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Sanders Environmental Inc.

March 8, 2013

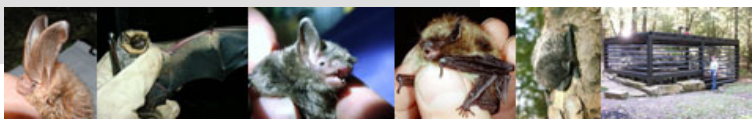
To whom it may concern,

Sanders Environmental is pleased to share some comments on the January 9th 2013 version of the USFWS Rangewide Indiana Bat Summer Survey Guidance Draft and associated documents.

This document is divided into several sections. First, we provide a detailed breakdown of the guidelines and our specific comments regarding this document. Second, we provide comments on the Acoustic Program Draft Test Criteria. Third, with the aid of the Penn State Statistical Consulting Center we provide an evaluation of the Maxium Likelihood Estimator. To conclude, we provide a list of potential options for the 2013 Contingency Plan and our professional opinions as to how the 2013 Contingency Plan could be implemented.

To summarize who we are and why are qualified both to review this document and to make the statements that we do; we are a firm that specializes in bats, mainly Indiana bat sampling. We have done a number of acoustic projects (though we are more experienced with long-term monitoring of bat activity/ guilds than Indiana bat presence/absence). When statements in this document start with 'I', those statements are directly from Chris Sanders, the owner/ president of the company. I've been working with bats since 1995 and, despite running one of the larger suppliers of Indiana bat services, I have consistently stayed in the field and continue to do 60-80 days per year of field work in the 90 day summer season as well as quite a bit of field work in the off season. I have approximately 1,000 nights of mist net sampling (not net nights or site nights, but actual nights in the field) within the range of the Indiana bat. As a company, we have sampled from 130-450 net sites per summer since 2000. We are a small, flexible company that can readily adapt to a new acoustic-based protocol. Reviewing this protocol has resulted in all of us here at Sanders Environmental embarking on an extensive refresher course in acoustic technology, literature and its implementation.

The literature cited was limited, and most of the serious citations stemmed from one cohort of writers (Gannon, Robbins, Britzke, and O'Farrell) while many of the other "references" provided fluff citations (e.g, "Researchers should be prepared to cut the net if a bat is severely entangled"). A more thorough literature search and many more citations supporting the acoustics this protocol relies on should be provided.

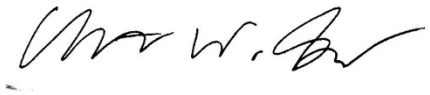


It's also worth noting that we see several avenues of abuse of this protocol which are likely to occur. As there is and can be no permit for listening in the woods (i.e., acoustic surveys), developers are under no legal compulsion to submit positive *sodalis* detections. Consultants are generally legally bound by confidentiality agreements to developers, so they could not report positive detections directly. Although we are sure that most project proponents would promptly report detection, some will not and will attempt a second round of sampling (maybe with a less diligent consultant, potentially in a different year/part of the accepted season) to get a presence-free survey. As the call analysis is completely automated and detector placement is not rocket science, anyone can buy a detector and place it in the woods. It seems quite likely, based on what we know of the software to be used, that if you record long enough, a false positive will pop-up. Many project opposition groups may do the same near planned projects. Also, bat calls can be played in their native frequencies with fairly affordable devices. Project opponents could very well play calls into a detector/near a detector to register false positives. The abuse/false call would be detectable if recorded on a full spectrum detector, but would be unlikely to be detected as false if recorded in zero crossing format.

A FAQ document was included with this release. Although we think a FAQ is a great place to clarify intent and to answer questions that inevitably arise between release of a protocol and a new version, most of the items currently covered in that 19 page document should have been clarified in the protocol and not addressed in a separate document. As it stands now, a reader has to switch back and forth each time a question arises to see where or if there has been a clarification. At a bare minimum the protocol should have a reference at each place the FAQ clarifies the protocol so one knows where/when to look to that resource.

Most importantly, as of the time of publication, NO TOOL EXISTS TO PERFORM ACOUSTIC IDENTIFICATION QUALITATIVLY. This makes the entire protocol moot. The protocol should reflect the capabilities of the tool, not the capabilities someone wishes the tool has. How this tool should be used would be widely different depending on its false positive or false negative rate. We firmly believe that until the actual software to be used to determine presence is available to the bat community for testing, this comment period, release and reliance of a protocol based on that (non-existent) tool is premature. Without a thoroughly cross validated automated identification tool released many months in advance of the season it is to be implemented in, acoustics should not be used to determine presence of Indiana bats.

Sincerely,



Christopher Sanders
President

DRAFT REVISED RANGEWIDE INDIANA BAT SUMMER SURVEY GUIDELINES
January 2013

The following guidance is designed to provide standardized, rangewide guidelines and protocols and to determine whether Indiana bats (*Myotis sodalis*) are present or likely absent at a given site during the summer (May 15 to August 15). The following phased approach, which includes habitat assessments, as well as acoustic, mist-net, radio-tracking, and emergence surveys, once finalized, will supersede the 2007 Indiana Bat Mist-Netting Guidelines. Future changes to this guidance are likely and will be posted on the U.S. Fish and Wildlife Service's (USFWS) Indiana bat website (http://www.fws.gov/midwest/Endangered/mammals/inba/index.html). Please check this website to ensure use of the most current version of the guidance.

GENERAL PROCESS

The following guidance was designed in an attempt to determine presence or probable absence of Indiana bats in an area of interest but are not intended to be rigorous enough to provide sufficient data to fully determine population size or structure. Following this guidance will help: 1) standardize range-wide survey procedures; 2) maximize the potential for detection/capture of Indiana bats at a minimum acceptable level of effort; and 3) ensure that survey results are sufficient to be accepted by the USFWS for regulatory purposes. Although acoustic detections and/or capture of Indiana bats confirm their presence, failure to acoustically detect or catch them does not absolutely confirm their absence (i.e., no currently-available bat survey techniques provide 100% detection).

As a reminder, the first step for determining presence of Indiana bats at a given site is to determine whether there is any existing occurrence data available for the vicinity of the project. Project sponsors should coordinate with the USFWS Ecological Services Field Office (USFWS FO) and state natural resource agency for information on known occurrence locations. Please note that survey guidelines may be modified in areas that are already known to be occupied by Indiana bats during part of the year (i.e., spring staging, summer, fall swarming, and/or winter).

Indiana bat surveys for some proposed projects will require modification (or clarification) of this guidance. These situations must be resolved through coordination with the USFWS FO responsible for the state in which the project occurs. Consultation with the USFWS FO is always recommended and may be required by federal permits. Implementing this survey guidance without prior coordination with the USFWS FO may result in invalid or unacceptable conclusions for regulatory purposes. An online directory of USFWS FO(s) is available at http://www.fws.gov/offices/directory/listofficemap.html. Unless otherwise agreed to by the USFWS, negative acoustic survey results obtained using this guidance are valid for two years[1] from the completion of the acoustic survey.

-- How is this going to be enforced/regulated? Work under most NPDES permits happens over a period of time significantly longer than 2 years. Are you going to ask

permitting agencies to expire these permits two years after sampling concludes? Bat survey is generally early in the design process of a project/E&S measures. A permit may not even be applied for several months after sampling is completed and may be 90 or so days from then to issuance, giving many projects only around a year until bat surveys expire - far less than is needed to complete construction. Is that realistic? Should a highway or pipeline quit construction a year after breaking ground at one end to resample for bats?

[1] The timeframe may be reduced if significant habitat changes have occurred in the area.

Both acoustic and mist-net surveys should be conducted in the best suitable habitat possible for each survey type to increase the likelihood of detecting/capturing Indiana bats. In some cases, the most suitable habitat for effectively conducting surveys may occur outside a project site boundary and may be sampled. However, if proposed sample sites are more than 1,000 feet (305 meters) from the project site boundary, then the USFWS FO should be consulted.

> -- As the netting section requests that netting be conducted in a mile radius, this sentence should be clarified that it applies only to acoustic surveys unless that really applies to netting as well. If it does apply to netting, it should be mentioned again in the netting section.

All efforts should be made to coordinate with adjacent landowners to obtain appropriate authorizations and to ensure the best possible sites are surveyed.

> -- Define "all efforts." What needs to be documented? Signatures from landowners saying we can't access sampling sites off a project?

There are four phases of surveys in this guidance, each dependent upon positive results of the prior phase (see Figures 1 and 2):

- Phase 1- Summer Habitat Assessments
- Phase 2- Acoustic Surveys
- Phase 3- Mist-net Surveys
- Phase 4- Radio-tracking and Emergence Surveys

Figure 1. Indiana Bat Survey Guidance Decision Tree for Phase 1

PHASE 1 – SUMMER HABITAT ASSESSMENTS

After coordinating with the USFWS FO to determine known Indiana bat occurrences, the next step in determining whether Indiana bats may be present at a given site is to assess whether there is any suitable Indiana bat summer habitat present.

> -- On most projects in the east, this is as simple as looking at aerial photos/ GIS and seeing that there will be forest removal. Why go through this assessment? If a project proponent can skip netting and assume a maternity colony is present, why not make the protocol more efficient by assuming presence of habitat and moving directly to an acoustic study plan? What is really required by this section? If we can determine habitat via desktop review can we stop there? How frequently is the datasheet to be used? What area does the datasheet have to cover? The whole project area or can a few plots be used to figure roost density? It could be interpreted that every roost on the project area needs to be counted or that this can be done from a desktop GIS review. What you want is very hard to understand from this section. The FAQ didn't answer the basic question: What do you want?

Habitat assessments can be completed any time of the year and ideally would be submitted to the USFWS FO(s) for review and approval well in advance of the summer survey period. Habitat assessments should be conducted for any projects that have the potential to impact Indiana bats within areas identified by the USFWS as being within the range of the Indiana bat: (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A000).

Suitable summer habitat for Indiana bats consists of the variety of forested/wooded habitats where they roost, forage, and travel, as well as surrounding non-forested habitats (e.g., agricultural fields, emergent wetlands, old fields, pasture). This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags greater than 3 inches[2] (7.6 centimeters) diameter-at-breast-height (dbh) that have exfoliating bark, cracks, crevices, and/or hollows), as well as linear features such as fencerows, riparian forests, and other wooded corridors. Habitat assessment guidelines are in Appendix A.

