying after August 15.

[47] Coordinate with your local FO regarding any state-specific requirements.

[48] At this time, all acoustic software programs are considered 'candidate' for locations identified in Figure 2.

## DETECTOR AND MICROPHONE REQUIRED CHARACTERISTICS

Full-spectrum (FS) and/or zero-crossing (ZC) detectors are suitable for use in this survey protocol, however, FS is preferred given that FS call files capture more detail and can be converted to ZC for analysis if desired.
Directional, hemispherical, and omnidirectional microphones are acceptable for acoustic surveys. The use of external microphones on an extension cable is the preferred deployment as it further limits degradation of call quality. Recording without directional horns on hemispherical and omnidirectional microphones is preferred as the addition of these systems may result in some signal degradation and directional microphones are commercially available.

Use recommended manufacturer detector settings for conducting IBAT and/or NLEB P/A surveys unless otherwise noted on the Service's IBAT Summer Survey Guidance webpage. For ZC detectors (as well as when converting WAV files to ZC files), the data-division ratio must be set to 8.

## ACOUSTIC SAMPLING PROTOCOL

Detector/Microphone Placement

Detector/Microphone placement is critical to the successful isolation of high-quality bat call sequences for later analysis. The following locations are likely to be suitable sites for detectors/microphones, including, but not limited to: (a) forest-canopy openings; (b) near water sources; (c) wooded fence lines that are adjacent to large openings or connect two larger blocks of suitable habitat; (d) blocks of recently logged forest where some potential roost trees remain; (e) road and/or stream corridors with open tree canopies or canopy height of more than 33 feet (10 meters); and (f) woodland edges (Britzke et al. 2010). Of equal importance to acoustic site selection is the surveyor's working knowledge of the sampling volume and area of highest sensitivity within the zone of detection around a given microphone, which helps to ensure that detector placement as well as microphone selection and orientation are best suited for a particular site to ensure the detection zone is free of clutter. Detection distance, placement (e.g., location, orientation, height of microphone), and specific features (e.g., vegetation, water, and other obstructions) at the sample site should dictate whether a directional, hemispherical, or omnidirectional microphone is used. If detectors/microphones are placed in unsuitable locations, effective data analysis may be impossible, and the results of the sampling effort will likely be invalid.

Many features (e.g., vegetation, water, wind turbines, high-tensile powerlines, micro-wave towers) can obstruct and reflect call sequences recorded in the field and thereby reduce the surveyor's ability to record high-quality bat call sequences. The following recommendations are provided to aid surveyors in their selection of acoustic sites (also see Chenger and Tyburec 2014). If surveyors choose acoustic sites outside of these recommendations, then adequate justification for doing so should be provided with the acoustic survey report provided to the USFWS FO(s); otherwise, results from these sites will not be accepted. Surveyors should deploy microphones: (a) at least 10 feet (3 meters) in any direction from vegetation or other obstructions (Hayes 2000; Weller and Zabel 2002;

Chenger and Tyburec 2014, Fraser et al. 2020); (b) in areas without, or with minimal[49], vegetation within 100 feet (30 meters) of highly directional microphones or 33 feet (10 meters) from other microphones; (c) parallel to woodland edges; and (d) at least 49 feet (15 meters) from known or suitable roosts[50] (e.g., trees/snags, buildings, bridges, bat houses, cave or mine portal entrances).

Elevating a detector greater than 3 meters above ground level (AGL) vegetation may dramatically improve recording quality. Microphones can be attached horizontally to a pole to listen out into flight space, rather than just listening up from the ground. This will serve to increase the volume of airspace sampled and avoid the distortion effect of recording near the ground. However, the relationship between the zone of detection and the vegetation/clutter, not the placement of the detector is the most important consideration during site selection. Because NLEBs are a clutter-adapted gleaning species (see definition of suitable summer habitat in Appendix A), placement of detectors should be as close to clutter as possible but not in clutter.

Surveyors should distribute acoustic sites throughout the project area or adjacent habitats. In most cases, acoustic sites should be at least 656 feet (200 meters) apart. If closer spacing is determined to be necessary or beneficial (e.g., multiple suitable habitats and acoustic sites immediately adjacent to each other), sufficient justification must be provided in the acoustic study plan and survey report submitted to USFWS FO(s).

Verification of Deployment Location

It is recommended to temporarily attach GPS units to each detector (according to manufacturer's instructions) to directly record accurate location coordinates for each acoustic site that is paired with the acoustic data files. Regardless of technique used, accurate GPS coordinates must be generated and reported for each acoustic detector location.

Verification of Proper Functioning

It is highly recommended that surveyors ensure acoustic detectors are functioning properly through a periodic verification of performance to factory specifications (a service currently offered or in development by several manufacturers). It may be possible that independent service bureaus would be willing to perform this service, providing that a standard test/adjustment procedure can be developed.

It is also recommended to ensure equipment is working during set-up in the field. This can be done simply by producing ultrasound (e.g., finger rubs, calibrator, or follow the equipment manufacturer's testing recommendations) in front of the microphone at survey start and survey finish. These tests document that the equipment was working when deployed and when picked up (and by assumption throughout the entire period). Detector field settings (e.g., sensitivity, frequency, etc.) should follow the recommendations provided by the manufacturer. Surveyors should also save files produced by detectors (e.g., log files, status files, sensor files) as an excellent way to provide documentation when equipment was functioning within the survey period. Many types of detectors allow for setting timers

[49] If necessary, surveyors can remove small amounts of vegetation (e.g., small limbs, saplings) from the estimated detection zone at a site, much like what is done while setting up mist-nets. Deployment of detectors/microphones in closed-canopy locations that typically are good for mist-netting are acceptable as long as the area sampled below the canopy does not restrict the ability of the equipment's detection zone to record high-quality calls (i.e., vegetation is outside of the detection zone).

[50] If the surveyor discovers a potential roost and wishes to document bat use, refer to Appendix E for guidance on conducting emergence surveys and contact the USFWS FO(s).

that initiate and end recording sessions. This saves battery life as well as reducing the number of extraneous noise files recorded. However, if the units are visited when the timer is on (i.e., unit is in standby mode), the surveyor cannot verify that the unit is functioning properly. This is particularly important in areas where no bat activity is recorded for the entire night or during the last portion of the night. In these cases, if the surveyor cannot demonstrate that the detector was indeed functioning properly throughout the survey period, then the site will need to be re-sampled, unless adequate justification can be provided to the USFWS FO(s).

Selection of acoustic sites is similarly important. Suitable set-up of the equipment should result in high-quality call sequences that are adequate for species identification. Nights of sampling at individual sites that produce no bat calls may need to be re-sampled unless adequate justification (e.g., areas with significant bat population declines due to WNS) can be provided to the USFWS FO(s). Modifications of the equipment (e.g., changing the orientation and/or microphone type) at the same location on subsequent nights may improve quantity and quality of call sequences recorded, which can be determined through daily data downloads. If modifications of the equipment do not improve call identification, then the detectors will need to be moved to a new location.

Orientation

Detectors deployed with directional microphones should be aimed to sample the majority of the identified flight path/zone to maximize the number of call pulses recorded from individual bats. Omnidirectional microphones deployed on a pole in the center of the flight path/zone should be oriented horizontally. In some circumstances, it might be desirable to aim a directional microphone straight up in smaller forest openings. As always, the goal is to sample as large a volume of likely bat flight space as possible while minimizing clutter. Hemispherical microphones should be aimed vertically, creating a dome-like detection field. Hemispherical microphones are best suited for open areas where deploying at heights greater than 3 meters AGL is problematic because of the lack of structure to hide the microphone and prevent it from becoming a novel item of interest to bats. Vertical orientation, however, precludes the use of weatherproofing for protection of the microphone. Once acoustic sites are identified, photographs documenting the orientation, detection zone (i.e., "what the detector is sampling"), and relative position of the microphone should be taken for later submittal to the USFWS FO(s) as part of the acoustic survey report (See Submission of Acoustic Survey Results for additional description).

Weather Conditions

If any of the following weather conditions exist at a survey site during acoustic sampling, note the time and duration of such conditions, and repeat the acoustic sampling effort for that night[51]: (a) temperatures fall below 50°F (10°C)[52] during the first 5 hours of survey period; (b) precipitation, including rain and/or fog, that exceeds 30 minutes or continues intermittently during the first 5 hours of the survey period; and (c) sustained wind speeds greater than 9 miles/hour (4 meters/second; 3 on Beaufort scale) for 30 minutes or more during the first 5 hours of the survey period. At a minimum, nightly weather conditions for survey sites should be checked using the nearest NOAA National Weather Service station and summarized in the survey reports.

[51] With prior USFWS FO approval, a survey may be completed after August 15 if it was initiated in time to be completed by August 15 and extenuating weather circumstances resulted in delaying completion. Delays as a result of not meeting the acceptable weather requirements are the ONLY valid justification for surveying after August 15.

[52] Overnight survey temperatures may be lower in northern portion of the NLEB range, coordinate with the local USFWS FO in the northern portion of the range for any variation in temperature requirements.

Weatherproofing

Depending on the brand and model, bat detectors may or may not be weatherproof when delivered from the factory or supplier. Recording without after-market weatherproofing is preferred as the addition of these systems may result in some signal degradation. The decision to weatherproof detectors or not should be determined nightly based on the likelihood of precipitation in the survey area. If necessary, detectors should be placed in after-market weatherproof containers and an external microphone, attached by an extension cable should be deployed greater than 3 meters AGL.

For directional microphones, the use of a polyvinyl chloride (PVC) tube[53], generally, in the form of a 45-degree elbow the same diameter as the microphone (Britzke et al. 2010) is acceptable, if the situation requires the use of after-market weatherproofing. The microphone should be placed facing the open end of the elbow and as close to the opening as is consistent with the aim of weatherproofing. The microphone should be pointing at an angle below horizontal so water will not collect in it. Corben & Livengood (2014) showed that the direction of greatest sensitivity of tubes like this varies greatly depending on details of the specific tube shape and the exact position of the microphone. Often the greatest sensitivity will be pointed up at a substantial angle (up to 45 degrees) above horizontal when the microphone itself is pointing 45 degrees below horizontal. Users should be aware of the characteristics of the setup they use so they can know what region is being sampled. Again, the preferred option for weatherproofing detectors is to detach the microphone from the detector so that the detector can be placed in a weatherproof container, but the microphone (tethered by a cable) remains unobstructed.

Other after-market weatherproofing systems may become available and approved by the USFWS provided they show that call quality and the number of calls recorded are comparable to those without weatherproofing.

## MINIMUM LEVEL OF EFFORT

The level of acoustic survey effort required for a project will be dependent upon the overall acreage of suitable habitat that may be impacted by the action (directly or indirectly). To determine the acoustic survey effort, quantify the amount of suitable summer habitat within the project area. **NOTE**: for projects where impacts other than tree removal are likely (e.g., collision), ensure that P/A surveys are designed to cover all suitable habitat within the entire project area and NOT just the locations where tree removal is planned.

### IBAT Range-wide Acoustic LOE (See Figure 1 and Table 2)

Linear projects: a minimum of 4 detector nights per km (0.6 miles) of suitable summer habitat (See Appendix F).

At least 1 detector location for at least 2 calendar nights (can sample the same location or move within the km site).

Non-linear projects: a minimum of 10 detector nights per 123 acres (0.5 $km^2$) of suitable

[53] The PVC option has only been tested with AnaBat SD1/SD2 detectors and directional microphones. It may not perform as well with other detector microphone combinations.

summer habitat.

At least 2 detector locations per 123-acre "site" shall be sampled over the course of at least 2 calendar nights (may be consecutive) until at least 10 detector nights has been completed.

**NLEB Range-wide Acoustic LOE (See Figure 1 and Table 2)**

Linear projects: a minimum of 4 detector nights per km (0.6 miles) of suitable summer habitat (see Appendix F).

At least 1 detector location for at least 2 calendar nights (can sample the same location or move within the km site).

Non-linear projects: a minimum of 14 detector nights per 123 acres (0.5 $km^2$) of suitable summer habitat.

At least 2 detector locations per 123-acre "site" shall be sampled over the course of at least 2 calendar nights (may be consecutive) until at least 14 detector nights has been completed.

The acoustic sampling period for each site must begin at sunset[54] and ends at sunrise each night of sampling.

**ANALYSIS OF RECORDED ECHOLOCATION CALLS**

**Step 5. Optional coarse screening - for high frequency (HF) or myotid calls (depending on available H/L frequency filters) or Proceed to Step 6.**

a) If no positive detection of HF calls[55] (≥35 kHz) or myotid calls, no further summer surveys recommended.

b) If positive detection of HF or myotid calls, then
   i) proceed to Step 6 for further acoustic analysis; **OR**
   ii) assume presence of IBAT and/or NLEB and coordinate with the USFWS FO(s); **OR**
   iii) assume presence and proceed to **Phase 3**.

**Step 6. Conduct Automated Acoustic Analyses for each site that had HF or Myotid calls from Step 5 or ALL sites and ALL calls if Step 5 was not conducted.**

Use **one or more** of the currently available 'approved' acoustic bat ID programs[56] (use most current approved software versions available and manufacturer's recommended settings for IBAT and/or NLEB P/A surveys) as previously identified in your Phase 2 study plan.

[54] Surveys may need to start a little earlier or later than official sunset times (i.e., at "dusk") in some settings such as a deep/dark forested valleys or ridge tops to avoid missing early flying bats or capturing late-flying birds, respectively. Sunset tables for the location of survey can be found at: https://sunrise-sunset.org

[55] HF calls are defined as individual call pulses whose minimum frequency is ≥35 kHz.

[56] Approved and candidate programs are listed on the USFWS website provided in the intro; note all programs are considered 'candidate' for areas identified in Figure 2.

'Candidate' programs are not yet approved by USFWS for stand-alone use for P/A surveys but may be used in conjunction with one or more of the approved programs. At this time, no acoustic bat ID programs are 'approved' for many western states (Figure 2). Two or more of the currently available 'candidate' programs must be used for surveys conducted in these locations (always use most recent versions of software programs).

Include your plans for which specific software program(s) you will use in your survey study plan and submit for USFWS FO(s) review prior to conducting surveys. Beginning with acoustic data from night one at each acoustic site, run each night's data for each site through your chosen ID program(s). Review results by site by night from each acoustic ID program used[57].

a) If IBAT and NLEB presence is considered unlikely by the approved and candidate program(s) used in analysis, then no further summer surveys recommended.

b) If IBAT and/or NLEB presence is considered likely at one or more sites on one or more nights by any approved or candidate program(s) used in analysis, then
   i) proceed to Step 7 for qualitative ID; **OR**
   ii) assume presence of IBAT and/or NLEB and coordinate with the USFWS FO(s); **OR**
   iii) assume presence and proceed to **Phase 3**.

**Step 7. Conduct Qualitative Analysis of Calls.**

At a minimum, for each detector site/night a program identified IBAT and/or NLEB presence likely (i.e., $P<0.05$), review all HF (i.e., ≥35 kHz) call files (regardless of MLE value and including no ID files) from that site/night. Qualitative analysis (i.e., manual vetting) must also include and present within a written report a comparison of the results of each acoustic ID program by site and night (see Reporting Requirements below).

a) If no visual confirmation of probable IBAT and NLEB, then no further summer surveys recommended[58].

b) If visual confirmation of probable IBAT and/or NLEB, then
   i) assume presence of IBAT and/or NLEB and coordinate with the USFWS FO(s); **OR**
   ii) assume presence and proceed to **Phase 3**.

## SUBMISSION OF ACOUSTIC SURVEY RESULTS

**NOTE**: All originally recorded (ZC or FS) data MUST be maintained for a period of 7 years and be made available to the USFWS FO(s), if requested. Failure to do so may result in invalidation of survey results.

[57] The approved acoustic identification programs all have implemented a maximum likelihood estimator (MLE) at this time. If the analysis of collected calls at a given site on a given night results in the probable presence of IBAT and/or NLEB with high levels of certainty ($P<0.05$), then select one of the options available in Step 6b.

[58] If you identify any suspected mis-identifications from programs, the Service will share those results with the software manufacturer(s) and the USGS to assist with future improvements and testing of software.

## APPENDIX C: PHASE 2 ACOUSTIC SURVEYS

Provide results of acoustic surveys to the appropriate USFWS FO(s) within 10 days of completing the survey unless otherwise agreed upon with the local USFWS FO(s)[59]. Each acoustic survey report should include the following[60] (also, see checklist at end of this appendix):

1. Copy of habitat assessment (if not previously provided)
2. Explanation of any modifications from original survey plan (e.g., altered site locations)[61]
3. Full names of all personnel conducting acoustic surveys, including those that selected acoustic sites and deployed detectors
4. Full name and resume of individual(s) conducting qualitative acoustic analyses (if applicable)
5. Description of acoustic monitoring sites, survey dates, duration of survey, weather conditions, and a summary of findings
6. Table with information on acoustic monitoring and resulting data, including but not limited to: detector GPS coordinates for each detector, survey dates, survey hours
7. Map identifying acoustic detector locations and a corresponding table including the GPS coordinates. Include arrow(s) showing direction(s) of microphone(s)
8. Photographs documenting the location of each detector, the orientation of the detector, and the intended sampling area. Include detector and something for scale (e.g., vehicle, person) in photographs of acoustic sites
9. Description of acoustic detector and microphone brand(s) and model(s) used, microphone type, use of weatherproofing, acoustic monitoring equipment settings (e.g., sensitivity, audio division ratios), deployment data (i.e., deployment site, habitat, date, time started, time stopped, orientation), and call analysis methods used
10. A description of how proper functioning of bat detectors was verified
11. Discussion of what software program(s) was/were used (including settings)
12. Acoustic detector log files renamed by site identifier
13. Acoustic analysis software program output/summary results by site by night (i.e., number of calls detected, species composition, MLE results, settings files)
14. Discussion for any site/nights with zero bat calls (were additional nights added? was detector functioning? was placement appropriate?)

[59] As discussed in the Introduction, we encourage coordination with USFWS FO(s) prior to implementation of any surveys to ensure that all parties agree upon the need for surveys, the methods proposed, and the decisions from various survey results.

[60] In 2016, the USFWS implemented a new standardized approach for reporting of bat survey data. In addition to a traditional written report, federal permit holders are now required to submit their survey data using the standardized permit reporting spreadsheets available on the IBAT Summer Survey Guidance webpage (http://www.fws.gov/midwest/Endangered/mammals/inba/inbasummersurveyguidance.html).

[61] If the USFWS previously agreed upon the study plan, we need to understand whether the revised work still accomplished the agreed upon methods.

15. If manual vetting was used, discussion of how this was done (e.g., what keys were used?)
16. If manual vetting was used, detailed analysis and results of any qualitative acoustic analysis conducted on those projects where a program(s) considered IBAT and/or NLEB presence likely, including justification for rejecting any program MLE results (if applicable). We recommend providing a table with each species ID from the program(s), suggested species ID from manual vetting, and rationale for any changes.
17. Any other information requested by the local USFWS FO(s) related to the project

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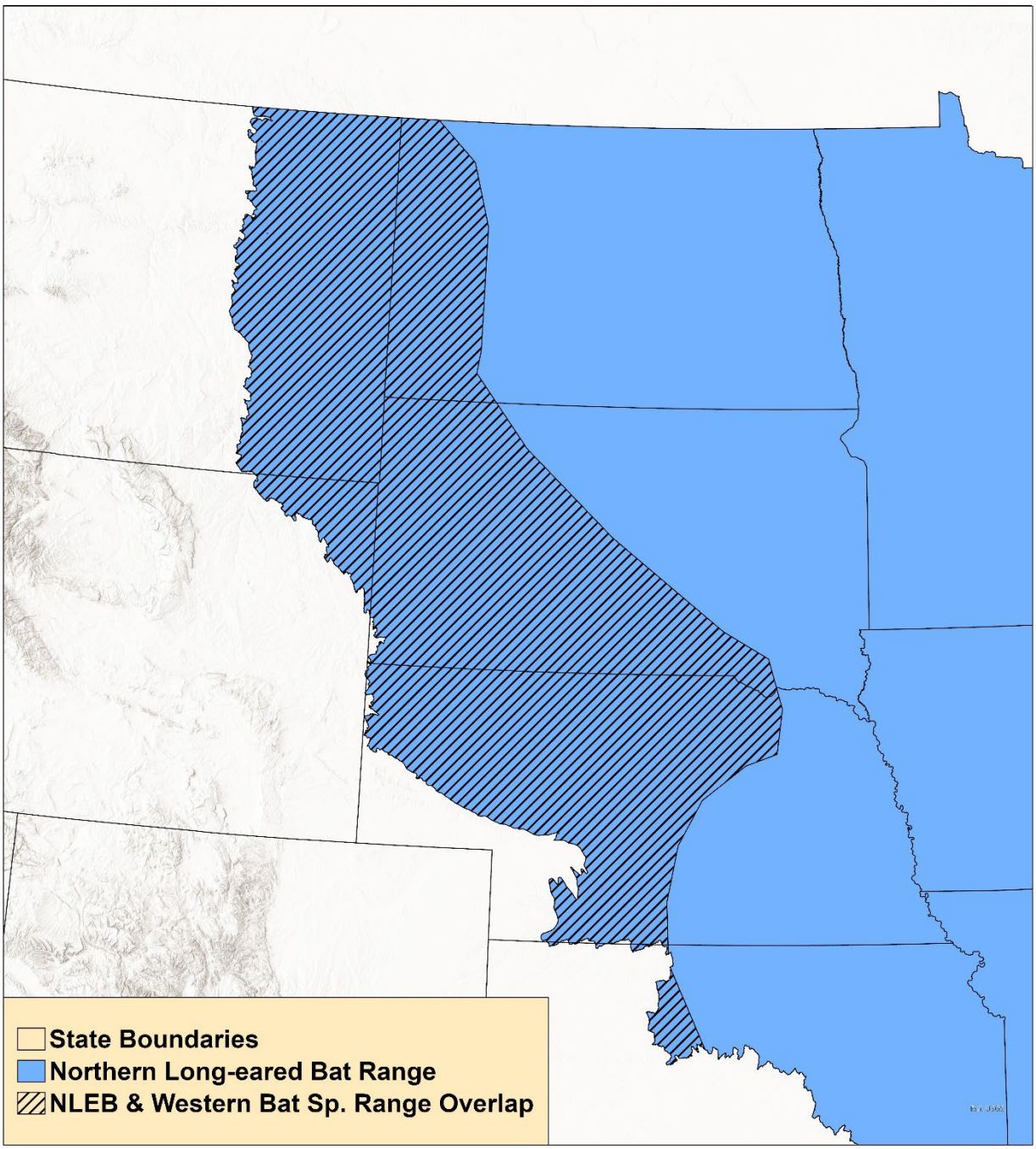


Figure 2. Portion of NLEB range overlapping with western bat species.

# General Checklist for Acoustic Surveys of Indiana and/or Northern Long-eared Bats

The following items should be documented and clearly presented within acoustic bat survey reports submitted to the Service

**ACOUSTIC SURVEY INFO**

- ☐ Project Name
- ☐ Site ID No./Name
- ☐ State and County
- ☐ Site Lat./Long. Coordinates (e.g., decimal degrees, NAD83)
- ☐ Approx. accuracy of Lat./Long. Coordinates
- ☐ Survey Date(s)
- ☐ Person who Selected Acoustic Site(s)
- ☐ Person who Deployed Detector(s)
- ☐ Detector Brand & Model
- ☐ Microphone Brand & Model
- ☐ Microphone Type: Directional/Hemispherical/Omnidirectional
- ☐ Type of Weatherproofing (if any)
- ☐ Microphone Height above Ground-level Vegetation(m)
- ☐ Distance from Nearest Vegetation or other Obstruction (m)(apart from veg. on ground)
- ☐ Horizontal Orientation of Microphone (1-360°)
- ☐ Vertical Orientation of Microphone (assuming 0° is parallel with horizon)
- ☐ Photographs of Detector Set-up at each Site
- ☐ Detector Settings and/or Log Files (all settings used for each brand/model of detector. For example, sensitivity, gain, data division, 16k high filter, sample rate, min/max duration, min trigger freq., trigger level, etc.)
- ☐ Survey Start Time (military)
- ☐ Survey End Time (military)
- ☐ Methods used to Field-test proper Functioning of Detector
- ☐ Were calls collected in Full Spectrum or Zero Crossing?
- ☐ Habitat Type and/or Feature Surveyed
- ☐ Weather Conditions during Survey Period

**ACOUSTIC ANALYSIS INFO**

- ☐ Program used to convert Full Spectrum to Zero Cross (if applicable)?
- ☐ Filter(s) used (if any) and parameters used (e.g., CFRead, noise, bug, etc.)
- ☐ Name of Service-approved Bat ID Software Program(s) and Version(s) used and Candidate program(s)(if used)
- ☐ Program Settings (if applicable):
  - Min. # of pulses for species ID
  - Min. # of pulses per group ID
  - Min. discrim. prob. for species ID
  - Other relevant settings affecting ID
  - Suite of species/groups included in program analysis
- ☐ Table summarizing Number of Calls ID'd for each Species/Site/Night/Program (including MLE p-values)
- ☐ If Qualitative Analysis was conducted, include Number of Calls Confirmed through Qualitative ID for each Species/Site/Night
- ☐ Full Name of Person(s) who conducted Qualitative Analysis
- ☐ Additional Survey Reporting Requirements
- ☐ Acoustic Report Appendices:
  - data sheets and maps,
  - photographs of detector set-ups,
  - computer screen captures of representative bat species identified during acoustic analyses, and
  - resume(s) highlighting relevant qualifications of person(s) who conducted qualitative analysis (e.g., experience visually identifying *Myotis*, certificates of training, publications etc.)

# APPENDIX D: PHASE 4 RADIO-TRACKING

PERSONNEL

**Transmitter Attachment:** A qualified biologist[62] who is experienced in handling IBAT and/or NLEB and attaching radio transmitters must perform transmitter attachments, as further explained in the protocol below.