If there is no suitable Indiana bat summer habitat present in the project area, no summer surveys for Indiana bats are necessary. If there is any suitable habitat, coordinate with the USFWS FO(s) regarding any impacts assessments for the proposed project. In addition, further coordination with the USFWS FO(s) may be necessary if known or potential migrating, swarming, or hibernating habitat is present in the project area.
If suitable Indiana bat summer habitat is present, proceed to Phase 2- Acoustic Surveys and submit the habitat assessment report and draft study plan for conducting acoustic surveys to the USFWS FO(s) for review and concurrence. Project modifications (e.g., inclusion of appropriate avoidance and minimization measures) may be possible at this phase in consultation with the USFWS FO(s) so that no additional surveys are needed.

> -- What would constitute "appropriate avoidance"? To make this protocol vaguely standardized rangewide, this must be well-understood by all involved (both the applicants and administrators of this protocol). The current method of avoidance is winter clearing. When this is occasionally done it seems reasonable, however if critical habitat (maternity roost trees) were removed in winter, there would undeniably be take. If this protocol is attempting to shift all clearing to winter, with no surveys or mitigation, it is clearly acting against ESA protections for this species.

[2] While any tree greater than 3 inches dbh (7.6 centimeters) with exfoliating bark, cracks, crevices, and/or hollows has the potential to be male Indiana bat summer roosting habitat, even-aged stands of 3-inch dbh and smaller trees are not defined as suitable roosting habitat for the purposes of this guidance. Suitable roosting habitat is defined as forest patches with trees of greater than or equal to 5 inches dbh (12.7 centimeters), although trees as small as 3 inches within the forest patch(es) may also be included.

Figure 2. Indiana Bat Survey Guidance Decision Tree Phase 2-4

PHASE 2 - ACOUSTIC SURVEYS

> -- Each time "acoustic surveys indicate" or "acoustic results show" or similar is used. Please change to "maximum likelihood estimator" indicates, shows, results. The MLE results vs the actual acoustic identifications is going to be a bit confusing under the best of conditions, so the protocols wording should be very specific. Those instances are highlighted below.

Acoustic surveys can be completed between May 15 and August 15 to determine whether Indiana bats may be present on-site, following the protocol described in Appendix B. If the acoustic surveys do not indicate that Indiana bats are present, no further summer surveys are needed.

Submit negative results of the surveys to the local USFWS FO(s) for review and concurrence.

If the acoustic surveys indicate that Indiana bats are present, then the project proponent should mist-net in an attempt to capture recorded bats, although the option exists to assume the presence of a maternity colony without additional surveys.

-- This indicates only one maternity colony will be assumed regardless of the acoustic results. Change to…of a maternity colony(ies)…

It is advantageous for project proponents to have biologists capture, track, and count Indiana bats initially detected with acoustics. The resulting information collected from radio-tagged bats greatly improves the USFWS's understanding about the type and level of bat presence (i.e., maternity or non-maternity) and their use of an area (e.g., focal roost sites), which facilitates the design of appropriate conservation measures and ultimately the analysis of project effects on the species. For example, evidence suggesting that maternity roosts are located off-site will typically benefit a project [5] proponent. If mist-netting is not conducted and no additional site-specific data are generated, then the USFWS FO(s) will have to assume a reasonable worst-case scenario (e.g., presence of a maternity colony(ies) roosting within suitable habitat within the middle of the project area boundary), and therefore, will require the most conservative measures for the protection of the species.

If the acoustic survey results indicate that Indiana bats are present, and the project proponent wishes to conduct mist-netting to better determine the use of the site by Indiana bats, then it is recommended that the project proponent prepare and submit a draft Phase 3/4 study plan to the local USFWS FO concurrent with the acoustic survey report. Although mist-netting does not have to be completed during the same field season as the acoustics, it is recommended to do so, and applicants would need to plan ahead accordingly to accomplish it.

PHASE 3- MIST-NETTING AND PHASE 4- RADIO-TRACKING/ EMERGENCE SURVEYS
Mist-netting should be completed between May 15[3] and August 15 in project areas previously confirmed as Indiana bat habitat by means of acoustic surveys. Mist-netting is designed to capture Indiana bats so that their gender, age, and reproductive condition can be determined. Additionally, captured bats may be banded (not required by USFWS; contact the applicable state natural resource permitting agency for banding recommendations/requirements) and have radio transmitters attached (as required). Mist-netting guidelines are contained in Appendix C.

If an Indiana bat(s) is captured during mist-netting, protocols for Phase 4- Radio-tracking and Emergence Surveys provided in Appendix D and E, respectively, must be followed. Radio-tracking and emergence surveys can provide vital data regarding roosting habitat and colony size. Emergence surveys should begin as soon as feasible after identification of a roost, preferably the same night.

If Indiana bats are not captured during mist-netting, coordinate with the local USFWS FO to determine which type of Indiana bat population (i.e., maternity colony or males) is likely to use the project site.

-- This is vague. What is the criteria for determining this?

--Also, the examples should be changed to "(e.g., maternity colony, males, or false acoustic positive)."

If a maternity colony is assumed to be present, buffer positive acoustic survey sites by an assumed 5-mile (8-kilometer) radius home range.

If positive acoustic results are obtained at sites located more than 5 miles apart, then multiple maternity colonies generally will be assumed present, but other factors will also be considered (e.g., spatial distribution of positive acoustic sites in conjunction with available summer habitat). Submit the results of all field work conducted for a project to the local USFWS FO(s) for review. The USFWS FO(s) will use this information in an analysis of effects (e.g., analysis of habitat quality or juxtaposition). [6]

NOTIFICATION/COORDINATION:

All work must be conducted in accordance with applicable federal and state endangered species permits.

-- Consider changing to…. "All phase 3 and 4 work must…" as phase 1 and 2 cannot have permits.

Following this guidance will meet USFWS requirements; however, surveyors also need to ensure they meet all applicable state permitting and reporting requirements. Failure to follow the survey guidance,

-- Please consider adding "or a study plan which has received concurrence from the local FO" that would clearly indicate the local FO has liberty to specify/clarify survey efforts.

as written, may result in USFWS FO recommendations for additional survey effort.

3 Due to concerns with transmission of white-nose syndrome, some USFWS FO(s) and state natural resource agencies have delayed the start of the Indiana bat summer field survey season/mist-netting until June 1. Surveyors/applicants should always coordinate with local USFWS FO(s) and state natural resource agencies before beginning surveys.

APPENDIX A PHASE 1 SUMMER HABITAT ASSESSMENTS

--This section does not really explain how to complete the surveys. It also does not clearly state whether or not these surveys must be completed on-site or can be conducted from maps. The datasheets imply multiple sites per assessment, however it is unclear when multiple sites should be sampled, and at what scale habitats should be considered. How are location and number of sites determined? This section should more clearly outline how to collect data for the worksheet. For example, are we considering only deciduous hardwood forest and a stream that runs through it, or should we consider smaller habitat scales (e.g. low-land deciduous forest, up-land deciduous forest, small forest clearing, fast moving stream, slow moving section with pools, etc.)? We really cannot tell what you want or why you want it.

The information below is provided to assist applicants, consultants, and/or project proponents (hereinafter termed the "applicant") in establishing whether summer surveys for Indiana bats should be conducted. As a reminder, the first step for determining presence of Indiana bats at a given site is to determine whether there is any existing occurrence data available for the vicinity of the project from the local USFWS FO. The applicant is responsible for developing and providing sufficient information as to whether potentially suitable summer Indiana bat habitat exists within a proposed project area (see attached Indiana Bat Habitat Assessment Datasheet). If suitable habitat is present, the applicant should calculate the amount present and submit this to the USFWS FO(s) with a proposed Phase 2 acoustic survey study plan. If no suitable habitat is present, no surveys are needed to assess risk during the summer. **Habitat assessments for Indiana bats can be completed any time of year and applicants are encouraged to submit results prior to the summer survey season.**

-- Why would this be required for a project that wanted to assume habitat presence?

PERSONNEL

Habitat assessments should be completed by individuals with a natural resource degree or equivalent work experience.

DEFINITION FOR POTENTIALLY SUITABLE SUMMER HABITAT

Suitable summer habitat for Indiana bats consists of the variety of forested/wooded habitats where they roost, forage, and travel as well as surrounding non-forested habitats (e.g., agricultural fields, emergent wetlands, old fields, pasture). This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags greater than 3 inches dbh[4] (7.6 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 considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of other suitable habitat.

[4] While any tree greater than 3 inches dbh (7.6 centimeters) with exfoliating bark, cracks, crevices, and/or hollows has the potential to be male Indiana bat summer roosting habitat, even-aged stands of 3-inch dbh and smaller trees are not defined as suitable roosting habitat for the purposes of this guidance. Suitable roosting habitat is defined as forest patches with trees of 5-inch dbh (12.7 centimeters) or larger, although trees as small as 3 inches within the forest patch(es) may also be included.

-- This footnote makes it seem like every tree on a project area between 3-5in dbh needs to be checked for exfoliating bark, cracks etc. That would be a monumental task. Please clarify.

--"forest patches" conflicts with "Individual trees may be considered suitable habitat" in the definition in the text body. The last sentence in the footnote probably should be integrated in the body and not part of a footnote.

SUBMISSION OF HABITAT ASSESSMENT AND PHASE 2 STUDY PLAN (IF NEEDED)

If a proposed project may affect (positively or negatively) Indiana bats, a habitat assessment report should be submitted to the appropriate USFWS FO(s) along with a draft study plan

for the acoustic survey (if suitable habitat is present). Complete 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 clearly identifying the project location and boundaries
3. A detailed project description
4. Documentation of any known-occupied spring staging, summer, fall swarming, and/or winter habitat for Indiana bats within the project area
5. A description of methods used during the habitat assessment
6. A summary of the assessment findings and a completed Indiana Bat Habitat Assessment Datasheet (see attached below; use of this particular datasheet is optional)

> -- The datasheet is lengthy, detailed, and complicated. If it is not required, a list of exactly what NEEDS to be included should be provided. Why would we spend time counting trees etc if we only are only attempting reach a yes/no conclusion?

7. Other information that may have a bearing on Indiana bat 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. Any other information requested by the local USFWS FO(s) related to the project
9. If a Phase 1- Habitat Assessment confirmed the presence of suitable Indiana bat habitat and an acoustic survey is planned, then submit a draft study plan for a Phase 2- Acoustic Survey to the USFWS FO(s) for review and approval. Phase 2 study plans should include a map/aerial photo identifying the proposed project area boundaries, suitable bat habitats and acreages within the project area, and the proposed number and tentative locations of acoustic monitoring sites (see Appendix B for level of effort).