**Tracking:** Biological technicians and/or a qualified biologist who is experienced in tracking transmittered bats must be present and actively involved in all tracking activities for IBAT and/or NLEB as further explained in the protocol below.

METHODS

If one or more IBAT and/or NLEB are captured, the following radio-tracking protocols will be applicable:

NOTE: The radio-tracking protocol may also be used for captured TCBs for the 2023 field season; however, radio-tracking of TCB should prioritize identification of the immediate roosting area of the transmittered bat given the difficulty in locating the bats exact roosting location.

1. Biologists should coordinate in advance with USFWS FO(s) regarding radio-tracking recommendations (e.g., number and distribution of transmitters, including prioritization of sex/age and maximum number per site) and whether foraging data would be beneficial to collect. Also, professional judgment should be used to determine whether attachment of transmitters could compromise the health of a bat. Since the maximum holding times for IBAT and/or NLEB targeted for radio-tracking is 30 minutes[63], or as allowed in federal and state permits, surveyors should be prepared to place transmitters on bats immediately following their capture to minimize holding times.

2. The radio transmitter, adhesive, and any other markings (e.g., wing bands) should weigh less than 5% of pre-attachment body weight (Aldridge and Brigham 1988, American Society of Mammalogists 1998), the total weight of the package (transmitter and adhesive) may not exceed 6% of the bat's body weight and must comply with any USFWS and state permits. In all cases, the lightest transmitters capable of the required task should be used, particularly with pregnant females and volant juveniles. With pregnant bats, biologists should always use the lightest transmitter possible but no more than 5% of their expected non-pregnant weight.

[62] A qualified biologist is an individual who holds a USFWS Recovery Permit (Federal Fish and Wildlife Permit) for federally-listed bats in the state/region in which they are surveying and/or has been authorized by the appropriate state agency to mist-net for IBAT and/or NLEB. Several USFWS offices maintain lists of qualified bat surveyors, and if working in one of those states with authorizations in lieu of a Recovery Permits, the individual will either need to be on that list or submit qualifications to receive USFWS approval prior to conducting any field work.

[63] Current standard federal Section 10 bat permit conditions require prior written approval from the Field Supervisor in the USFWS FO(s) if capture times may exceed 30 minutes

3. Proposed radio telemetry equipment (e.g., receivers, antennas, and transmitters) and frequencies should be coordinated with the appropriate state natural resource agency and USFWS FO(s).

4. The qualified biologist or biological technician(s) should track all radio-tagged bats captured to diurnal roosts in accordance with permit requirements. We generally recommend tracking until the transmitter fails, fall off, or cannot be located for at least 7 days and should conduct a minimum of 2 evening emergence counts at each identified roost (See Appendix E for Emergence Survey Protocols). However, biologists are encouraged to continue radio-tracking efforts for the life of the transmitter. Biologists should contact the USFWS FO(s) immediately if they plan to cease tracking efforts before the 7-day tracking period ends. If landowner access is denied, approximate roost locations (i.e., coordinates) should be determined using triangulation.

5. Daily radio telemetry searches for roosts must be conducted during daylight hours and should be conducted until the bat(s) is located or for a minimum of 4 hours of ground or 1 hour of aerial-searching effort per tagged bat per day for 7 days. However, multiple bats captured at the same net location or nearby may be tracked simultaneously. Once a signal is detected, tracking should continue until the roost is located. At a minimum, biologists should document all ground and aerial-searching effort for all bats not recovered during radio-tracking for submittal with the survey report. For each roost identified during tracking, the biologist should complete a "USFWS IBAT and/or NLEB Roost Datasheet".

6. To minimize potential for disease transmission, any equipment that comes in contact with bats should be kept clean and disinfected, following approved protocols; this is particularly a concern relative to WNS. Protocols are posted at http://www.whitenosesyndrome.org/. Federal and state permits may also have specific equipment restrictions and disinfection requirements.

## SUBMISSION OF RADIO-TRACKING RESULTS

Phase 4 radio-tracking results should be included with the Phase 2 or 3 mist-netting report and submitted to the appropriate USFWS FO(s). Each report should include the following information related to radio-tracking efforts[64]:

1. Copy of prior phase reports (if not previously provided)
2. Explanation of any modifications from original survey plan (e.g., number of transmitters used, frequency of transmitters changed)[65]
3. Map and narrative detailing all ground and aerial searching effort for all bats not recovered during radio-tracking and relative to the negotiated or agreed effort as determined by the appropriate USFWS FO(s)

[64] In 2016, the USFWS implemented a new standardized approach for reporting of bat survey data. In addition to a traditional written report, federal permit holders are now required to submit their survey data using standardized permit reporting spreadsheets available on the USFWS website provided in the intro.
[65] If the USFWS previously agreed upon the study plan, we need to understand whether the revised work still accomplished the agreed upon methods.

4. Map summarizing IBAT and/or NLEB data collected from summer surveys for the proposed project (e.g., project area boundary and results from the site habitat assessment, acoustic survey, mist-net survey, radio-tracking, and emergence surveys)
5. Full names and permit numbers of personnel who attached transmitters to IBAT and/or NLEB and full names of all personnel conducting radio-tracking efforts
6. Photographs of all roosts identified during radio-tracking
7. Legible copies of all original USFWS IBAT and/or NLEB Roost Datasheets
8. Any other information requested by the local USFWS FO(s) where work was conducted

REFERENCES

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# USFWS INDIANA AND/OR NORTHERN LONG-EARED BAT ROOST DATASHEET

**Biologists (Full Name):_____ Date: _____**

**UTM: Zone_____ Easting _____ Northing_____ *OR***

**LAT_____ LONG_____**

**Property Owner: _____ Phone#_____**

**State_____ County_____ Site #_____**

**Roost #_____ Roost Name: _____**

***Roost Tree Data***

**Species: _____ Live __ Snag __ Other __**

**(if other, explain) _____**

**DBH (in or cm) _____ Total Height (ft or m) _____**

**Height of roost area (if known) _____Dist. from capture site_____**

**Roost position aspect (deg) _____**

**Exfoliating bark on bole (%) _____ Describe: sloughing __ platy__ tight__**

**Cavities present? ____ If so, describe: _____**

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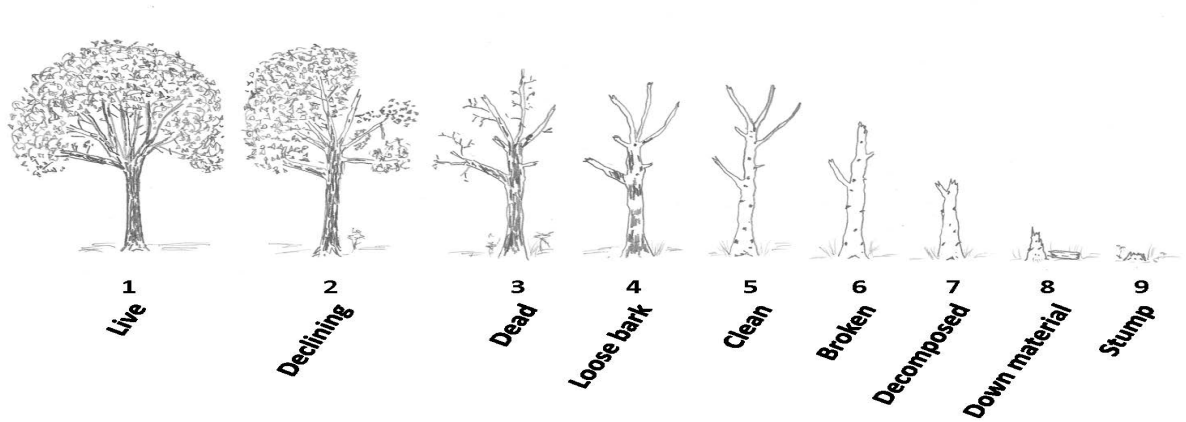
**Roost Decay State: 1 2 3 4 5 6 7 8 9 Other**



**Roost tree or snag canopy position: Dominant __ Co-Dominant __ Suppressed __**

***Surrounding Habitat Condition***

**Canopy closure at roost (%) _____**

**Approximate woodlot size (ac or ha) _____ Distance to non-forest (ft or m) _____**

**Describe forest/woodlot current condition (mature, partially cut-over, burned, insect damage, etc.)**
_____

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**Additional Comments**_____

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# APPENDIX E: PHASE 4 EMERGENCE SURVEYS

PERSONNEL

Qualified biologists[66], biological technicians, and any other individuals deemed qualified by a local USFWS FO may conduct emergence surveys for IBAT and/or NLEB by following the protocols below.

EMERGENCE SURVEYS FOR KNOWN IBAT AND/OR NLEB ROOSTS

The following protocols should begin as soon as feasible after identification of a diurnal roost (ideally that night):

NOTE: The emergence survey protocol should not be used for radio-tracked TCBs or emergence surveys of identified potential roosts for the 2023 field season given the variability in roosting locations typically used by the species (e.g., roosting in dead leaf clusters in the canopy of live trees) and difficulty observing bats emerging. An emergence count may be attempted on the rare occasion that the surveyor is able to discover the exact roosting location of a transmittered TCB and believes he/she can observe the bat(s) emerging.

1. Bat emergence surveys should begin one half hour before sunset[67] and continue until at least one hour after sunset or until it is otherwise too dark to see emerging bats. The surveyor(s) should be positioned so that emerging bats will be silhouetted against the sky as they exit the roost. Tallies of emerging bats should be recorded every few minutes or as natural breaks in bat activity allow. There should be at least one surveyor per roost. Surveyors must be close enough to the roost to observe all exiting bats but not close enough to influence emergence. That is, do not stand directly beneath the roost, do not make noise or carry on a conversation, and minimize use of lights (use a small flashlight to record data, if necessary). Do not shine a light on the roost as this may prevent or delay bats from emerging. Use of an infra-red, night vision, or thermal-imaging video camera or spotting scope is encouraged but not required. Likewise, use of an ultrasonic bat detector may aid in identifying the exact timing of bats emerging and may be used to help differentiate between low- and high-frequency bats species, and therefore, is strongly recommended. If multiple roosts are known within a colony, then simultaneous emergence surveys are encouraged to estimate population size. [NOTE: If a roost cannot be adequately silhouetted, then the local USFWS FO(s) should be contacted to discuss alternative survey methods].

2. Bat activity is affected by weather; therefore, emergence surveys should not be conducted when the following conditions exist: (a) temperatures that fall below 50°F (10°C); (b) precipitation, including rain and/or fog, that exceeds 30 minutes or continues intermittently

[66] A qualified biologist is an individual who holds a USFWS Recovery Permit (Federal Fish and Wildlife Permit) for federally listed bats in the state/region in which they are surveying and/or has been authorized by the appropriate state agency to mist-net for IBAT and/or NLEB. Several USFWS offices maintain lists of qualified bat surveyors, and if working in one of those states with authorizations in lieu of a Recovery Permits, the individual will either need to be on that list or submit qualifications to receive USFWS approval prior to conducting any field work.

[67] Surveys may need to start a little earlier or later than one half hour before official sunset times (i.e., before "dusk") in some settings such as deep/dark forested valleys or ridge tops, respectively. Sunset tables for the location of survey can be found at: https://sunrise-sunset.org

during the survey period; and (c) sustained wind speeds greater than 9 miles/hour (4 meters/second; 3 on Beaufort scale).

3. Surveyors should use the attached (or similar) "Bat Emergence Survey Datasheet".
4. Surveyors should also complete an "IBAT and/or NLEB Roost Datasheet" for each roost known to be used by one or more IBAT and/or NLEB (see Appendix D for an example).
5. Completed datasheets should be included in reports prepared for the USFWS.

EMERGENCE SURVEYS FOR POTENTIAL IBAT AND/OR NLEB ROOSTS

In some limited cases (e.g., individual hazard tree removal during the active season[68]), surveyors may have the option of conducting emergence surveys for individual potential IBAT and/or NLEB roosts to determine use prior to removal. Evaluations whether potential roosts meet the criteria to conduct emergence surveys should be for each individual tree rather than groups of trees. The following protocol applies to these surveys:

1. Consult with the local USFWS FO(s) to determine whether a tree(s) that needs to be felled/ cleared may be potential roosting habitat for IBAT and/or NLEB and whether conducting an emergence survey is an appropriate means of avoiding take of IBAT and/or NLEB[69]. In general, the USFWS only approves of conducting emergence surveys as a means of avoiding direct take of bats for projects that only affect a very small number of potential roosts (e.g., less than or equal to 10)[70] in relatively small project areas. In addition, emergence surveys are only valid if all parts of the tree (limbs and trunk) can be observed by the surveyor. Therefore, trees within woodlands that are directly adjacent to other trees and whose canopy is blocked are not suitable for emergence surveys. An online directory of USFWS offices is available at: http://www.fws.gov/offices/.

2. If the USFWS FO(s) approves/concurs with Step 1, then follow the emergence guidelines for Emergence Surveys for Known IBAT and/or NLEB Roosts (above) to determine if any bats are roosting in the tree(s).

3. At the conclusion of the emergence survey:

    a. If **no** bats were observed emerging from the potential roost(s), then it maybe felled immediately. If safety concerns dictate that a tree cannot be felled immediately (i.e., in the dark), then the tree(s) should be felled as soon as possible after sunrise on the following day. If a tree is not felled during the daytime immediately following an emergence survey, then the survey must be repeated, because bats may switch roosts on a nightly basis. Immediately after the tree is felled, a visual inspection of the

[68] The active season for IBat and/or NLEB is, generally, April 1 to October 15; however, contact the local USFWS FO(s) to determine if emergence surveys are acceptable during the time proposed.

[69] If a potential bat roost tree poses an imminent threat to human safety or property, then emergency consultation procedures should be followed as appropriate. (50 CFR §402.05). If a hazard tree does not pose an imminent threat, then the USFWS requests that it be felled during the bat's inactive season (i.e., generally from October – March, but contact the FO for specific dates for your area.) When possible, felling of potential roost/hazard trees should be avoided during the primary maternity period (June – July) to avoid potential adverse effects to non-volant pups.

[70] Areas containing >10 hazard trees will be assessed by the USFWS on a case-by-case basis with the project proponent.

downed tree must be completed to ensure that no bats were present, injured, or killed. The USFWS FO(s) should be contacted immediately, if bats are discovered during this inspection.

b. If **1 or more** bats (regardless of species, because species identification cannot reliably be made during visual emergence counts alone) are observed emerging from the roost, then it should **not** be felled, and the USFWS FO(s) should be contacted the next working day for further guidance.

SUBMISSION OF EMERGENCE SURVEY RESULTS

Emergence survey results should be included with the mist-netting survey report, unless the survey was completed as an evaluation of potential roosts and should be submitted to the appropriate USFWS FO(s) for review. Each survey report should include the following information related to emergence survey efforts[71]:

1. Copy of prior phase reports (if not previously provided)
2. Explanation of any modifications from the Phase 4 emergence count study plan (e.g., number of potential roosts surveyed), if applicable
3. Summary of roost emergence data
4. Map identifying location of roost(s) identified during radio-tracking and/or emergence surveys for IBAT and/or NLEB(s) including GPS coordinates
5. Full names of personnel present during emergence survey efforts and who conducted emergence surveys of roosts
6. Photographs of each identified roost
7. Copies of all "Emergence Survey" and "IBAT and/or NLEB Roost" datasheets
8. Any other information requested by the local USFWS FO(s) where work was conducted
9. Copy of the pre-approved site-specific written authorization from USFWS and/or state natural resource agency (if required)

[71] In 2016, the USFWS implemented a new standardized approach for reporting of bat survey data. In addition to a traditional written report, federal permit holders are now required to submit their survey data using standardized permit reporting spreadsheets available on the USFWS website provided in the intro.

# USFWS BAT EMERGENCE SURVEY DATASHEET

Date: _____ Surveyor(s) Full Name: _____

**State: _____ County: _____ Project Name: _____**
Site Name/#: _____ Roost Name/# _____ Bat #:_____

**Lat/Long or UTM of Roost:** _____
Description of Roost/Habitat Feature Surveyed: _____

_____

**Bat Species Known to be using this Roost/Feature (if not known, leave blank):**
_____
**Other Suspected Bat Species (explain): _____**
**Weather Conditions during Survey (temperature, precipitation, wind speed):**
_____
**Survey Start Time: _____ Time of Sunset: _____ Survey End Time: _____**

**NOTE:** Emergence surveys should begin ½ hour before sunset and continue until at least one hour after sunset or until it is otherwise too dark to see emerging bats. The surveyor(s) should position him or herself so that emerging bats will be silhouetted against the sky as they exit the roost. Tallies of emerging bats should be recorded every few minutes or as natural breaks in bat activity allow. Ensure that surveyor(s) are close enough to the roost to observe all exiting/returning bats, but not close enough to influence emergence (i.e., do not stand directly beneath the roost and do not make unnecessary noise and/or conversation, and minimize use of lights other than a small flashlight to record data, if necessary). Do not shine a light on the roost tree crevice/cave/mine entrance itself as this may prevent or delay bats from emerging. If available, use of an infra-red, night vision, or thermal-imaging video camera or spotting scope and an ultrasonic bat detector are strongly recommended but not required.

| Time | Number of Bats Leaving Roost* | Comments / Notes |
|---|---|---|
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APPENDIX E: PHASE 4 EMERGENCE SURVEYS

Site Name/#: _____ Roost Name/#: _____

| Time | Number of Bats Leaving Roost* | Comments / Notes |
|---|---|---|
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| **Total Number of Bats Observed Emerging from the Roost/Feature During the Survey:** | | |

* If any bats return to the roost during the survey, then they should be subtracted from the tally.

**Describe Emergence**: Did bats emerge simultaneously, fly off in the same direction, loiter, circle, disperse, etc. If a radio-tagged bat was roosting in the tree, at what time did it emerge?

# APPENDIX F: LINEAR PROJECT GUIDANCE

For linear projects (e.g., pipelines and roadways) >1 km in length (shorter lengths should be considered as a non-linear project), surveyors have the option to use either mist nets or acoustic detectors in any given 1-km segment of suitable habitat. A survey site may also cover other associated linear project facilities (e.g., access roads) that are located within a pre-determined distance of each segment. When possible, surveyors should seek out the best available survey sites located within the footprint of the project alignment, and directly adjacent to, or near, the alignment if no suitable sites are available within the footprint. Because the best survey sites for capturing/detecting bats may fall outside of a project footprint, the surveyor and project proponent should coordinate with the appropriate USFWS FO(s) to establish a project-specific maximum distance from the centerline or project boundary prior to initiating surveys.

Tentative survey site locations along linear projects should be included in a proposed study plan to be reviewed and approved by the USFWS FO(s). Adequate survey effort should be conducted within each approximate 1-km segment that contains suitable forested habitat along the proposed workspace. It is not appropriate to cumulatively add up each habitat block crossed until 1km of habitat has been traversed. Segments along a linear project that do not contain suitable habitat should be skipped until the next patch of suitable habitat is encountered (Figure 5). Establishing exactly how many survey sites are needed for P/A surveys along a linear project often involves some give and take particularly in fragmented habitat areas (Figure 5, rows B and C). The final number of survey sites could be greater than the minimum number of sites prescribed in the protocol to adequately cover the areas of suitable habitat to be impacted. When available, habitat quality and quantity (e.g., size and location of suitable maternity roost trees) from on-the-ground habitat assessments can be used to fine tune and guide the placement of survey sites. In some marginal habitat areas, the quality and quantity of the existing habitat may be low enough to justify skipping some survey segments (e.g., Figure 5, Site 11). Likewise, some isolated woodlots, fence lines or individual trees may be considered too isolated and/or small to independently support bats and may be skipped if the USFWS FO(s) concurs. Habitat suitability in fragmented areas should be assessed on a site-specific basis and consider habitat configuration and connectivity to other suitable habitat patches. In general, we recommend surveying a few more sites for a project than the absolute minimum required.

In instances where a mist netting survey has been proposed, but no suitable mist net sites can be found or accessed within a particular segment, biologists should contact the USFWS FO(s) for further guidance or ideally agree in advance as to how such situations will be handled when encountered in the field (e.g., an acoustic survey may be substituted). Similarly, if an area of forest habitat that seemed suitable from aerial photography appears to be unsuitable or of particularly low quality upon field inspection, then you should coordinate with the USFWS FO(s) to determine if an area may be exempted from surveys. To avoid problems, any significant departures from previously agreed to survey plans should be justified and coordinated with the USFWS FO(s) prior to leaving the field.

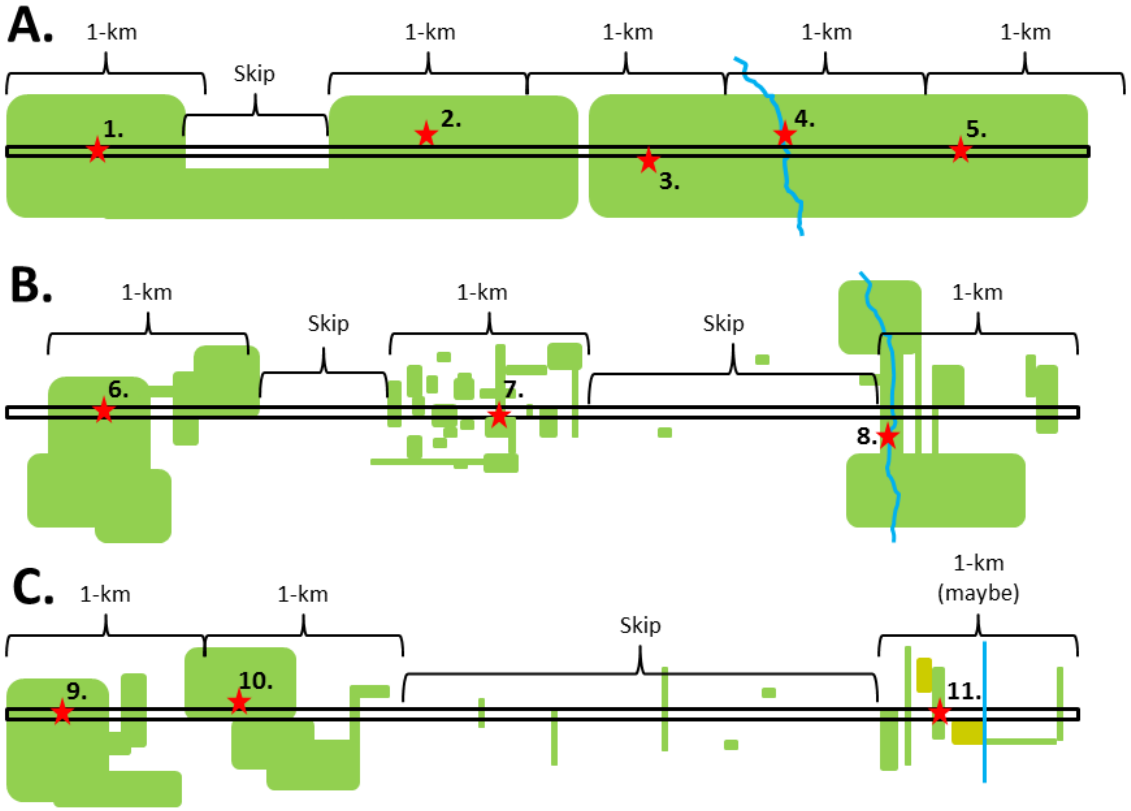


**FIGURE 5.** Conceptual linear project (black double lines) through relatively contiguous (A.) and fragmented (B. and C.) forested habitats (green patches) delineated into approximate 1-km survey sections. Numbered red stars represent suitable survey sites (1-11) on or near the project boundaries. Blue lines represent natural streams (A. and B.) and a ditch (C.). Yellow-green patches near Site 11 represent low-quality habitat.

# APPENDIX G: THE OUTER–TIER GUIDANCE

Since early radio-tracking studies in Illinois, it has become standard practice for USFWS FOs to assume that an IBAT summer maternity colony will utilize suitable habitat within approximately 2.5 miles of its primary roost tree(s)/focal roosting area. However, if a reproductive adult female or juvenile IBAT is captured (or acoustically detected), but not radio-tracked to a roost site, then FOs typically assign its capture site a 5-mile conservation buffer and assume that its roost tree is located somewhere within 2.5 miles of the capture site. This approach is further detailed in the Service's IBAT Section 7 and Section 10 Guidance for Wind Energy Projects[72].

**NOTE**: The same principles used for the IBAT can be used for the NLEB using a 3-mile conservation buffer around capture/detections and 1.5-mile buffer around roost trees. Additionally, the outer-tier guidance may also be used for TCB presence/probable absence surveys for the 2023 field season using a 3-mile conservation buffer around capture/detections and 1.5-mile buffer around roost trees.

Because a 5-mile buffer encompasses four times more area than a 2.5-mile buffer (50,265 acres vs. 12,566 acres), it is reasonable to assume that only approximately 25% of a 5-mile buffered area is actually occupied by the documented IBAT summer maternity colony at any given time and that approximately 75% remains unoccupied or could be used by members of another yet undocumented colony(s). Therefore, if a subsequently proposed project is either ≤123 acres in size or affects ≤1% of existing suitable summer habitat within a 5-mile buffer (whichever is greater) but is situated ≥2.5 miles from the original capture/detection site, then it will have a relatively low probability of being within the true maternity colony home range (assuming suitable habitat is more or less evenly distributed in all directions from the capture site) (See Figures 6 & 7). Allowing project proponents of such "outer tier" projects to conduct a summer P/A survey for IBAT and/or NLEB using the standard survey level of effort (LOE) (as outlined in Appendix B and C) in such cases is reasonable and the additional survey data would 1) help refine the home range boundaries of the original colony, 2) confirm presence of additional colonies if present, 3) provide additional radio-tracking opportunities /roost tree locations, and 4) provide an option for project proponents to survey instead of always assuming presence.