> -- This is a list of items that must be in a habitat assessment report. Most of number 9 is a Phase 2 study plan. It should not be in this numbered list.

10. Some federal and state permit holders[5] are required by his or her permit to request and receive written authorization from the local USFWS FO(s) at least 15 days prior to initiation of proposed survey work. These requests should be submitted in conjunction with the draft study plan for acoustic surveys.

> -- Till we get to phase 3 and 4 there are no permits. Please consider deleting #10 as it adds confusion as it does not apply to Phase 1 or 2.

[5] Federal permits are not required for individuals to complete Phase 1 Habitat Assessments.

APPENDIX B PHASE 2 ACOUSTIC SURVEYS

SUMMER ACOUSTIC SURVEY SEASON: May 15 – August 15

> --This section tends to try to micro manage how, when, and where detectors are used and the language used raises many questions. Please consider just setting a target

sample and leave the details to surveyors to figure out how to achieve that sample. Give a list of citations for people to reference if they need extra guidance, but avoid micro managing.

PERSONNEL

Acoustic surveyors must have a working knowledge of the acoustic equipment, analysis tools, and Indiana bat ecology.

-- How is "working knowledge" defined?

Surveyors must be able to identify appropriate detector placement sites and establish those sites in the areas that are most suitable for recording high-quality Indiana bat 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.

DETECTOR AND MICROPHONE REQUIRED CHARACTERISTICS

Full-spectrum and/or zero-crossing detectors are suitable for use in this survey protocol. Directional microphones are the only microphone type accepted for acoustic surveys at this time.

--Some manufactures are using omnidirectional microphones with cones slide over the end to make them "directional", is this type of microphone acceptable? Be clear about what is acceptable.

ACOUSTIC SAMPLING PROTOCOL

Detector Placement

--This section does not mention how important it is to "camouflage" the detector. Bats are curious and will continually zoom the microphone instead of using their search phase calls if the detector is sitting out in plain sight.

-- This section should be about the microphone – it doesn't matter where the detector is. I understand what is trying to be said and using the word "detector" to encompass the entire recording system is fine, but clarify the language as the mic may be up in the air while the detector is inside a case on the ground.

Detector placement is critical to the successful isolation of high-quality bat calls for later analysis. The following locations are likely to be suitable sites for detectors, including, but not limited to: (a) forest-canopy openings that are no more than 164 feet (50 meters) wide; (b) 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). If detectors are placed in unsuitable locations, effective data analysis may be impossible, and the results of the sampling effort may be invalid.

-- How are "unsuitable locations" being verified? By photos? By results?

Surveyors should deploy detectors/microphones in the following manner:

-- Is this a recommendation? Is it required? If photos are reviewed and the FWS is displeased, are the results invalid even if an ideal number of bat calls is obtained?

(a) at least 5 feet (1.5 meters) in any direction from vegetation or other obstructions (Hayes 2000; Weller and Zabel 2002);

-- Why any direction? This means the microphone or detector will be completely exposed making them a hazard on human traveled corridors such as a roadway.

(b) in areas without, or with minimal[6], vegetation within 33 feet (10 meters) in front of the microphone; (c) orient detectors parallel when sampling woodland edges; (d) at least 49 feet (15 meters) from water surfaces (Johnson et al 2012);

-- The first paragraph states that "water sources" are a suitable site. This seems contradictory, as it would be difficult to sample a forested pond/stream from 49 feet away.

-- Why 49 ft(15 meters)? Does this include puddles? What scale of water sources? Is this to keep from recording poor, buzz phase,(quick pulsed) calls or about distortion from reflecting? You would just have to orient the detector at a different angle and you would still be able to take recording that are in closer proximity (less that 49 ft) to a water source. (e) I understand that high-frequency emitters(like powerlines) produce interference but being at least 100 meters from one is in some cases impossible if you doing work in an existing power line. (f) at least 15 meters from suitable roots (e.g. trees/snags…) if you in the woods then there will most likely be a lot of suitable root habitat. These deployment methods are too specific and/or too extreme. Following this, there will be few suitable locations. I understand the need for such specific guidelines but they will be impossible to follow in some cases. Considering these points, I think this is a primary example as to how an acoustic only protocol is just not effective in every scenario and therefore should not be acceptable as the primary single means to sampling a survey area.

(e) at least 328 feet (100 meters) from artificial high-frequency emitters (e.g., wind turbines, high-tensile power-lines, and micro-wave towers) (Johnson et al 2012); and (f) at least 49 feet (15 meters) from known or suitable roosts[7] (e.g., trees/snags, buildings, bridges, bat houses, cave or mine portal entrances).

-- How will it be possible to survey any areas with trees including corridors and fence rows? Especially in projects that mainly consist of forested habitat?

-- Please indicate if these distances are in the front of the microphone or in any direction from the microphone

--I feel confident in my ability to deploy detectors and record good calls. However, based on these requirements I have no idea what USFWS is really looking for as many areas are requested, then excluded. You have set a goal in terms of minimum number of calls and % identifiable. Give references as tips, but let us sample where, when, and how we can get that sample.

[6]If necessary, surveyors can remove small amounts of vegetation (e.g., small limbs, saplings) from the estimated detection cone at a site, much like what has been done while setting up mist-nets in the past. Deployment of detectors 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 cone to record high-quality calls (i.e., the vegetation is outside of the detection cone).

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

Surveyors should distribute acoustic sites throughout the project area or adjacent habitats. In most cases, detector 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 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 survey site.

> --I realize this is a recommendation – but isn't the most obvious method of recording a GPS point just having the technician/surveyor who places the detector take one? Instead of this odd description, state the level of accuracy you want. Is a 12m accuracy GPS accurate enough or are you requiring 1m mapping grade precision. This doesn't really belong in a protocol, it belongs on a datasheet.
> -- So what is accurate 15m? 50m? 1m?

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) in front of the microphone at survey start and survey finish. This documents that the equipment was working when deployed and when picked up (and by assumption throughout the entire period). Many types of detectors allow for setting timers 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 off, 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).

> -- The last two sentences conflict with the required target in another section. These statements imply that if a detector is working, but no calls were recorded re-sampling would NOT be needed.

Suitability of the selected acoustic survey sites will also be assessed in the data-analysis stage. Suitable set-up of the equipment should result in high-quality calls that are adequate for species identification. Thus, at least 10 bat calls (i.e., greater than or equal to 3 high-quality pulses in a call) must be recorded AND a minimum of 40% of all recorded bat calls must be identified to the species level for each detector on each survey night for the site to be deemed suitable. Nights of sampling at individual sites that do not meet these minimum requirements will need to be re-sampled unless adequate justification can be provided to the USFWS FO(s).

--Define "adequate justification".

Modifications of the equipment (e.g., changing the orientation) at the same location on subsequent nights may improve quantity and quality of calls 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 should be aimed 45 degrees or more above horizontal. In some circumstances (e.g., forest openings), it might be desirable to aim the detector vertically.

-- Is this required? Will results from a microphone aimed horizontally not be accepted even if they meet the data requirements?

-- If the detector and/or microphone is more than 5 feet off the ground can the angle be less than 45 degrees? Shouldn't it be under the discretion of the surveyor who is deploying the detectors to determine the proper angle to record the best calls?

This has shown to record high quality calls but precludes the use of weatherproofing for protection of the microphone, since no currently-approved weatherproofing system will adequately protect the microphone of a detector aimed vertically.

Deploy detectors at or below the lowest expected flight height of the bats but high enough above ground vegetation to avoid interference within the detection cone.

-- The lowest expected flight height is always the ground.

Once acoustic sites are identified, photographs documenting the orientation, detection cone (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.

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: (a) temperatures fall below 50°F (10°C) 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) 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.

-- We have a target goal number of calls/% identifiable. Our experience is that rainy/drippy nights drive bats into more open areas, giving us more to record where detectors can be deployed, even with reduced times that they are flying. If we can get a good sample on these nights, let us do so. Please consider deleting this whole section.

Weatherproofing

Most bat detectors are not weatherproof when delivered from the factory. Recording without after-market weatherproofing is preferred as the addition of these systems may result in some signal degradation.

For directional microphones, the use of a polyvinyl chloride (PVC) tube, 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. Attach the elbow to a weatherproof box that houses the main portion of the detector. Point the microphone into one end of the elbow and point the open end of the elbow in the direction to be monitored (generally 45 degrees to horizontal). Another 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 Service provided they show that call quality and the number of calls recorded are comparable to those without weatherproofing.

-- Why is this a requirement/ single approved method? Shouldn't whatever method the surveyor selects be acceptable so long as the data is high quality and meets the analysis standards? If we use a reflector plate and the data is not usable that's our fault and we will need to find a better way to gather the data. However if we design a new method and the quality is ideal why does it matter how we "weather proofed" our system?

MINIMUM LEVEL OF EFFORT

The number of acoustic survey sites required for a project will be dependent upon the overall acreage of suitable habitat proposed to be impacted by the action. To determine the acoustic survey effort, quantify the amount of suitable habitat within the project area. Using detection probabilities as determined in post-white-nose syndrome (WNS) environments as the baseline necessary to document Indiana bats, all projects will require (1) a minimum of two acoustic survey sites, (2) the deployment of a minimum of one detector per survey site, and (3) all sampling to be conducted for at least six suitable nights. To reduce the survey duration, additional detectors may be added at individual survey sites accordingly: 5 nights for 2 detectors per site, 4 nights for 3 detectors per site, and 3 nights for 4 detectors per site (MacKenzie and Royle 2005). The acoustic sampling period begins at sunset and ends at sunrise each night of sampling.

-- Please consider the above wording changes (in green highlight) as it is more specific. --
-- How big is a site? If a there is road running adjacent to a stream corridor and we use a detector at each - does this meet the additional detector requirement? (similar to 2 net sets at a mist-net site) Or do the additional detectors need to sample the same habitat?

• For non-linear projects: one site per 30 acres (12 hectares) of suitable habitat

-- How does one draw the conclusion that the old number of sites is adequate for linear projects, but needs to be 5 times heavier for area projects? The old protocol worked very well for area projects, with many captures on area projects with *sodalis* known to be present. Acoustic methods are supposedly more effective, so why increase the number of sites?