Prior to emergence of WNS, NLEBs were widely distributed throughout much of the eastern U.S. and Canada. Although not nearly as common today, surveys show that the species continues to occur in pockets distributed throughout the WNS-impacted portion of its range. NLEB populations continue to remain stable in portions of the Southeast Coastal Plain (Virginia, North Carolina, and South Carolina) and Louisiana where they are active year-round in forested or wooded habitats due to mild winter temperatures, and these populations, which are not dependent upon caves or mines for hibernation, may not be susceptible to WNS. Similarly, IBATs within the Northeast and Appalachian Recovery Units (RUs) have seen significant declines due to WNS; however, populations continue to do well within the Midwest and Ozark-Central RUs (USFWS unpublished data 2023).

Due to the severity of the impact of WNS on populations across much of the NLEB and eastern IBAT RUs (i.e., Northeast and Appalachian) ranges, there is uncertainty where surviving NLEBs and IBATs are located in these portions of their ranges. To address this uncertainty, we recommend allowing project proponents whose project is either ≤123 acres in size or affects ≤1% of existing suitable summer habitat within a 5-mile (IBAT) or 3-mile (NLEB) buffer (whichever is greater) the

[72]Document is available on the USFWS website provided in the introduction.

opportunity to survey in both the inner-tier and outer-tier of known Seasonal Range NLEB buffers and IBAT buffers within the Northeast and Appalachian RUs when the buffered occurrence was prior to 2 years[73] after WNS was first confirmed in the state. We recommend coordinating with the local USFWS FO in the state where the proposed project survey is planned to determine whether inner-tier NLEB and/or IBAT buffers can be surveyed or not. Provided proponents use at least the prescribed minimum LOE for NLEBs and/or IBAT in these locations and the survey is approved by the Field Office, the USFWS would accept the results as evidence of presence/probable absence. For example, if WNS was confirmed in 2011, project proponents can survey both inner and outer tiers of a known buffer for presence/probable absence if the occurrence was in 2012 or earlier. For this example, presence/probable absence surveys could not be conducted in the inner tiers of occurrence buffers documented in 2013 and later.

**NOTE**: USFWS FO(s) may decide not to approve an outer-tier survey under the following circumstances: (1) If available forest habitat with a 5-mile (or 3-mile for NLEB) buffer is not more-or-less evenly distributed, but rather is highly clumped or restricted to a relatively narrow strip(s) (e.g., a riparian corridor); (2) <10% of a 5-mile (or 3-mile for NLEB) buffer contains suitable summer habitat; or (3) other site-specific reasons.

If a project proponent of an "outer-tier" project coordinates with the USFWS FO(s) upfront and conducts a valid summer mist-netting (Appendix B) or acoustic (Appendix C) survey using the appropriate LOE and does not capture/detect an IBAT and/or NLEB(s), then no IBAT or NLEB related restrictions will be required for that specific project area. However, all restrictions/ assumptions of IBAT and/or NLEB presence outside of a completed outer-tier project survey area shall remain intact indefinitely within the 5-mile (or 3-mile for NLEB) buffer zone or until additional negative survey data or discovery of roost trees indicate adjustments to a buffer are warranted by USFWS. Negative survey results from "outer-tier" projects are valid for 5 years for that project area. If an IBAT and/or NLEB(s) is captured/detected/radio-tracked during the survey, then the project area will be presumed to be occupied, restrictions will remain in place, and the USFWS FO(s) will reassess/adjust the original buffer(s) if warranted using the newly acquired bat location data.

[73] An alternative year may be used if the USFWS FO(s) has data to more precisely support when WNS affected abundance and distribution in their state.

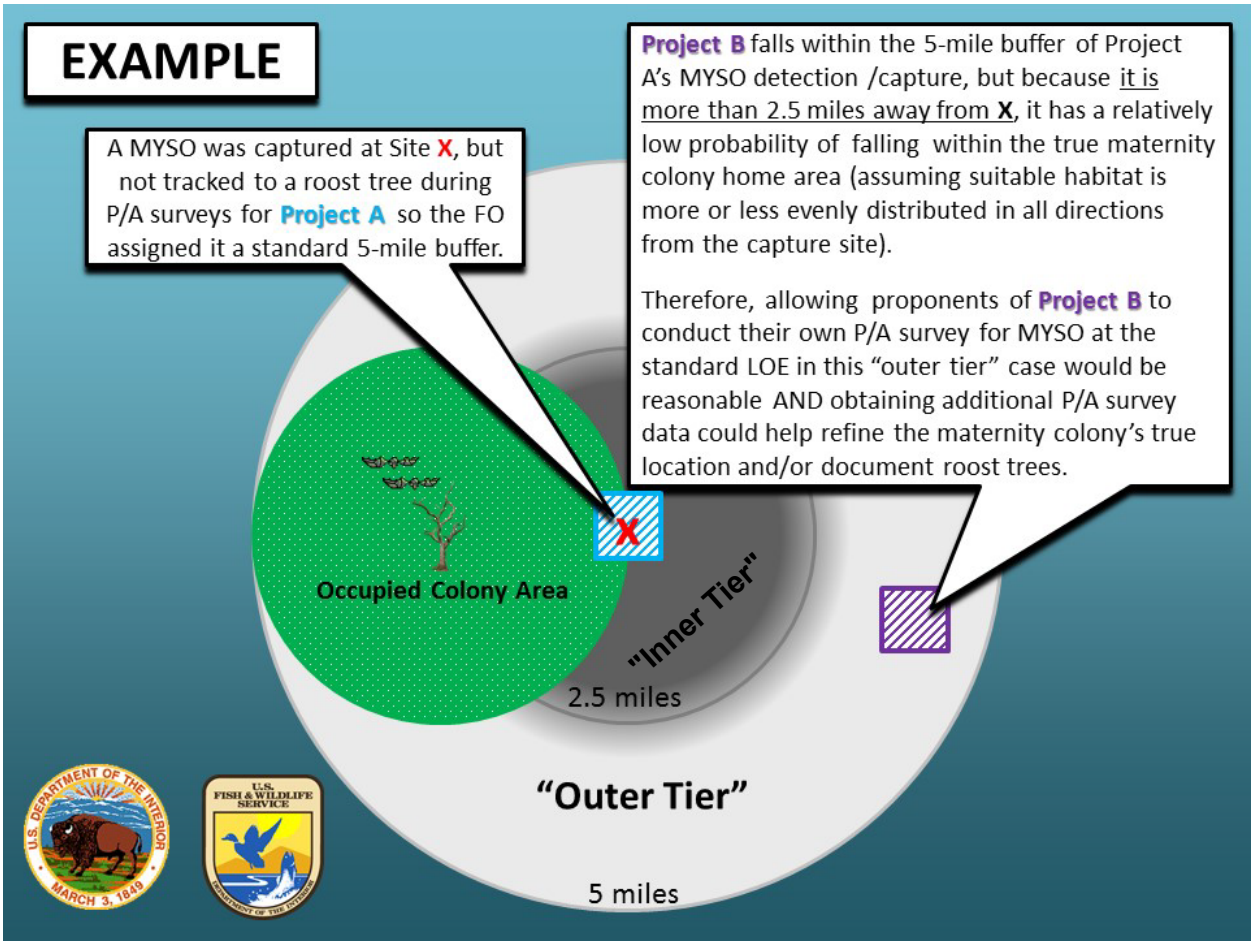


FIGURE 6. Graphical example depicting the proper application of the outer-tier guidance.

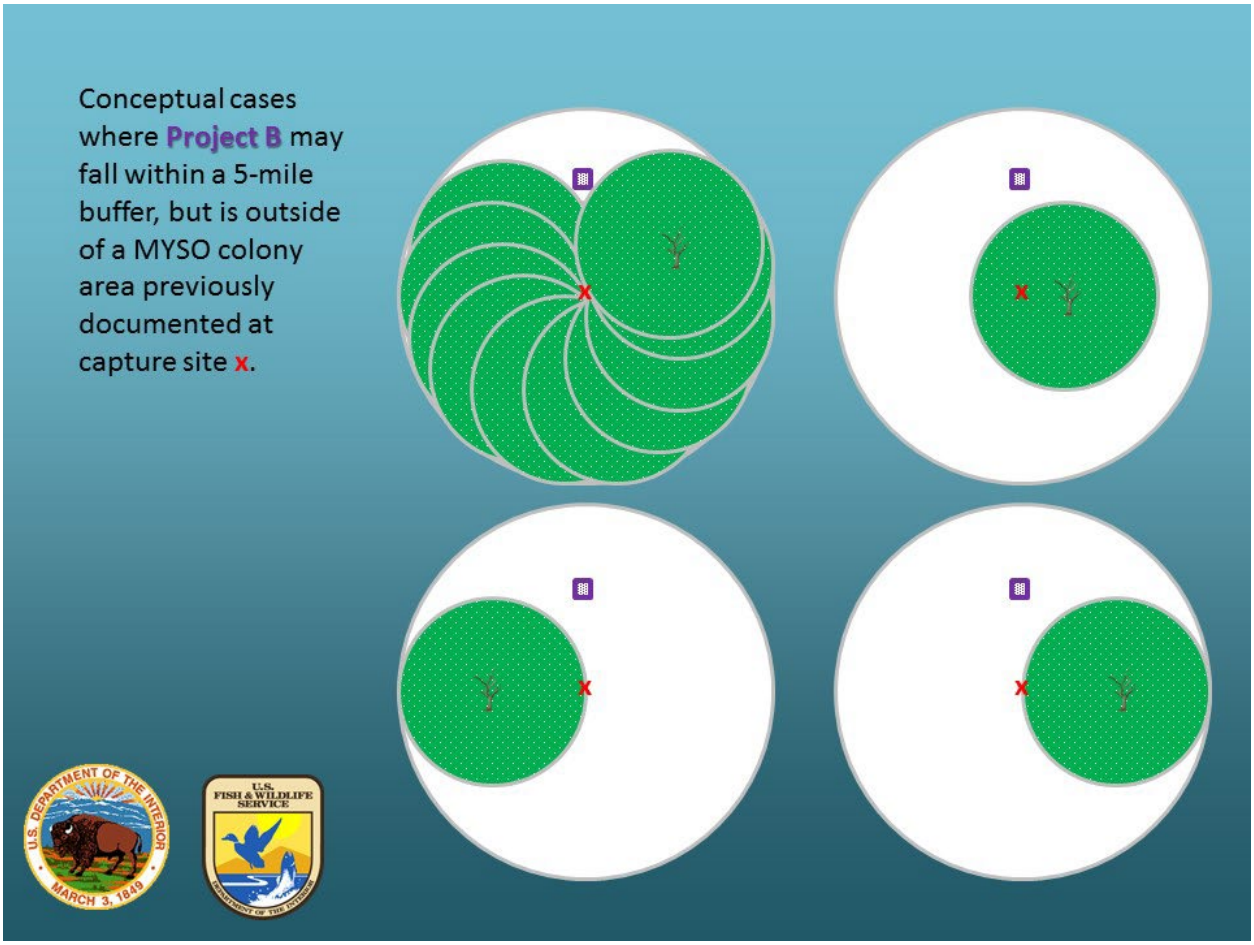


FIGURE 7. Hypothetical outer-tier scenarios where a proposed project area (depicted by a purple square) falls outside of the "true" IBAT maternity colony area(s) (depicted in green).

# APPENDIX H: POTENTIAL HIBERNACULUM SURVEY GUIDANCE

Indiana and NLEBs have been documented using caves (and their associated sinkholes, fissures, and other karst features), as well as anthropogenic features such as mines and tunnels as winter hibernation habitat (i.e., hibernacula). Project proponents need to evaluate whether any potentially suitable IBAT and/or NLEB hibernacula exist within a proposed project area. This knowledge will be derived from a variety of sources. The following phased process should be followed to determine presence or probable absence of IBAT and/or NLEB in potential hibernacula:

NOTE: The potential hibernaculum survey guidance may also be used for TCB presence/probable absence surveys, including winter (internal) surveys, for the 2023 field season in portions of the TCB range that the species hibernates. TCBs use a wider variety and warmer hibernacula than what would often be considered as suitable for IBATs and NLEBs. Coordinate with the local USFWS FO(s) if you are proposing to use this guidance to survey for TCB.

## PHASE 1 – INITIAL PROJECT SCREENING

### Step 1. Coordinate with the USFWS FO(s) and appropriate state natural resource agencies regarding existing federally listed bat hibernaculum or other occurrence information.

Prior to initiating P/A surveys (Phase 2) of potential IBAT and/or NLEB hibernacula (as determined by the Phase 1 Habitat Assessment), the USFWS FO(s) and appropriate state natural resource agencies must be contacted to determine if any caves or other underground features have been previously documented as hibernacula or other habitat for federally listed bat species. Any proposed surveys of previously documented hibernacula must be coordinated directly with these agencies to ensure that adverse effects to listed species do not occur because of the survey.

### Step 2. Desktop Analysis and Initial Field Reconnaissance.

After coordinating with the FO and appropriate state natural resource agency (when applicable), a desktop analysis and initial field reconnaissance should be completed by individuals with a natural resource degree or equivalent work experience and a solid understanding of karst topography and/or surface features associated with underground mines. These initial assessments can be completed at any time of year.

For all projects, a FO-approved field survey of all land within 0.5 miles of the edge of the project footprint (where access can be obtained) and documentation (e.g., a literature search, maps and information provided by local cave survey groups or grottos, review of aerial photography and topographical maps, previous mining records (if applicable), forest inventories, previous species survey reports, and the work of consultants or other designees) of all known caves and abandoned mines within 3 miles of the outside edge of the project footprint should be conducted. If caves or abandoned mines are found, further detail about the known or estimated underground extent of the cave/mine should be provided to the USFWS FO(s), including minimum and maximum depth of features and where those features are located on a map(s).

In general, underground openings can be deemed unsuitable as a hibernaculum and dismissed from further assessment and surveys if:

a) There is only one horizontal opening, and it is less than 6 inches (15.2 cm) in diameter;

c) Vertical shafts are < 1 foot (0.3 m) in diameter; Passage continues < 50 feet (15.2 m) and terminates with no visible fissures that bats can access;

d) Openings are prone to flooding, collapsed shut and completely sealed, or otherwise are inaccessible to bats; and

e) Openings that have occurred recently (i.e., within the past 12 months) due to human activity or subsidence. (Include written documentation verifying this determination).

The results of initial field assessments should be submitted to the USFWS FO(s) and State regulatory partners (when applicable) for review and approval prior to proceeding to Step 3. FO-approved results from Step 2 will remain valid for a minimum of five years. **NOTE**: longer time frames may not be appropriate due to cave/mine dynamics.

**Step 3. Conduct a Phase 1 Habitat Assessment of Potentially Suitable Hibernacula.**

If underground openings are documented during field surveys in Step 2 and cannot be dismissed during initial project screening above, then a qualified biologist[74] will need to conduct a Phase 1 Habitat Assessment to determine whether bats using a potentially suitable hibernaculum within a project area could be adversely affected by the proposed project as described below (see Phase 1 Habitat Assessment Sample Data Sheet).

Habitat assessments should include all entrances or openings that will be directly or indirectly impacted by the proposed project. This would include those caves (and their associated sinkholes, fissures, and other karst features), as well as anthropogenic features such as mines and tunnels that are within the project site or that are otherwise connected (i.e., by physical passageway, airflow or hydrologically) to any underground feature that will be directly or indirectly impacted by the proposed project.

The results of a Phase 1 Habitat Assessment should be submitted to the USFWS FO(s) and State regulatory partners (when applicable) for review and approval prior to proceeding to Phase 2. FO-approved results from Step 3 will remain valid for a minimum of five years. **NOTE**: longer time frames may not be appropriate due to cave/mine dynamics.

## PHASE 2 – PRESENCE/PROBABLE ABSENCE SURVEYS

### Surveys to Confirm Use of Suitable Winter Habitat

If suitable winter habitat is discovered as a result of the Phase 1 Habitat Assessment above, do not alter, modify, or otherwise disturb entrances or internal passages of caves, mines, or other entrances to underground voids (potential hibernacula) within the action area before completing a Phase 2 survey. The survey protocols for determining occupancy are detailed below. Some surveys may require modification (or clarification) of these guidelines; therefore, submittal of a study plan and coordination with the USFWS FO(s) and state natural resource agency is necessary prior to initiating suitable winter habitat/hibernacula surveys. Submit results of

[74] A qualified biologist is an individual who holds a USFWS Recovery Permit (Federal Fish and Wildlife Permit) for IBAT and/or NLEB in the state/region in which they are surveying. Alternatively, in States within Region 5 of the USFWS, state agencies assess qualifications and provide authorization to net, handle, and conduct hibernaculum surveys of/for IBAT and/or NLEB in that State (authorization is only valid in the State that provides the authorization). Several USFWS offices maintain lists of qualified bat surveyors, and if working in one of those states with authorizations in lieu of a Recovery Permits, the individual will either need to be on that list or submit qualifications to receive USFWS approval prior to conducting any field work.

completed summer and/or winter surveys to the appropriate FO(s) prior to clearing or altering of identified bat habitat. The USFWS FO(s) will review the results of P/A surveys conducted according to these guidelines for the purposes of determining whether IBAT and/or NLEB are occupying hibernacula in the project area and whether they may be adversely affected by any proposed actions.

## WINTER (INTERNAL), FALL, AND SPRING SURVEY PROTOCOLS FOR IDENTIFYING POTENTIAL BAT HIBERNACULA

White-nose syndrome (WNS) is a devastating fungal disease that has killed unprecedented numbers of hibernating bats in eastern North America. WNS and/or *Pseudogymnoascus destructans* (Pd), the fungus causing the disease has been detected throughout the range of the IBAT, as well as most of the range of the NLEB. Users of this guidance must follow the recommendations provided in the most recent USFWS Cave Advisory[75] as they relate to reducing the potential for humans to disturb hibernating bats or inadvertently transporting Pd to uncontaminated bat habitats. All surveys conducted at caves/mines should be coordinated with the USFWS FO(s) and appropriate state natural resources agencies prior to initiation (see example USFWS Project Proposal Form).

Winter (Internal) Surveys

Working near and within abandoned mines and caves can be inherently dangerous due to a variety of potential hazards (e.g., ceiling collapse and presence of toxic gases)[76]. Therefore, surveyors must thoroughly assess their work sites for any known and potential health and safety hazards and must use appropriate personal protective equipment and take proper precautions to avoid and minimize identified risks. Only sites that are deemed safe should be entered at the surveyor's discretion.

Potential hibernacula that are deemed safe to enter should be entered and all its accessible passages visually surveyed for the presence of IBAT during mid-winter (i.e., beginning January 1st and ending prior to March 1st of the same calendar year (also see Appendix 4 of the USFWS 2007 Indiana Bat Draft Recovery Plan: first revision). **NOTE:** The use of direct internal surveys is not adequate for NLEB due to the difficulty in visually detecting the species inside hibernacula (i.e., it typically roosts in deep cracks and crevices). Only properly trained and qualified individuals with the appropriate federal and/or state permits and equipment should attempt internal P/A surveys for the IBAT. If the qualified biologist, who completed the Phase 1 Habitat Assessment, does not have the necessary experience/permits to complete internal survey work, then this portion of the project should be subcontracted to another individual or group that does. If a site is unsafe or too difficult to enter or it is believed that significant portions of the underground system are inaccessible, it should be surveyed using the Fall or Spring emergence survey guidance to determine presence or probable absence of federally listed bat species, including the IBAT and/or NLEB (also see Sample Data Sheet for Fall or Spring Surveys of Potential Hibernacula).

[75] https://www.whitenosesyndrome.org/press-release/updated-cave-advisory-recommendations-for-managing-access-to-subterranean-bat-roosts-to-reduce-the-impacts-of-white-nose-syndrome-in-bats

[76] The Service highly recommends that surveyors seek counsel from an occupational health and safety professional(s) prior to working underground or under other potentially hazardous field conditions.

Fall or Spring Emergence Survey

1A. Fall surveys of mine/cave entrances must be conducted between September 15 and October 31[77] and prior to any tree clearing by the project applicant. A minimum of one night of harp trap sampling per week for 6 weeks (i.e., 6 nights of sampling) is required at each suitable entrance as determined by the Phase 1 Habitat Assessment. Each night of sampling should be separated by at least one week of the survey window if weather conditions allow it. However, multiple nights of sampling per week can be accepted in the last two weeks of October if forecasted weather conditions require it, at least 3 nights of sampling were completed during the first 3 weeks of the survey period, and the modification is approved by the appropriate USFWS FO(s). Survey effort may be suspended if no bats (of any species) are captured after the first 2 nights of acceptable survey effort in the fall. Surveys of a potential hibernaculum are in addition to any summer P/A surveys that may be required for a proposed project.

OR

1B. Spring surveys of mine/cave entrances must be conducted between April 1 and April 21[78] and prior to any tree clearing by the project applicant. Conducting surveys during the spring emergence is typically more complex than conducting fall surveys due to a greater number of uncontrollable factors (e.g., weather related factors). Thus, a minimum of three nights of harp trap sampling per week for three weeks (i.e., 9 nights of sampling) is required at each suitable entrance as determined by the Phase 1 Habitat Assessment. Due to the need to monitor weather conditions closely, each proposed spring mine/cave survey must be coordinated with the USFWS FO(s) and appropriate state natural resource agencies prior to surveying to ensure that adequate survey results are achieved. Surveys of a potential hibernaculum are in addition to any summer P/A surveys that may be required for a proposed project.

2. Unless otherwise approved by the USFWS FO[79], the capture of an IBAT and/or NLEB during a fall or spring mine/cave survey requires that the applicant complete three additional nights of sampling per week for three consecutive weeks (9 additional nights LOE) to determine the relative significance of the mine(s) and/or cave(s) and their associated underground workings to the IBAT and/or NLEB. If the mine/cave survey season (i.e., September 15 to October 31 for fall sampling and April 1 to April 21 for spring sampling) ends prior to the completion of the required additional sampling, then sampling must be completed the following fall or spring.

3. Harp traps are the preferred method for sampling entrances as they are less stressful on captured bats. Mist nets can also be deployed along corridors immediately adjacent to the entrance to increase survey effectiveness. Mist nets may also be used at the entrance but only when the mine or cave configurations are not suitable to harp trapping. The use of mist nets must be approved by the USFWS FO(s) and appropriate state natural resource agency prior to initiation of survey. Mist nets should be made of the finest, lowest visibility mesh commercially available. Currently, this is 2-ply, 50-denier nylon (denoted 50/2). The mesh should be approximately 1.5-inch in size. No other specific mist netting hardware is required.

[77] Timing of fall surveys may need adjustment based on location and weather conditions leading up to the survey. Coordination with local USFWS FO(s) and State regulatory partners (when applicable) during development of the study plan/project proposal form is required.

[78] Timing of spring surveys may need adjustment based on location and weather conditions leading up to the survey. Coordination with local USFWS FO(s) and State regulatory partners (when applicable) during development of the study plan/project proposal form is required.

[79] Additional survey effort may not be recommended in cases where a project proponent agrees to modify their project to completely avoid adverse impacts to newly documented hibernacula

4. Entrances must be entirely enclosed by the survey gear when harp trapping. If mist nets are used, entrances should not be entirely enclosed by the survey gear.

5. All entrances that are potentially inter-connected should be surveyed on the same night. In cases where one team of surveyors cannot feasibly sample all entrances in one night, a modified method could also be used. This method should only be used in situations where the entrances are known to be interconnected. In this modified method, half of the interconnected entrances are surveyed on the first night, and the other half of the entrances are completely blocked using bird-exclusion netting, plastic sheets, or other impervious material. On the second night, survey efforts are reversed. Any materials used to block the entrances must be removed each night immediately after conducting the survey. No entrances should be left blocked over-night. Plastics or other materials used to block the entrances should be removed each night immediately after conducting the survey. Entrances that are not connected (e.g., as determined by existing mine maps) do not have to be surveyed simultaneously.

6. The sampling period should begin at sunset and continue for at least 5 hours each night. During this time, harp traps (most preferable method) and/ or mist nets (acceptable method, but less preferable from a bat-handling perspective) should be monitored for captured bats continuously to minimize the number of bats that escape. Surveyors monitoring set-ups continuously must minimize noise, lights and movement near the traps or nets. Monitoring with a bat detector (ideally using ear phones to avoid alerting bats) can be beneficial: (a) bats can be detected immediately when they are captured, (b) prompt removal from the trap/net decreases stress on the bat and potential for the bat to escape, and (c) monitoring with a bat detector also allows the biologist to assess the effectiveness of each trap/net placement (i.e., if bats are active near the set-up but avoiding capture), which may allow for adjustments that will increase capture success on subsequent nights. There should be no other disturbance near the set-up, other than to check traps/nets and remove bats. Biologists should be prepared to cut the net if a bat is severely entangled and cannot be safely extracted within 3 or 4 minutes. Capture and handling are stressful for bats. Emphasis should be on minimizing handling and holding bats to as short a time as possible to achieve field study objectives. Bats should not be held for more than 30 minutes after capture or as allowed in federal and state permits.

7. If captures increase during the survey or if 6 or more bats of any species were captured during the last hour of monitoring, the survey effort must continue until activity declines or fewer than 6 bats are captured per hour. A total of 30 (fall) or 45 (spring) hours of sampling should take place for a mine/cave survey to be approved.

8. Severe weather adversely affects the activity levels of bats. If any of the following weather conditions exist during the fall or spring mine/cave survey, the time and duration of such conditions must be noted on the data sheets and in the survey report, and the survey effort for that night must be repeated: (a) winds sufficiently strong and variable enough to move equipment (i.e., traps or nets) more than 50 percent of the time; and (b) precipitation, including rain and/or fog, that does not stop within 30 minutes or continues intermittently during the survey period; and (c) temperatures that are less than 50° F (10° C) for the first 2 hours, and that drop below 40° F (1.6° C) at any point during the survey.

9. All bats captured during fall or spring surveys must be temporarily marked with a USFWS FO-approved non-toxic material that will last for the remainder of the survey period to identify any recaptures during subsequent survey nights.

10. If IBAT and/or NLEB (or other federally listed species) are captured during fall or spring mine/cave surveys, notification to the local USFWS FO(s) is required within 48 hours (or in accordance with permit conditions), and the sex and reproductive condition of the bat and GPS coordinates of the capture site should be provided.