• For linear projects up to 328 feet (100 meters) wide: one site for each 0.6 mile (1 kilometer) of the project corridor that contains suitable habitat.

[8] Sunset tables for the location of survey can be found at:
http://aa.usno.navy.mil/data/docs/RS_OneYear.php

ANALYSIS OF RECORDED ECHOLOCATION CALLS

The analysis of acoustic calls recorded under this guidance must be conducted with a USFWS-approved call identification software program. A list of approved programs will be available on the USFWS's website at:
http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html

Interpretation of Acoustic Analysis Results

If the acoustic analysis results in the identification of Indiana bat calls with high levels of certainty (e.g., a maximum likelihood result of P< 0.10),

--e.g. needs to be clearly defined, change to i.e.
-- e.g. and i.e. mean two different things. Both are latin.
i.e. = id est = "in other words"
e.g. = exempli gratia = "for example"
Look at how these are used throughout the document and make sure the appropriate one is used.

then the project proponent should mist-net in an attempt to capture recorded bats, although instead, the option to assume the presence of a maternity colony exists. Additional survey work should follow the mist-netting guidance found in Appendix C. While mist-netting is encouraged immediately after acoustic surveys are completed, mist-netting

-- The above wording (highlighted) is clearer.

to capture and radio track Indiana bats can occur at any time within the mist-netting survey window.

-- I don't think this section is detailed enough. This MLE result is the determining factor for presence/absence of a federally endangered species it should have more than one sentence in the protocol. There should be an entire section or even a separate document on this.
--Maximum likelihood results - Analyzed per night? Per site? Why would the data not be analyzed by site? A larger sample is always more statistically reliable. The nightly minimum of 10 will probably not produce statistically reliable results.

Additionally, if the data analysis of collected calls results in the identification of other federally endangered bat species (e.g., gray bats, *Myotis grisescens*), then the USFWS FO(s) in the state(s) where calls were detected should be notified immediately to determine if any additional survey effort for those species is necessary.

SUBMISSION OF ACOUSTIC SURVEY RESULTS

If acoustic surveys document the presence of Indiana bats, then the appropriate USFWS FO(s) must be notified within 48 hours by providing the project name, date, and GPS location(s) of positive detection.

-- The USFWS has no authority to set a date for an acoustic positive submission as no report is legally required for this activity. Surveyors are bound to confidentiality agreements and cannot legally submit it themselves. Project proponents have complete flexibility when to submit (or not) acoustic reports as there is no legal mechanism to require submission.

A complete acoustic survey report documenting the presence and/or absence of Indiana bats must be submitted to the appropriate USFWS FO(s) for review and concurrence at the conclusion of all project-specific summer survey field work discussed in this guidance document. If acoustic surveys do not indicate the presence of Indiana bats, no further sampling is needed. Each acoustic survey report must include the following:

1. Copy of habitat assessment and acoustic survey study plan report (if not previously provided)

-- This is something that should be submitted *with*, not *in* the Acoustics Survey Results Report. It should not be included in this list, but put at the end of this section.

2. Explanation of any modifications from study plan (e.g., altered site locations)

-- Change wording from "any modifications from study plan" to "modifications *of the* study plan."

--On site locations being moved: How far of a move needs to be called out and explained? 50 feet? 500 feet?

3. Description of acoustic monitoring sites, survey dates, duration of survey, weather conditions, and a summary of findings

-- The format of requested weather data should be specified somewhere as well. Do you want start/end temperatures, nightly averages, or hourly min/max temperatures? Do you want an hour-by-hour breakdown of wind and rain or just the general nightly weather? This level of detail seems odd for the report body, this is stuff that belongs on datasheets as part of the report. A summary of findings is so general, but weather conditions is so specific. This may need better wording.

4. Map identifying acoustic monitoring locations and a corresponding table including the GPS coordinates

-- A table with GPS cords seems pretty specific, this should be on datasheets, a table just increases copying errors. Asking for a shape file would be more reasonable. We can make a table, it just seems odd when data that specific should already be included on datasheets.

5. Full names of all personnel conducting acoustic surveys, including those that selected acoustic sites and deployed detectors

6. Table with information on acoustic monitoring and resulting data, including but not limited to: acoustic detector brand(s) and model(s) used, microphone type, use of weatherproofing, acoustic monitoring equipment settings (e.g., sensitivity, audio and data division ratios), deployment data (i.e., deployment site, habitat, date, time started, time stopped, orientation), and automated acoustic identification program used

-- On equipment settings, are there standards or any guidance at all?

-- Is this by night? By site? Failed included? Why would we have some of this in a table rather than in a methods section? Or on datasheets?

7. Acoustic analysis software program output/summary results by site (i.e., number of calls detected, species composition, MLE results)

--I think the green highlighted words belong.

8. Photographs of each acoustic site documenting the location of the detector, the orientation of the detector, and the detection cone (i.e., what the detector sampled)

9. A description of how proper functioning of bat detectors was verified

10. Any other information requested by the local USFWS FO(s) related to the project

11. If an acoustic survey resulted in the documentation of Indiana bats and the project proponent has elected to continue with mist-netting surveys, then provide a draft Phase 3 & 4 mist-netting, radio-tracking, and emergence survey study plan for USFWS FO(s).

--The draft study plan should not be mentioned until the next section, or the end of this appendix. Stick with results in your results section. Consider adding a 'next step' section that talks about submitting a mist-netting plan.

--We suggest that (in both this appendix and the others) you put any instructions regarding the submission of study plans for the next phase at the end of the "Submission" section. It is out-of-place before (and in) the numbered list which details what must be in the report.

REFERENCES

Britzke, E.R, B.A. Slack, M.P. Armstrong, and S.C. Loeb. 2010. Effects of orientation and weatherproofing on the detection of bat echolocation calls. Journal of Fish and Wildlife Management 1(2):136-141.

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MacKenzie, D.I., and J.A Royle. 2005. Designing occupancy studies: general advice and allocating survey effort. Journal of Applied Ecology 42:1105-1114.

Weller, T. J., and C. J. Zabel. 2002. Variation in bat detections due to detector orientation in a forest. Wildlife Society Bulletin 30:922-930.

APPENDIX C PHASE 3 MIST-NETTING

SUMMER MIST-NETTING SEASON: May 15[9] – August 15

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 determine the presence or absence of a maternity colony or large concentrations of bats in the area when males and/or non-reproductive females are captured.)

PERSONNEL

A qualified biologist(s)[10] must (1) select/approve mist-net set-ups in areas that are most suitable for capturing Indiana bats, (2) be physically present at each mist-net set-up throughout the survey period, and (3) confirm all bat species identifications. This biologist may manage more than one mist-net set-up if the net-check timing (i.e., every 10 minutes) can be maintained while **walking** between nets (which is similar to managing two net set-ups at one net site in past guidance).

-- Why is walking specified? ATV's, automobiles, and bicycles can all be used as reliable methods of moving between netting locations, especially if a technician is present at each site to remove bats from nets. Setting a maximum holding time is sufficient, let surveyors figure out how to get between point a and b.

--2 and 3 conflict. One says one biologist per mist-net set one says they can walk between sets. Consistency within this document would be great to have.

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 at this time. The finest mesh size available is approximately 1½ inches (38 millimeters).

-- Are high bag bird nets acceptable, or should only nets tailored to bat capture be used? This is not specified.

No specific hardware is required. There are many suitable systems of ropes and/or poles to hold nets. The system of Gardner et al. (1989) has been widely used. See NET PLACEMENT 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 must 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.

-- This is a legal permit requirement everywhere when it comes to handling bats. Delete this and stick to your main topic. It's not necessary to deal with this at all in this document. There's a good chance the web link goes away before this document does.

--State protocols (as required by state permits) sometimes disagree with the protocol on this website (e.g., bleaching nets vs. boiling vs. other sterilization methods). At most the protocol should simply instruct surveyors to "Follow permit guidelines regarding WNS decontamination."

[9] Due to concerns with transmission of white-nose syndrome, some USFWS FO(s) and state natural resource agencies have delayed the start of the Indiana bat summer field survey season/mist-netting until June 1. Surveyors/applicants should always coordinate with local USFWS FO(s) and state natural resource agencies before beginning surveys.

[10] 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 Indiana bats. 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.

MINIMUM MIST-NETTING EFFORT

The following guidelines are the minimum-suggested level of effort to give surveyors a reasonable chance of capturing Indiana bats previously documented by acoustic surveys. Surveyors may increase the level of effort, as needed.

To determine the suggested minimum mist-netting effort for each individual project (linear or non-linear), complete the following steps (also see Figures 1 and 2 for examples of small and large projects, respectively):

1. For projects with one positive acoustic site for Indiana bats, place a 1-mile (1.6-kilometer) radius buffer circle around the positive site, then continue to Step 3.a.
2. For projects with multiple positive acoustic sites documenting Indiana bats: a. Identify the two positive acoustic sites that are in the closest proximity to each other.
b. If those sites are within 1 mile (1.6 kilometer) of each other, then identify the midpoint of the line connecting the two sites. Place a 1-mile radius buffer circle around the midpoint and identify the total number of positive acoustic sites within that buffer circle. Once positive acoustic sites are included within a buffer circle, they will not be considered during the creation of any remaining buffer circles.
c. If the sites are greater than 1 mile (1.6 kilometer) from each other, place a 1-mile radius buffer circle around each positive site.
d. Continue this process until all sites are placed in a buffer circle and proceed to Step 3.

3. For each buffer circle identified, mist-netting, distributed throughout suitable habitat near positive acoustic sites, should be conducted using the following schedule (overlapping buffer circles do not affect the minimum number of net nights recommended):
a. 1 positive acoustic site within a buffer circle = 10 net nights[11]
b. 2 positive acoustic sites within a buffer circle = 14 net nights
c. 3 positive acoustic sites within a buffer circle = 18 net nights
d. 4+ positive acoustic sites within a buffer circle = 20 net nights

-- Distributed across the circle or near the acoustic positive? This protocol seems to vacillate between the two. Clarity would be nice.
--Even with footnote 11 "net nights" is not clear. Are you really talking net nights or should this be net set nights? A net night is one individual net. So a triple high for one night is three net nights. A net set night would be all nets on one set of poles, or an array of singles in close proximity sampling something like a water source.

The USFWS FO responsible for the state in which the project occurs should be consulted during survey design to resolve project-specific issues related to mist-netting.