11. A bat detector/roost logger should be on site to monitor general bat activity when trapping or netting. Bat passes should be monitored and tallied hourly. Bat tallies should be reported along with the time sampled. Report the beginning time and number of bat passes in hour blocks. Analysis of recorded bat calls to attempt species identification should not be completed as these calls are not expected to be foraging calls.

12. Noise, the use of lights, or other potential disturbances should be kept to, at a minimum, no closer than 300 feet (91.4 m) of the sampling site.

13. At least one member of each survey crew must hold, and have in his or her possession, a valid endangered species collection permit issued by USFWS and/or[80] the appropriate state natural resource agency that allows the qualified biologist to collect bats, including federally listed species. All activities must be carried out with strict adherence to permit conditions and authorizations specified in your federal permit, as well as any State authorizations. A qualified biologist(s) must (1) select/approve harp trap/mist-net sets, (2) be physically present at each site throughout the survey period, and (3) confirm all bat species identifications. This biologist may oversee other biological technicians and manage set-ups near one another as long as the traps/nets are being monitored continuously.

14. All survey efforts must follow the most recent USFWS decontamination protocols regarding WNS.

[80] Surveyors working in States within Region 5 of the USFWS only require a permit from the State where the survey is taking place.

## Phase I Habitat Assessment Sample Data Sheet

**Location** _____

**Observers (include permit numbers)** _____

**Latitude** _____ **Longitude**[81] _____

**Date** _____ **Time** _____ **Temp (outside)** _____

| | Opening #1 | Opening #2 | Opening #3 | Opening #4 |
|---|---|---|---|---|
| Opening Type (e.g., cave, portal, shaft) | | | | |
| Opening vertical or horizontal | | | | |
| Opening Size: Height x Width (or Diameter) | | | | |
| Internal Dimensions: Height x Width | | | | |
| Slope (up or down from entrance) | | | | |
| Entrance Stable? | | | | |
| Direction of Airflow (In or out?) | | | | |
| Amount of Airflow (e.g., none, slight, heavy) | | | | |
| Internal air warmer or cooler than outside temp.? | | | | |
| Evidence of collapse? | | | | |
| Ceiling Condition | | | | |
| Amount of water in opening | | | | |
| Evidence of past flooding? | | | | |
| Observed length of internal passage | | | | |
| Distance to nearest water source | | | | |
| % Canopy Cover at entrance | | | | |
| Foraging Signs? (e.g., moth wings) | | | | |

Are any portals suspected or known to be connected? Which ones?

Any observable side passages?

Additional comments:

*Entry of abandoned mine portals, quarries, or caves can be extremely dangerous because of the potential for ceiling collapse and presence of toxic gases. Safety or health problems may occur as a result of entering abandoned mines. The FWS does not authorize or require anyone to enter any potential hibernaculum that is or could be unsafe while implementing surveys. These guidelines do not require any applicant or applicant employee, consultant, lessee, or other such designee to enter any cave, quarry, or mine portal.*

[81] Provide coordinates for each opening.

# Sample Data Sheet for Fall or Spring Surveys of a Potential Hibernaculum

| | | | |
|---|---|---|---|
| DATE: | TEMPERATURE | Start: | End: |
| PRECIPITATION*: | | WIND*: | |
| MOONLIGHT: | TIME | Start: | End: |
| PERSONNEL (include permit numbers): | | LOCATION (lat/long): | |

| Time | Species | Age | Sex | Repro Cond. | RFA (mm) | Mass (g) | Flight Direction (in or out) | Notes and General Comments |
|---|---|---|---|---|---|---|---|---|
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***Precipitation and Wind should be measured hourly**

****Repro. Cond (Reproductive Condition): (P) pregnant; (L) lactating; (PL) post-lactating; (NR) non-reproductive, (TD) testes descended**

# APPENDIX I: CALCULATING LOE FOR A COMBINED ACOUSTIC AND MIST-NETTING SURVEY

Numerous publications discuss the general advantages of using acoustics and mist-netting in tandem for inventorying bat communities (Kunz and Brock 1975, Kuenzi and Morrison 1998, Murray et al. 1999, O'Farrell and Gannon 1999, Flaquer et al. 2007). One of the stated objectives of the IBAT and NLEB survey guidelines is to maximize the potential for detection/capture of these species at a minimum acceptable LOE. The USFWS has long recognized that offering a combination acoustic and mist-netting option has advantages over the current single technique options presented in Appendices B and C; however, developing the methodology to calculate an acceptable LOE for a combined approach is challenging because our recommended LOE approaches were calculated based exclusively on either mist-netting or acoustic datasets.

Some advantages of a combined approach are that it provides flexibility to address challenging survey conditions (e.g., situations where mist-net set-ups are limited or the reverse). These situations are not uncommon, especially for linear projects which can pass through highly variable habitats. A combined approach provides project proponents with the ability to reduce overall survey time and cost while still providing for a suitable LOE. Finally, a combined approach alleviates challenges associated with number of sites/acoustic locations and limits on number of survey nights per net-site for projects impacting smaller acreages of suitable habitat.

To calculate the mist-netting and acoustic LOE using the combined approach the surveyor must consider survey LOE as a percent, and then balance the netting percent against the acoustic percent, which is what the guidance inherently does in setting the existing sole mist-netting and acoustic LOE standards.

- X mist-net nights of effort/123 acres = Y acoustic nights of effort/123 acres

First, determine the proportion of effort that will be applied using either the mist-netting or acoustic method. The decision to use mist-netting or acoustic should be made with consideration to the project area and the total number of high-quality survey sites of each survey method available for the species (i.e., IBAT and/or NLEB) the survey is being conducted for. Next, refer to Table 2 of the guidance and identify the highest LOE for the selected method and species' being surveyed. Finally, use the information above to calculate the total survey LOE that would be accomplished by the previously selected method at high-quality mist-net sets or acoustic locations for the proposed P/A survey.

Proportion of Effort (PoE) for combined LOE should be calculated as follows:

A. PoE using mist-netting x highest mist-netting LOE for surveyed species' = Total survey LOE in nights accomplished by mist-netting
   – or –

   PoE using acoustics x highest acoustic LOE for surveyed species' = Total survey LOE in nights accomplished by acoustics

Once the number of nights of the total survey LOE to be conducted by either method is known, then it can be used to determine the minimum required LOE for the other survey method. To calculate the necessary LOE for the second survey method, simply subtract the calculated PoE (see A, above)

from 1 and multiply that proportion by the highest overall LOE for the second method for the species' being surveyed from Table 2.

B. (1 - PoE used in A, above) x highest overall species LOE prescribed for the method not used in A = Total number of survey nights necessary to meet the recommended LOE using the second method.
C. Round nights calculated in A and B up to nearest whole number.

**EXAMPLE:** The construction of a new bourbon distribution center (non-linear project) in KY falls within the range of IBAT and NLEB according to IPaC. A Phase 1 Habitat Assessment (see Appendix A) determined that 95 acres of suitable habitat for both species would be permanently removed to construct the project. The permitted bat biologist contracted to complete the P/A survey calculated that 35% of the project area could be surveyed with high-quality mist-netting set-ups. Using the simple equation in A above, a total of 3 nights of mist-netting effort (0.35 x 6 = 2.1; rounded up) are recommended for this project impacting under 123 acres of suitable habitat. Using equation B above, the proposed project would need a total of 10 nights of acoustic effort ([1 – 0.35] x 14 = 9.10; rounded up) for the proposed project.

For the USFWS to approve a combined mist-netting and acoustic survey, the survey must be completed as described below:

1) There must be a minimum of two mist-net sets and two acoustic locations proposed in the study plan and surveyed to be accepted by the USFWS FO(s).

2) Each mist-netting set may only be surveyed two nights (either consecutive or otherwise) if a combined mist-netting/acoustic survey is proposed.

3) Surveyors should distribute mist-netting sets and acoustic locations throughout the project area or adjacent habitats. In most cases, net sets and acoustic locations should be at least 656 feet (200 meters) apart. If closer spacing is determined to be necessary or beneficial (e.g., multiple suitable habitats and acoustic sites immediately adjacent to each other), sufficient justification must be provided in the study plan, approved by the USFWS FO(s), and submitted as part of the survey report to the USFWS FO(s).

4) The combined mist-netting and acoustic survey, including the calculation of LOEs for each method, must be proposed and submitted for approval to the USFWS FO(s) with the study plan. The study plan must also include written justification for the use of the mixed effort including how the proposal will lead to improved survey quality. The mixed LOE may be adjusted before the beginning of the survey with written approval from the USFWS FO(s); however, no modifications are allowed once the survey has started.

5) Because the combined approach represents a single LOE for individual project areas, under no scenario can a surveyor use either mist-netting or acoustic Phase 2 surveys to challenge the other methods results. If a species is documented to be present with one method but not the other, then the USFWS FO(s) will still consider it present in the context of a subsequent consultation or other decision-making process.

6) Except for 1-5 above, all other guidance provided in Appendices B and C apply to individual mist-netting sets and acoustic locations under this combined survey approach.

## REFERENCES

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Murray, K.L., E.R. Britzke, B. Hadley, and L.W. Robbins. 1999. Surveying bat communities: a comparison between mist nets and the Anabat II bat detector system. Acta Chiropterologica 1(1):105-111.

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# APPENDIX J: GUIDANCE FOR SURVEYING YEAR-ROUND ACTIVE NLEBs

A portion of the NLEB's range overlaps with coastal areas of the eastern and southern U.S. where NLEB behavior, habits and habitat use differ significantly from the rest of the species' range. Bats may be active in these areas (see Figure 3) at any time of year and have not been documented utilizing traditional hibernation strategies found in the rest of the species range. Because of this, the USFWS collated and analyzed mist-netting data from local partners and worked with USGS and Virginia Tech to calculate year-round active NLEB minimum recommended LOE for mist-net surveys to provide expanded survey opportunities where allowed (also see Armstrong et al. 2023). Both acoustic and mist-netting techniques may be used in this region as a presence/probable absence method (Phase 2 surveys). Alternatively, mist-netting can be conducted for the purpose of attempting to capture NLEBs after detection during acoustic presence/probable absence surveys (Phase 3 surveys). The same recommendations (e.g., habitat assessments, personnel, coordination with USFWS FOs, nightly survey period, equipment, net/detector placement, checking nets, weather and other environmental conditions (temperature and precipitation), analysis of recorded echolocation calls, radio-tracking, emergence surveys, linear project guidance, outer-tier guidance, etc.) provided in other guidance appendices apply for either use of mist-netting or acoustics in the year-round active portion of the NLEB's range unless specifically addressed below.

NOTE: These protocols can also be used for tricolored bat (TCB) presence/probable absence surveys using the year-round active NLEB level of effort (LOE) for the 2023 field season in portions of the TCB range that the species is also considered to be year-round active. Coordinate with the local USFWS FO(s) if you are proposing to use this guidance to survey for TCB to determine which LOE is appropriate for the specific project area.

### SURVEY SEASON FOR YEAR-ROUND ACTIVE NLEBs: March 1 – November 15

While NLEBs may be captured in every month of the year in occupied coastal plain regions, the late fall/early winter is not an optimal time to conduct surveys because of lower and inconsistent temperatures as well as reduced availability of insect prey. Capture of reproductive adult females[82] (i.e., pregnant, lactating, or post-lactating) and/or young of the year between March 1 – November 15 confirms year-round presence of NLEB and the presence of a maternity colony in the area. Since adult males and non-reproductive females have commonly been found summering with maternity colonies, radio-tracking results will be relied upon to help determine the presence or absence of a maternity colony or large concentrations of bats in the area when only males and/or non-reproductive

[82] We recognize that the reproductive condition of captured female NLEBs in early spring may not be possible; however, available data indicates NLEBs are not migrating to different areas from summer to winter so it is likely many of those adult females are indicative of the presence of maternity colonies.

females are captured. Likewise, detection of NLEBs using acoustic equipment and approved[83] software program(s) confirms year-round presence in the project area.

## MINIMUM PRESENCE/ABSENCE LEVEL OF EFFORT

The level of mist-netting or acoustic survey effort required for a project in the year-round active portion of the NLEB range will be dependent upon the overall acreage of suitable habitat that may be impacted by the action (directly or indirectly). To determine the survey effort, quantify the amount of suitable habitat within the project area. For projects where impacts other than tree removal are likely (e.g., collisions with infrastructure), ensure that presence/probable absence surveys are designed to cover all suitable habitat within the entire project area (where exposure to any kind of impacts may be anticipated) and NOT just the locations where tree removal is planned. Additional guidance for linear projects is available in Appendix F.

### Year-Round Active NLEB Mist-netting LOE: (also see Figure 1 and Table 2)

Linear projects: a minimum of 2 net nights per km (0.6 miles) of suitable habitat (see Appendix F).

Non-linear projects: a minimum of 6 net nights per 123 acres (0.5 km2) of suitable habitat.

After 2 consecutive nights of netting at the same location without capturing target species, you must change net locations or wait at least 2 calendar nights before resuming netting at the same location.

a) If no capture of NLEB(s), then no further surveys are recommended.

b) If capture of NLEB(s), then stop or proceed to Phase 4 as previously decided in coordination with the FO.

### Range-wide NLEB Acoustic LOE: (also see Figure 1 and Table 2)

Linear projects: a minimum of 4 detector nights per km (0.6 miles) of suitable habitat (see Appendix F).

Non-linear projects: a minimum of 14 detector nights per 123 acres (0.5 km2) of suitable habitat.

[83] For surveyors planning optional TCB P/A acoustic surveys in western states where the TCB range overlaps with western bat species and TCBs are year-round active for 2023, note that no acoustic ID software programs are approved for this portion of the TCB range. Refer to optional TCB survey guidance (see FAQ) and use of candidate software programs for 2023.

A minimum of 2 detector locations per 123 acre "site" shall be sampled until at least 14 detector nights has been completed over the course of at least 2 calendar nights (may be consecutive).

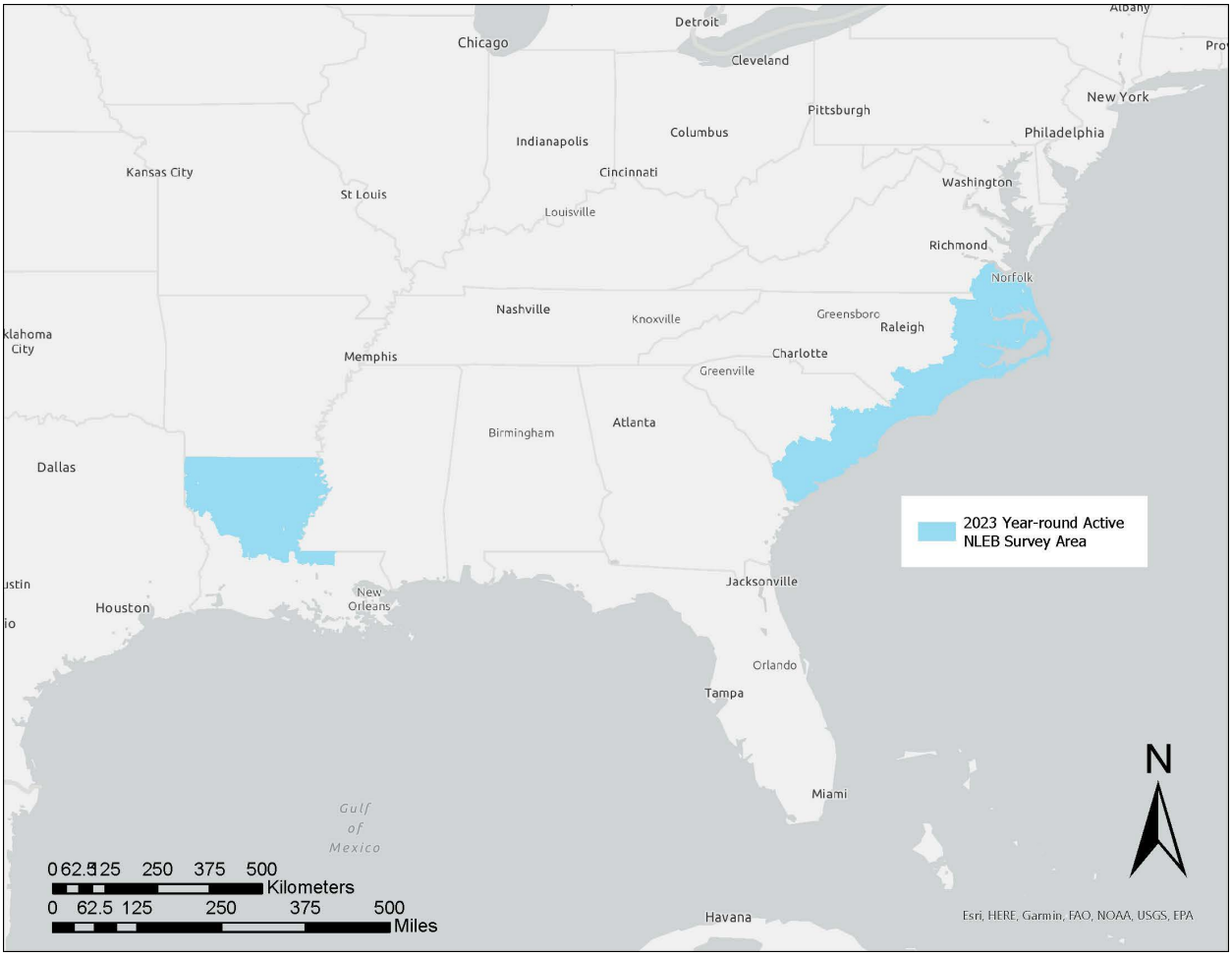


Figure 3. Areas delineated for use of year-round active NLEB survey guidance in 2023.

# APPENDIX K: GLOSSARY OF TERMS

**Above ground level (AGL) –** height at which an acoustic detector microphone is elevated above the top of ground-level vegetation present at the detector deployment location.

**Acoustic bat survey** – bat sampling conducted through recording and analyzing echolocation calls.

**Acoustic location** – actual site where an acoustic detector and microphone is deployed; multiple acoustic locations may be used for a full acoustic bat survey.

**Approved software program** - bat acoustic program (see also *automated bat call ID software*) approved through the USFWS software testing procedures for stand-alone use in presence/probable absence surveys for Indiana bat and/or northern long-eared bat.

**Automated bat call ID software** – a form of echolocation identification in which recorded files are filtered and identified within a software program; the program compares the statistical properties of a recorded call to a library of known calls to classify to species.

**Bat detector** – equipment capable of detecting ultrasonic echolocation calls of bats that are above the range of human hearing.

**Call quality** – how closely the sequence matches typical search-phase behavior for the species.

**Call sequence** – a series of bat echolocation call pulses.

**Candidate software program** – bat acoustic program (see also *automated bat call ID software*) submitted to USFWS for software testing, but not yet approved for stand-alone use in presence/probable absence surveys for Indiana bat and/or northern long-eared bat.

**Clutter** –obstacles present in an area that can affect recording of bat echolocation calls; may be caused by either scattering echolocation calls from sound bouncing off obstacles (thereby reducing call quality) or by bats adjusting their normal search phase calls in response to additional obstacles resulting in changed bat echolocation call parameters.

**Detection probability** – the likelihood of detecting the presence of a species when that species is present.

**Detector sensitivity** – measures the ability of a bat detector to detect an echolocation call.

**Detector** - see *bat detector*.

**Directional microphone** – a microphone that is more sensitive to sound arriving from certain directions; compared to omni-directional, may detect sounds from a further distance away, but within a narrower cone of detection.

**Echolocation** – use of ultrasound and the returning echoes to orient and navigate in the environment.

**Emergence survey –** a survey method that involves visually counting bats that emerge from a known or suspected roost; usually conducted in early evening (e.g., 30 minutes before sunset) when bats exit to forage.

**False negative** – the failure to detect a bat species when it is present in the area; statistically a type II error in hypothesis testing.

**Frequency filter** – pre-programmed range of sound frequencies (in kHz) set for acoustic bat detectors to record.

**Full-spectrum detector** – bat detectors in which all desirable information about the recorded sound is preserved, including time, frequency, and amplitude.

**Harp-trapping –** capture method by which a device (harp-trap) composed of a metal frame, multiple strands of equally-spaced nylon strings, and a catch bag at the bottom, is deployed near the entrances of caves, cave-like openings, and mines. Bats are captured as they exit a restricted opening to forage.

**Hemispherical microphone** – see *omni-directional microphone*.

**Hibernaculum (*pl.* "hibernacula")** – a thermally-stable roost used by bats for extended periods of torpor during winter. Typically, a cave, natural cave-like feature (e.g., sinkhole, fissure, talus opening, etc.), or anthropogenic structure (e.g., mine, tunnel, bridge, etc.).

**High-frequency calls** – a general classification of calls that refers to those with minimum frequencies >35 - 40 kilohertz.

**Kilohertz (kHz)** – a unit of measure of the frequency of sound; one thousand hertz.

**Level-of-effort (LOE) –** Minimum number of survey nights required (using a particular survey methodology) to determine probable absence of a target bat species; statistically set at a particular confidence level (e.g., 90%, 95%, etc. – depending upon species and region) by USFWS.

**Linear project –** a project with a footprint greater in length than width (e.g., pipeline, roadway, or right-of-way) with ≥ 1 km (0.6 mi) of suitable habitat; may contain contiguous and fragmented patches of suitable habitat, but only segments at least ≥ 1 km in length can be considered for presence/probable absence survey sites.

**Manual-vetting** – see *qualitative call identification*.

**Maximum-Likelihood Estimate (MLE)** – a statistical method of estimating the parameters of a statistical model. For our purposes, the MLE is a statistical method that can be used to determine species presence or probable absence at a particular site on a particular night by means of a classification matrix.

**Microphone sensitivity** – the minimal amplitude required at a given frequency for a microphone to detect a sound.

**Microphone orientation** – the direction in which the microphone is pointing' thereby affecting the cone of detection.

**Mist-netting** – survey technique that uses low-visibility, mesh nets affixed between two poles to capture foraging bats in areas of increased activity (e.g., travel corridors, ponds, etc.)

**Net set** – one mist-net deployment consisting of two poles and typically from 1-3 affixed mist-nets stacked onto one another. A typical net set is at least 5 m to 9 m high consisting of two or more nets stacked on top of one another (without gaps) and from 6 m to 18 m wide.

**Net site** – see *site*.

**Noise** – unwanted or extraneous environmental sound or electronic interference detected by a bat detector.

**Non-linear project** – any project generally not linear in nature or linear and < 1 km in length; may contain contiguous and fragmented patches of suitable habitat, but only blocks ≤ 123 acres can be considered for presence/probable absence survey sites.

**North American Bat Monitoring Program (NABat)** – A multi-national, multi-agency coordinated bat monitoring program across North America that was created to monitor bats at local to rangewide scales. It incorporates winter hibernaculum counts, maternity colony counts, mobile acoustic surveys, and stationary acoustic surveys (https://www.nabatmonitoring.org).

**Omni-directional microphone** – a microphone that can detect equally in all directions (e.g., has a spherical cone of detection). Hemispherical microphones are a type of omni-directional microphone.

**Out-tier project guidance** – a USFWS discretionary survey guidance scenario that can be applied when an Indiana and/or northern long-eared bat has been captured or acoustically-detected, but no known roosting areas have been identified. Under "out-tier" guidance, 2.5 and 5-mile or 1.5 and 3.0-mile buffers are placed around the Indiana bat or northern long-eared bat capture or detection location. Surveyors are allowed to perform a standard P/A survey to help refine a maternity colony's true location and/or document roost trees if the project area is more than 2.5 or 1.5 (for NLEB) miles away from the Indiana bat capture/detection site, but within the 5- or 3-mile (for NLEB) buffer.

**Pass** – a single crossing of a bat through a bat detector's cone of detection; see *call sequence*.

**Probable absence** – using the appropriate Level of Effort (LOE), a determination that survey protocols are not 100% likely to detect IBAT or NLEB when present and that identification errors may occur.

**Pulse** – a brief, continuous emission of sound; see *call sequence*.

**Qualified biologist –** For activities involving the handling of bats, an individual who holds a USFWS Section 10(a)(1)(A) Recovery Permit (Federal Fish and Wildlife Permit) for federally-listed bats in the state/region in which they are surveying. For qualitative analysis of acoustics, an individual that has completed one or more of available bat acoustics trainings/workshops and/or able to show similar on-the-job or academic experience; furthermore, have demonstrated multiple years of experience in 1) gathering known calls of the target species, 2) have identified bat calls recorded in numerous habitat types, 3) are familiar with species likely to be encountered within the project area, and 4) must have stayed current with qualitative identification of bat calls.

**Qualitative call identification** – identification of call sequences through visual comparison with a known call library. Qualitative analysis must also include and present within a written report a comparison of the results of each acoustic ID program by site and night. Qualitative analysis of each acoustic site and night with probable detections of IBAT and/or NLEB should include the entire night's high frequency call data, including "no ID" files, and not just those files making it through the acoustic analysis tools as probable IBAT and/or NLEB; accuracy can be highly variable based on researcher experience; also referred to by some as manual vetting (see *qualified biologist*).

**Roost tree** – A live or dead standing tree (snag) occupied by one or more bats. Throughout most of the Indiana bat and northern long-eared bat range, trees are typically occupied by bats outside of the hibernation period (spring, summer, fall), although see Appendix J regarding year-round active populations.

**Roost** – see *roost tree*.

**Site** – an area containing one or more individual net sets or harp traps in relatively close proximity that can be efficiently walked to and checked by a survey team (typically two people) within a 10-minute window from a central bat-processing location.

**Ultrasonic/ultrasound** – sounds made of frequencies that are beyond the range of human hearing (often arbitrarily set at 20 kilohertz, although most adults have trouble hearing sounds above 15 kHz.)

**Weather proofing** – various methods/materials used to protect a bat detector/microphone from the elements (primarily rain).

**Winter habitat** – see *hibernaculum*.

**Zero-crossing detector** – a detector type that calculates frequencies by measuring the time between moments of zero sound pressure, which corresponds to the period of the wave.