[11] A "net night" is defined as 1 location surveyed using 1 mist-net set-up for a single night.

Figure 1. An example of a small project area depicting positive and negative results at Phase 2 acoustic survey sites and 1-mile (1.6- kilometer) buffers used for establishing an appropriate number of Phase 3 mist-net locations. Using the suggested minimum mist-netting effort described in this guidance, at least 32 net nights would be sampled in this example.
Figure 2. An example of a large project area depicting positive and negative results at Phase 2 acoustic survey sites and 1-mile (1.6- kilometer) buffers used for establishing an appropriate number of Phase 3 mist-net locations. Using the suggested minimum mist-netting effort described in this guidance, at least 38 net nights would be sampled in this example.

NET PLACEMENT
Under these guidelines, mist-netting is a focused effort to capture Indiana bats that were detected during the Phase 2- Acoustic Surveys and captures will help to better understand Indiana bat use of a project area. Thus, mist-net set-ups should be as near to positive acoustic detection sites for Indiana bats as possible, as well as in suitable habitat.

-- We like this, but elsewhere the language used indicates sampling should be distributed across the 1 mile circle. Please be consistent.

Potential travel corridors (e.g., streams, logging trails) typically are the most effective places to net (although other places may also be productive; see Carroll et al. 2002).
Place nets approximately perpendicular across the corridor. Nets should fill the corridor from side to side and from stream (or ground) level up to the overhanging canopy.

-- Change this to "corridor from side-to-side*, extending beyond the corridor boundaries when possible,* and…"

Nets of varying widths and heights may be used as the situation dictates. If netting over water, ensure there is enough space between the net and the water so that the bat will not get wet upon capture.

Occasionally it may be necessary or desirable to net where a suitable corridor is lacking. The typical equipment described in the section above may be inadequate for these situations, requiring innovation on the part of the surveyor (see Humphrey et al. 1968). See Kiser and MacGregor (2005) for additional discussion about net placement.

Although no minimum spacing between mist-nets is being specified, surveyors should distribute net set-ups throughout suitable habitat.

-- Above it is stated that net set-ups should be as close to detection locations as possible. Here it's asking for distribution throughout suitable habitat. Please be consistent.

Net set-ups can be repeatedly sampled throughout the project, but generally no more than two 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 nets.

SURVEY PERIOD

The survey period should begin at sunset[12] and continue for at least 6 hours (longer survey periods may also improve success).

[12] Sunset tables for the location of survey can be found at: http://aa.usno.navy.mil/data/docs/RS_OneYear.php.

-- It was implied that many parts of the mist-netting protocols are suggestions. Therefore survey start and length is not mandatory?

-- This is misguided. Sunset is a specific time by location. At almost all sites, it remains sunlit for a half hour after the official sunset time. We will catch many, many birds which can spillover into bat time and cause loss of real sampling (during the time a net is down for bird removal). Dusk is when nets are, and should be, opened. "Dusk" is flexible to cover proper sampling of sites on a mountaintop and in a forested valley right next to it.

We acknowledge that "dusk" is less specific than the official sunset time. While "dusk" is open to individual interpretation, there is likely to be only a minor variance between start times based on this individual interpretation. We believe that this small difference (usually no more than 10 minutes) of potential net open times is well worth it when weighed against the disadvantages of opening nets too early (i.e., bird captures resulting in net down-time, unnecessary damage to mist nets, possible harm to birds, etc.).

-- Has anyone documented the worth of another hour of netting? This is getting to be very long days. Generally projects are 30-60 minutes from a hotel/camp area. Setup takes around an hour, and you want at least a 30 minute pre-dark buffer in case things go wrong. Landowners often want to talk and slow setup down. Pulling nets off/ full tear-down if moving net sets is another 30-60 minutes. That's a minimum of 9 hours, and net decontamination still has to be done the next day. This seems excessive. If you want more effort, please consider adding more net set nights.

--There should be a new paragraph after this stating:

"It is worth noting that this is the minimum level of effort the USFWS is comfortable with for detecting maternity or bachelor colonies (larger concentrations) of Indiana bats. Failure to detect Indiana bats after meeting this level of effort is indicative that large summer colonies are unlikely to be present."

CHECKING NETS

Each net set-up should be checked approximately every 10 minutes, never exceeding 15 minutes (Gannon et al. 2007). If surveyors monitor continuously, take care to avoid noise and movement near the nets. Monitoring the net set-up continuously with a bat detector 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-up 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).

> -- This protocol is for experienced individuals with years of bat experience prior to being permitted. This sentence on cutting nets is not needed. It's like saying, "you need headlights because it's dark when bats are out."
> --It is interesting that there are 2 sources listed for this basic, uncontroversial point, yet there is only 1 source (Britzke) referenced to back-up the assumption that Indiana bats can be identified via acoustic analysis.

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 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 45 minutes after capture, or as allowed in federal and state permits. See Kunz and Kurta (1988) for general recommendations for holding bats.

WEATHER AND LIGHT CONDITIONS

Surveyors should conduct additional mist-netting if any of the following weather conditions are experienced throughout all or most of a sampling period: (a) temperatures that fall below 50°F (10°C); (b) precipitation, including rain and/or fog, that exceeds 30 minutes or continues intermittently during the survey period;

> -- This is deeply flawed, and a profound misunderstanding of bat field craft. Stormy, rainy, or drippy nights are probably the BEST nights for sampling for myotis-type bats. These bats are often in the clutter or canopy or areas that are difficult/not possible to net or acoustically sample. These tighter flight areas are probably a lot less attractive for foraging when rain/drips are falling on bats. These bats seem to move out to the larger, nettable and acoustically sampleable areas on these drippy nights. Yes, rain probably interferes with the detector getting good calls, so you need a significant spell of time without rain, but during a full night sampling, three hours of rain would probably help detection. Remember, lactating and pregnant bats really need to feed. Myotis capture protocols need to work to encourage sampling on rainy/drippy nights.

Bats fly when it is raining, and rain itself is irrelevant to the success of nets. It is the amount of time when the NETS are wet that matters since bats are generally not caught in wet nets. If nets are under canopy, it can rain fairly hard and the nets will stay dry and productive.

--There are several ways to enable netting on drippy nights and still ensure ample sampling periods. 1) Use the old protocol wording of 'majority of the time'. 2) Allow extension for down-time (so a total of 5 hours with nets dry, temps over 10°C, and so on). 3) Allow for at least an hour (not a half hour) of precipitation in the sampling period.

and (c) sustained wind speeds greater than 9 miles/hour (4 meters/seconds; 3 on Beaufort scale).

It is typically best to place net set-ups under the canopy where they are out of moonlight, particularly when the moon is half-full or greater. Net set-ups illuminated by artificial light sources should also be avoided.

DOCUMENTATION OF *MYOTIS SODALIS* CAPTURES

If an Indiana bat(s) is captured during mist-netting, protocols for radio-tracking and emergence survey requirements, as provided in Appendix D and E, respectively, must be followed.

-- Why is telemetry required? Who is required? Are you requiring this of federal permittees as part of their permit or are you requiring the project proponent? Clients may use netting to verify a maternity colony (based on an acoustic hit) and then decide to move or abandon the project. Why would they want to pay for telemetry if this is their plan?

In addition, the appropriate USFWS FO(s) must be notified of the capture within 48 hours, and the sex and reproductive condition of the bat and GPS coordinates of the capture site should be provided.

--48 hours is tight (if it's a weekend capture) to get clients up-to-speed and notify agencies. 72 or 96 hours would be much more reasonable and not cause undue issues for USFWS.

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

-- Why are you only requesting photos of Little Brown bats? What about other species of myotis (*septentrionalis, leibii*)? Among less experienced bat workers (who should be the only surveyors that might have difficulty identifying Indiana bats), other myotis are as commonly confused with *sodalis* as Little Browns.

Photo-documentation should include diagnostic characteristics:

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

SUBMISSION OF MIST-NETTING RESULTS

A Phase 3 mist-netting report must be submitted to the appropriate USFWS FO(s) for review and approval.

-- This is not true. In Region 5, our permits generally don't mandate submission to the USFWS. Those are submitted by the project proponent if and when he/she decides to ask that the endangered species hit be resolved. We are mandated to submit our report to the state agency that issued the permit under which work was conducted.

If Indiana bats are captured, this report should also include the data submission requirements of the subsequent radio-tracking and emergence count efforts.

-- Again, project proponents should not have to do this if their goal is to verify a maternity site and then avoid the presence area or abandon the project.

Each mist-netting report must include the following:

1. Copy of Phase 1- Summer Habitat Assessment, Phase 2 acoustic survey report and Phase 3 and 4 mist-netting/radio-tracking/emergence count survey study plan (if not previously provided).

--This is a list of items to be included in each mist-netting report. Do you really want all the items listed in number 1 **in** the netting survey report? If you want them submitted **with** the report, then that should be a separate paragraph after this numbered list.

2. Description and justification of any modifications from the Phase 3 and 4 mist-netting/radio-tracking/emergence count study plan (e.g., altered net locations).

3. Description of net locations (including site diagrams), net set-ups (include net heights), survey dates, duration of surveys, weather conditions, and a summary of findings.

4. Map identifying netting locations and information regarding net set-ups, including lat/long or UTM, individual net placement, and net spacing (i.e., include mist-netting equipment in photographs of net locations).

--Photographs must be on the map? This line is about maps. With photographs scattered on them those are going to be some super big maps. I think you wanted photographs as another line – maybe move the bit about photos to #7 (which also mentions photos of netting locations). Coords printed on the map?

5. Full names of mist-netting personnel attending each mist-net set-up during an operation, including the federally-permitted/qualified biologist present at each mist-net set-up. Indicate on the field data sheet the full name of person who identified bats each night at each set-up.

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, height of capture in net, 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 (available at: http://www.fws.gov/northeast/PDF/Reichard_Scarring%20index%20bat%20wings.pdf).

-- That's pretty much all the data on the data sheets. That's a lot of info on a summary table. Why would you want some of these items, like weight and forearm on a summary table when they are on a the data sheets included in the report? How do those items

help with management decisions that one would be turning to a summary table to help make?

7. Photographs of all net set-ups, as well as **all** Indiana bats 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.

-- You listed this (photos of all netting locations) in #4. Again, this should be mentioned in the guidance sections along with detailed instructions. Why are you only requesting photos of Little Brown bats? What about other species of myotis (*septentrionalis, leibii*)? Among less experienced bat workers (who should be the only surveyors that might have difficulty identifying Indiana bats), other myotis are as commonly confused with *sodalis* as Little Browns.

8. Any other information requested by the local USFWS FO(s) related to the project

9. Copy of the site-specific written authorization from USFWS and/or state natural resource agency (if required)

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APPENDIX D PHASE 4 RADIO-TRACKING

PERSONNEL

A qualified biologist[13] who is experienced in handling Indiana bats and attaching radio transmitters must perform transmitter attachments, as further explained in the protocol below.

METHODS

If one or more Indiana bats are captured, the following radio-tracking protocols will be applicable:

1. Radio transmitters shall be attached to all[14] female, juvenile, and adult male[15] (greater than or equal to 0.2 ounces/6.0 grams) Indiana bats captured (a maximum of 5 individuals per potential colony), unless restricted by state regulations.
   -- This should mention apparent health, ensuring that there are no obvious injuries, and avoiding harassment of pregnant bats for which birth is imminent.
   -- Why *must* telemetry be conducted? Couldn't a client use mist netting to confirm maternity populations and, when one is captured, decide not to pursue the project (and thereby avoid the need for telemetry)?
   -- Define potential colony or reference the section that does. Does this mean 5 bats per 8 km buffer? If so, is this a buffer around the acoustic detector hit or around the first located roost tree.

   Since the maximum holding times for Indiana bats targeted for radio-tracking is 45 minutes, 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. Biologists should carry a minimum of 5 transmitters with them for each project area, unless the size of the project area could encompass more than one maternity colony home range (i.e., 5-mile [8-kilometer] buffered area from center of project).
   --"5 mile buffered area" is a vague and confusing way to describe this. Do you mean a 5 mile radius from the center of the project or a 2.5 mile radius? What does the center of the project have to do with maternity colonies? We believe you mean to say "the center of the acoustic detection location."

   These large-scale projects would require biologists to have a minimum of 5 transmitters per potential colony.
   --So, on a 200 mile pipeline we would be REQUIRED to have 200 transmitters (one set per 5 mile stretch)? Why would this requirement relate to project area/size and not the

number of separate acoustically determined sampling circles being sampled simultaneously?

[13] 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 Indiana bats. 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.

[14] Biologists should coordinate in advance with USFWS FO(s) regarding recommendations for distribution of transmitters (e.g., prioritization of sex/age, maximum number per site, etc.) 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.

2. The radio transmitter, adhesive, and any other markings (e.g., wing bands) should ideally weigh less than 5% of pre-attachment body weight but must not weigh more than 10% of a bat's total body weight (Kurta and Murray 2002). 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. 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).

   -- This (that is, telemetry equipment and frequencies) should be in the study plan guidance for inclusion in the netting study plan. Where IS the guidance for any of these study plans?

3. The qualified biologist or biological technician(s) should track all radio-tagged bats captured to diurnal roosts for at least 7 days and must conduct a minimum of 2 evening emergence counts at each identified roost (See Appendix F for Emergence Survey Protocols). However, biologists are encouraged to continue radio-tracking efforts voluntarily until the transmitter fails, fall off, or cannot be located. Biologists should contact the USFWS FO(s) immediately if they suspect a transmitter has failed or fallen off before the 7-day tracking period ends. In all cases, landowners should be contacted and grant access to roosts prior to conducting these activities. If access is denied, approximate roost locations (i.e., coordinates) should be determined using triangulation. Surveyors should never trespass during radio-tracking.

   -- Why is this last sentence needed? Are we endorsing any other law-breaking in this protocol? Why would one infer that you can break the law and trespass?

   -- These are instructions for roost tree telemetry only. If there is an anticipation of the possibility of foraging telemetry (see footnote 2 – and why would the USFWS not want to collect as much data as possible?), then this appendix should clearly outline a protocol/minimum level of effort. There should be a standard protocol so that any foraging telemetry completed is done in a standardized manner.

4. Daily radio telemetry searches for roosts must be conducted during daylight hours and must 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 must 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 Indiana Bat Roost Datasheet" (Appendix D).

-- Is this USFWS datasheet mandatory?

5. To minimize potential for disease transmission, any equipment that comes in contact with bats must 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.

SUBMISSION OF RADIO-TRACKING RESULTS

Phase 4 radio-tracking results should be included with the Phase 3 mist-netting report and must be submitted to the appropriate USFWS FO(s) for review and approval.
Each report must include the following information related to radio-tracking efforts:
1. Copy of Phase 1 habitat assessment, Phase 2 acoustic survey report, and Phase 3 and 4 mist-netting/radio-tracking/emergence count survey study plan (if not previously provided)

--We suggest that (in both this appendix and the others) you put any instructions regarding the submission of study plans for this/ subsequent phase(s) at the end of the "Submission" section. It is out-of-place before (and in) the numbered list which details what must be **in** the report.

2. Description and justification of any modifications from the Phase 3 and 4 mist-netting/radio-tracking/emergence count study plan (e.g., number of transmitters used, frequency of transmitters changed)
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)
4. Map summarizing spatial Indiana bat 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 *and any hibernacula surveys*)

--We suggest the above wording changes/additions.

5. Full names and permit numbers of personnel who attached transmitters to Indiana bats 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 Indiana Bat Roost Datasheets

-- Is use of these particular datasheets mandatory?

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)

[15] Please consult with the USFWS FO in the state in which mist-netting will occur in advance to determine if tracking of adult males is necessary, and if so, what the project-specific protocol will be.

REFERENCES

Kurta, A., and S. Murray. 2002. Philopatry and migration of banded Indiana Bats (*Myotis sodalis*) and effects of radio transmitters. Journal of Mammalogy 83:585-589.

APPENDIX E PHASE 4 EMERGENCE SURVEYS

PERSONNEL
Biological technicians and/or a qualified biologist[16] who is experienced in conducting emergence surveys for Indiana bats must be present and actively involved in all emergence surveys for Indiana bats as further explained in the protocol below.

EMERGENCE SURVEYS FOR KNOWN INDIANA BAT ROOSTS

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

1. Bat emergence surveys should begin one half hour before sunset[17] and continue until at least one hour after sunset or until it is otherwise too dark to see emerging bats.

--This should be a half hour prior to dusk – not half an hour before sunset. In a deep, dark forested valley, bats may be gone by half an hour before sunset while, on top of a ridge, it may not even be dark for an hour after sunset.

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 made at approximately 2-minute intervals. There should be at least one surveyor per roost.

--Is this intended to disallow the setup of night vision cameras to record emergence without disturbance of the roost? If we use a camera to record each emergence, must we still have one surveyor present for each tree?

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 or similar 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 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 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 “Bat Emergence Survey Datasheet”.

4. Surveyors should also complete an “Indiana Bat Roost Datasheet” for each roost known to be used by one or more Indiana bats (Appendix D).

5. Completed datasheets should be maintained in project files and included in reports prepared for the USFWS.

-- The phrase "maintained in project files and" should be removed from this sentence unless you explain who is responsible for maintaining a project file and specify how and for how long.

EMERGENCE SURVEYS FOR POTENTIAL INDIANA BAT ROOSTS

In some limited cases (e.g., individual hazard trees), surveyors may have the option of conducting emergence surveys for individual potential Indiana bat roosts to determine use prior to removal. The following protocol applies to these surveys:

1. Consult with the local USFWS Field Office(s) to determine whether a tree(s) that needs to be felled/ cleared may be potential roosting habitat for Indiana bats and whether conducting an emergence survey is an appropriate means of avoiding take of Indiana bats. 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). An online directory of USFWS offices is available at: http://www.fws.gov/offices/directory/listofficemap.html.

-- Consider removing the last sentence. Maybe the USFWS contact info should be included on the cover page, but by Appendix E it certainly is not useful, and that HTML location is likely to change more often than this document is updated.

2. If the USFWS FO(s) approves/concurs with Step 1, then follow the emergence guidelines for Emergence Surveys for Known Indiana Bat 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 should be 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 has to be repeated, because bats may switch roosts on a nightly basis. Immediately after the tree is felled, a visual inspection of the 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) 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 must be submitted to the appropriate USFWS FO(s) for review. Each survey report must include the following information related to emergence survey efforts:

1. Copy of Phase 1 habitat assessment, Phase 2 acoustic survey report, and Phase 3 and 4 mist-netting/radio-tracking/emergence count survey study plans (if not previously provided)
2. Explanation of any modifications from the Phase 3 and 4 mist-netting/radio-tracking/ 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 Indiana bat(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 "Indiana Bat 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)

[16] 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 Indiana bats. 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.

[17] Sunset tables for the location of survey can be found at: http://aa.usno.navy.mil/data/docs/RS_OneYear.php

Acoustic Bat Identification Software Testing Criteria – Draft
January 2013

Software programs meeting all the criteria outlined below and validated by the U.S. Fish and Wildlife Service (Service) (through testing by the U.S. Geological Survey) will be approved for use for analysis of bat calls obtained during summer surveys of Indiana bats. A list of candidate and approved programs will be maintained on the Service's Indiana bat summer survey guidance website: http://www.fws.gov/midwest/Endangered/mammals/inba/inbasummersurveyguidance.html

The testing process developed and implemented by the USGS should be transparent and available for public review. Each program should be rigorously tested on each criteria item as well as all baseline mathematical/statistical methods used for species identification, the cross-validation process, and maximum likelihood estimator. Each program should be tested with several robust call libraries (at least 3). The libraries should contain calls collected from a variety of habitats and regions to reduce bias. The USGS should be responsible for creating/releasing the cross-validation table(s) for each program.

1. The program must be quantitative and automated to ensure repeated consistency in analysis.

2. Any call identification analysis program must be based upon an extensive call library of free-flying bats (see question #27 in the FAQs). Program developers must provide the Service with a copy of their call library, which must indicate the number of calls per species, call recording location and the method of collection (e.g., free-flying bats, hand release, light tag).

The library should contain only 100% known voucher calls. Free-flying calls that have been hand-vetted for identification should not be included in these libraries. A minimum library size and a minimum of calls/sequences per species should be set by the agency.

3. Each program and/or its supporting materials must explicitly state which species and geographic area(s) it covers.

4. The program must include filtering to remove extraneous noise and non-bat files, as well as feeding buzzes, files with multiple bats, poor-quality passes that are recognizable as a bat but not to species, and medium-quality passes that are only recognizable to genus.

Setting requirements? Many of these items can be "teased" into an identification with the proper program settings. Number of acceptable passes should be defined here. The requirements listed in the protocol should be addressed here as well – 10 calls, 40% identifiable. If everything unidentifiable gets tossed out – how are we expected to

measure this? These items should be bulleted and well-defined so it is crystal clear how each of these variables is to be addressed.

5. The program must include an "unknown" category for classifying calls that are not characteristic of species in the call library to ensure that such calls are not forced to a species identification.

   It seems like some programs have multiple categories – guild level (Sonobat only), unknown, unidentifiable, and some programs just don't run/identify/produce results on certain calls as they get scrubbed out for quality. Set how each type of call is defined and how each should be handled. If one program calls a file unidentifiable and another calls it noise/junk/not a call sequence, that's significant in the analysis, so all need to handle those files similarly.

6. Accuracy rates of the program must be derived through cross-validation (e.g., qualitative assessment). Correct classification rates of files identified to individual bats species for the underlying analytical program within identification software, i.e., discriminant function analysis, neural networks, classification and regression tree (CART) or other statistical tests (see #6) must be provided to show the initial basis used for maximum- likelihood estimator calculations. Minimum correct classification rate on the software's training data must be 90% or better for all Myotis species that may occur within the range of the Indiana bat.

   This should also include an "unknown" category as individual bat species may be misclassified as unknown. Why 90% on myotis species? This means that if red bats are being misclassified 50% of the time as MYSO that is acceptable?

7. As species identifications are never perfect, all analysis programs must utilize a maximum-likelihood estimator approach to determine species presence at the site rather than relying on a single sequence. Post-hoc maximum-likelihood estimator p-values will be used to determine acceptance thresholds for final identification determination.

   This should be a set standard so that all outputs are obtained in the same manner. Minor differences in formulas can cause large differences between results. Perhaps the FWS should provide the base formula for this analysis so all programs are making decisions in a similar manner.

8. Results must include file level summaries (e.g., # of pulses, species IDs, unknown species, invalid), site/night analyses (e.g., # of files, # of invalid files, # of files ID'd to species vs. unknown, IDs for each species), and the maximum-likelihood estimator value assignments.

General Comments:

Why is there an entire sheet of instruction for the identification process of calls but there are no requirements on the settings of the actual recording device. Length of recording/frequency/sensitively settings etc.

The bottom line is: Will each program provide similar results? If the FWS approves 3 program and each provides **significantly** different presence/absence results what impact does that cause? How will proponents know which program to rely on and which program to use for guidance when making decisions about mist netting. How will the FWS enforce this? How will these results hold up under the scrutiny of the law?

Maximum Likelihood Estimator Evaluation

As part of our peer-review efforts we elected to analyze the proposed statistical methods for determining absence of the Indiana bat from a defined location.

Using the references from the FWS Guidelines and accompanying documents we made the assumption that the underlying statistics in the proposed Maximum Likelihood Estimator (MLE) statistical method are those described in *Acoustic Identification,* a paper published in *The Indiana Bat: Biology and Management of an Endangered Species* in 2002 by Eric Britzke, Kevin Murray, John Heywood, and Lynn Robbins. Since our background and knowledge of MLE statistics is limited we decided to bring the method to the Pennsylvania State University Statistical Consulting Center (SCC) for an in-depth breakdown of the statistical process. After several meetings and revisions for clarity the SCC provided us with the attached report (Attachment A). The following is a brief breakdown of the key components and findings of the statistical review and our expressed opinions on how the MLE can be properly used to determine presence/absence.

To start we would like to make four statements that will be discussed in more depth below:

1. **The bottom-line statistical methods being proposed (in Britzke et al., 2002) are appropriate for presence/absence analysis of a species if used properly and precursor assumptions are met before data is analyzed.**

2. **The two major assumptions associated with this method of MLE are:**
   Sample size is large.
   The cross-validation accuracy table is correct.

3. **Numerical sensitivity and other known problems associated with MLE should be intensively evaluated.**

4. **Samples of zero and unknown bat calls are not addressed in the Britzke et al. (2002) article; however these are both important factors in a "real-world" setting.**

1. **The bottom-line statistical methods being proposed (in Britzke et al., 2002) are appropriate for presence/absence analysis of a species if used properly and precursor assumptions are met before data is analyzed.**

As mentioned above, this entire assessment was made on the assumption that the underlying statistics used for the MLE are those described in the Britzke et al. article. Alterations to the formula may cause drastically different results and another assessment would need to be conducted. If used correctly, the MLE and accompanying likelihood ratio test is appropriate for determining statistical based presence or absence of a bat species.

2. **The two major assumptions associated with this method of MLE are:**
   Sample size is large.
   The cross-validation accuracy table is correct.

The assumptions listed above are imperative to ensuring the MLE will provide accurate, reliable results on presence/absence. Ignoring these assumptions or presuming the estimator will continue to work properly without meeting these requirements is poor science.

The entire underlying basis of the MLE is a large sample size. Those samples displayed in Britzke et al. article ranged roughly from 25-35 individual passes per sample and are considered to be on the small side for this statistical method. The minimum sample size proposed in the current FWS Guidelines is only 10 per night with analysis nightly. Generally speaking, the larger the sample size, the smaller the margin of error. Since error in this case will likely have extreme impacts, a large random sample is required for meaningful results.

The component most important to MLE accuracy is the cross-validation table. Each ID program (e.g. Echoclass, BCID, Sonobat, etc) and each region (or breakdown of species) will need a unique table in order to run data through its corresponding MLE software. Furthermore, it is also worth mentioning a new table will need to be generated every time the software in the ID program is updated to ensure accuracy rates are current and the most reliable data for the bat community is used in sampling. The Britzke et al. (2002) article only showed a snap shot of the full cross-validation table results (original table would have had 8 species).

Keep in mind this table has several know caveats already associated with its accuracy. These include: the assumption that “wild” calls are identifiable in the same manner as known voucher calls, habitat in which calls were recorded should be similar to those used to create the table (calls obtained in clutter were not well represented in the Britzke et al. article), the voucher library used in the cross-validation process is large, robust, and 100% accurate.

It CANNOT BE OVERSTATED that an inaccurate cross validation table will yield bad identifications. The cross validation must be accurate when there is precipitation, fog, wind, pregnant bats, bats in the presence of young, high humidity and about 10,000

other variables, unless each of those variables are somehow corrected for in other ways (like tracking and invalidating any calls recorded during precipitation). It is not good enough that the cross validation works on voucher calls, it has to work in the wild.

3. **Numerical sensitivity and other known problems associated with MLE should be intensively evaluated.**

As with all statistical/mathematical methods there are often several known, well-documented drawbacks associated with any given method. In this specific case, known drawbacks of the MLE include numerical sensitivity, inadequate sample size, and risk of a non-random sample. Each of these issues should be evaluated extensively and scrutinized by the USGS during the approval process for an accepted "Automated Acoustic Bat ID Software Program".

Numerical sensitivity, in short, means that minor differences between two samples (i.e. input data; number of calls per species) could cause large changes in the resulting statistical p-values.

4. **Samples of zero and unknown bat calls are not addressed in the Britzke et al. (2002) article, however these are both important factors in a "real-world" setting.**

It is important to note species totals of zero will likely be quite common from a normal night or site of acoustic sampling. This means at any given site there is a possible bat community (all species possible at that location) and an actual bat community. For example let's use a project where we have the possibility of catching 9 species. Remember this means 9 species would be included in the cross-validation table and the estimator would be based on these same 9 species. However, experience tells us that we rarely document all 9 species at a single site (especially in a single night). Therefore our data are likely to look more like this:

LABO = 4
EPFU = 15
MYLU = 2
MYSE = 1

This means the remaining 5 species (LACI, MYLE, MYSO, LANO, PESU) will enter the MLE as a zero. It is important that everyone can understand exactly what this means and how the MLE will respond and react to zeros. If used correctly there is potential for presence to show up for a species that has entered the MLE as a zero due to associated accuracy rates for that species. However the sample size would likely need to be very large for this to occur. This means species that have a zero sample size cannot be eliminated from the statistical iterations done by the MLE early in the process, every possible species should have an associated p-value.

It is also unclear how species identified as an "unknown" are treated and accounted for in the MLE. It is important to consider that all ID programs will be required to have an

unknown category which will prevent tricky calls from being forced into an incorrect classification. For this same reason the cross-validation table will also need an "unknown" category as some known voucher calls may be incorrectly classified as unknown during this process. This also means unknown will have its own accuracy rate which should be present in the MLE statistic. Therefore each bat region/community will need one additional "species" for unknown calls collected during a sample. Though significance of this "species" will not mean anything it is still important to the functionality of the MLE.

In conclusion, we would like to end with several key issues/comments:

1. **Transparency of Statistical Methods**
   The statistical methods being used by programs should be available for public/peer review. Statistics are complicated and not well understood by the general public. It is important that everyone understands exactly how these methods work and all programs used for presence/absence are functioning in a similar manner. It does the surviving bat populations no good if every program available provides different results. Proponents will simply run each program until they find one with results they deem acceptable. It is also worth noting that issues known to be associated with this method such as numerical sensitivity should be tested extensively in each program.

2. **Increased Sample Size**
   The minimum of 10 calls per night per site is too low for reliable statistics. There is a large margin of error associated with such a small sample size. A very simple fix to this problem is to run data at a site level instead a site-night level. This means a minimum of 60 calls will go into the MLE. This also means there will be less zeros entering the MLE as the species accumulation curves will be more complete after six nights of sampling. Furthermore, one overall analysis will provide a more accurate representation of the site than six separate nights.

3. **Cross-validation Tables should be Public Information and Rigorously Tested**
   The cross-validation table is the most important variable associated with the MLE method. Cross-validation tables should be generated independently of software developers, preferably by the USGS in a fully transparent process. These tables should be generated not just from a developer's calls, but from at least 3 large call libraries, preferably more. Voucher libraries used to test the cross-validation tables by the USGS must be 100% accurate, contain a large number of calls for each species collected in a variety of habitats, and contain calls from multiple regions to eliminate bias. These tests should be repeatable and should continually produce similar results. The cross-validation tables generated by the USGS testing should be made publicly available and these should be the tables used for the associated MLE software. It is also crucial that tables are updated

EVERY time there is an update to the ID software. As is the norm, technology will continue to improve and accuracy should continue to get better and better.

Once again, thank you for the consideration of our comments. We hope you find them constructive and helpful during the revision process. We appreciate the need for a more rigorous Indiana Bat survey in a post-White Nose Syndrome environment and hope we can aid in the development of a stronger, more accurate, and more successful presence/absence survey.

Literature Cited:

Britzke, E.R., K.L. Murray, J.S. Heywood, and L.W. Robbins. 2002. Acoustic identification. Pages 221-225 *In* A. Kurta, and J. Kennedy, eds. The Indiana Bat: Biology and Management of an Endangered Species, Bat Conservation International, Inc., Austin, Texas.

Draft 2013 Field Season Contingency Plan for Conducting Indiana Bat Summer Surveys January 2013

Thank you for the opportunity to review and provide comments on the proposed *Draft 2013 Field Season Contingency Plan for Conducting Indiana Bat Summer Surveys-January 2013* (2013 Contingency Plan). Based on the a request (Attachment B) received by email on the North Eastern Bat Working Group (NEBWG) List-serve from Andy King we would like to offer our comments and suggestions for the implementation of a 2013 Contingency Plan.

Based on the NEBWG Email the Fish and Wildlife Service (FWS) has expressed a want to implement a modified version of the proposed 2013 Contingency Plan that will include options "to incorporate mist-netting at a level that would result in similar probabilities of detection as acoustics and establish presence/probably absence of Indiana bats in summer habitat". We would like to offer several options based on this request and an evaluation of each.

We would like to start with several key realities that will be present within these options. First, the FWS would ideally like to gather as much rangewide acoustic data as possible in the 2013 field season to help support and improve upon the new proposed survey protocol, however in order to "require" this extra data collection the data must aid in management decisions for the Indiana bat at a proposed project. Second, in order to make any kind of pre-cursor acoustic surveys (those that would potentially eliminate the need for netting under certain circumstances) worth proponent participation the acoustic survey must be inexpensive enough (in both implementation and data analysis) that proponents will choose to use acoustics as a pre-cursor rather than more-expensive mist-netting options. Otherwise, many proponents will simply choose to skip acoustics and spend the money on mist netting surveys and the FWS will lose out on the opportunity to collect much needed "real-life" acoustic data. Furthermore, the FWS must consider logistics and a cost/benefit ratio for each of the proposed options.

Changes to the proposed 2013 Contingency Plan will focus on two areas; acoustic surveys and mist netting. We will first provide the options we see possible in these two areas and then we will provide a 2013 Contingency Plan based on our experience that will be the best, logical, cost-effective way to move forward.

Acoustic Options

1. **Use acoustic surveys to identify species present at a given site and consider these results valid for presence/probable absence.**

Currently, no program can provide good identification accuracy. When multiple of the contending programs are used on one set of data, radical differences in results are seen. No reliable options for using acoustics to identify Indiana bats currently exist. Therefore this option is unreasonable as it will result in unclear results and would very likely lead to serious legal complications. Since available programs are producing significantly different results it would be very difficult to make sound, responsible management decisions regarding the Indiana bat.

2. **Use acoustic survey results to trigger more intensive mist netting surveys.**

Acoustic surveys would be run prior to any mist netting effort in order to determine preliminary presence of *Myotis* species. This option has potential to be useful for proponents, ideally eliminating the need for netting in areas of sub-par habitat and reducing costs of sampling. However this option gets tricky when determining factors such as length of acoustic surveys, intensity of acoustic surveys (how many sites), and what should reasonably trigger mist netting. The other glaring issue with this option is cost to the proponent and whether or not the cost/benefit ratio will make it worth it for proponents to take this pre-cursor step in surveys, or just perform an increased netting effort.

3. **Use acoustic survey results to validate mist netting (surveys in tandem).**

This option would involve deploying acoustic gear while mist netting so results could be directly compared. Results from acoustic surveys could trigger more intensive netting if high frequency bats are detected but not caught. While this method would provide much needed data in a variety of habitats, there are several factors that make the logistics of this option difficult. These factors include length of surveys (both in number of nights and recording length per night), the ability to use detectors successfully in areas ideal for netting and vice versa, determining a realistic trigger for more intensive netting and determining what is more intensive netting (see netting section below).

Mist Netting Options

1. **More nets per site**

The benefits of this option include increased coverage within a project area, and a greater chance of species detection. The drawbacks of this option include the selection of poorer quality net locations as two good sets are often all a site has to offer, especially on linear projects.

2. More net sets per site or project.

The benefits of this option include increased coverage within a project area, and a greater chance of species detection. The drawbacks of this option include the selection of poorer quality net locations as the best would have been selected first.

3. More nights of netting.

This option would involve running net sites for longer than 2 nights. While this may increase the chances of accumulating the maximum number of species for a given area, captures seem to fall sharply after two or three nights. Additional sites are probably more cost effective.

4. Non-consecutive nights of netting.

The basic idea of this option is that nights of netting would not be conducted consecutively in order to increase captures and reduce net avoidance. The large drawback associated with this option is mainly logistical and once again involves cost to the proponent from increased gear transfer/setup/teardown. The benefits from this type of sampling are relatively small in comparison to the costs.

5. **More hours of netting per night.**

Nets would be open longer during each night of netting. Bat activity often falls off as night progress. Costs would be low compared to other options, but so would benefits.

Based on these options we would like to provide our proposal for a 2013 Contingency Plan.

Step 1. Conduct Phase 1 Habitat Assessment.

a) Suitable summer habitat present, proceed to Step 2.
b) Suitable summer habitat absent, no further summer surveys required.
or
c) Assume habitat is present, skip this step and continue to step 2.

Step 2. Can all adverse effects to Indiana bats be avoided?

a) No, assume presence of Indiana bats or proceed to Step 3. b) Yes, no further summer surveys required.

Step 3. Conduct Phase 2 Acoustic Surveys* for mist-netting trigger.

a) At sites with no positive detection of high frequency calls (≥35 kHz), no further summer surveys required.

b) At sites with positive detection of high frequency calls, assume presence of Indiana bats at sites with detections or proceed to Step 4 and mist net those sites.

or

c) Skip this step 3 and continue to step 4.

Step 4. Conduct Phase 3 Intensive Mist-netting Surveys.**

a) No Indiana bats are captured, assume they are probably absent from the area.

b) Indiana bats are captured, proceed to Step 5.

Step 5. Follow Phase 4 Protocols (Radio-tracking and Emergence Surveys).

***Acoustic Surveys**

We propose that these surveys are conducted per USFWS proposed guidelines.

****Intensive Mist Netting Surveys**

We propose that mist netting surveys should be intensified in two different ways based on project type. For linear projects we suggest increasing the number of sites per kilometer from 1 to 2. This would also the best available habitat to be sampled without forcing nets into an already limited landscape (as would occur if the minimum net set was increased instead of site). For area based projects we suggest increasing the minimum number of net sets from 2 to 4 per site.

On linear projects it is rare that the sites lend themselves to increased number of net sets. On area projects site quality often allows for increased net sets.

Once again we thank you for the opportunity to provide our opinion on these matters and hope you will find our suggestions both constructive and helpful in your efforts to modify the 2013 Field Season Contingency Plan.

Attachment A

Pennsylvania State University Statistical Consulting Center Review Document

l) 863-0281
4) 863-7114

iversity

March 8, 2013

Sanders Environmental Inc.
Re: SCC # 13-1-005

Thank you for bringing your project to the Statistical Consulting Center. My responses to your research questions are included in this report. The report is organized in several parts. In the first section, I will summarize my understanding of your project and the statistical questions. Second, I will provide my response to your questions. Finally, I will provide a list of references.

1. Project Description

As you explained during our on-call meeting, your firm is interested in evaluating the methodology of bat acoustic sampling used by a third party organization. It is important to identify the presence of certain species of bats, in this case, the Indiana bat, in order to determine whether a site is fit for development. If the presence of the endangered Indiana bat is found through sampling techniques at a specific location, this will change/alter the process of development on this particular site. As a result, it is very important to accurately determine the presence or absence of the Indiana bat. If the Indiana bat is incorrectly detected on a particular site, this would wrongfully alter/slow the development on that site. If, on the contrary, the Indiana bat is incorrectly not detected, this harms the efforts to protect the species. Your specific concern regarded maximum likelihood estimation and the likelihood ratio test which were used in the acoustic sampling methodology for statistically determining the presence or absence of the Indiana bat species at select communities. You provided me with an article by Britzke, Murray, Heywood and Robbins which was the framework for the methodology applied by the third party organization. This report addresses three main areas of the maximum likelihood estimation procedure on which you wanted more clarification:

1. Description of the maximum likelihood estimator and the likelihood ratio test
2. Assumptions/appropriateness of the maximum likelihood estimator and the likelihood ratio test
3. Potential drawbacks associated with this testing procedure

The following section will address these concerns and hopefully provide you with a better understanding of this methodology, while referring to the work of Britzke et al.

2. Evaluation of the Maximum Likelihood Estimator

This section serves as a detailed description of both the maximum likelihood estimator

and the likelihood ratio test, as they go hand in hand for this particular analysis. This should serve as a tool in your process of evaluating the overall acoustic sampling methodology implemented by the third party organization.

2.1 Description of the maximum likelihood estimator and the likelihood ratio test

In order to describe either of these concepts, it is necessary to define the likelihood function. In the context of this problem, the likelihood is a function which represents a "measure of the relative support for different values of **θ**" (Millar).

Now, I will reference Britzke et al. when describing the methodology in more detail. The authors discuss four species of Myotis: Gray bat, Indiana bat, Little brown bat, and Northern bat. Since a sampled bat can be only one of four species of bats, the likelihood, $\mathrm{L}(\theta)$, for this data is the multinomial distribution with unknown relative frequencies $\theta_1, \theta_2, \theta_3, \theta_4$ as shown in the formula below:

$$\mathrm{L}(\theta) = \binom{n}{x_1\, x_2\, x_3\, x_4} {p_1}^{x_1}\, {p_2}^{x_2}\, {p_3}^{x_3}\, {p_4}^{x_4}$$

Where x_1, x_2, x_3, x_4 are the number of calls identified as Species 1, 2, 3 and 4, respectively, in the sample of calls, n is the total number of calls in the sample, and

$$p_i = \sum_{j=1}^{4} \phi_{ij}\theta_j$$

In Britzke et al., the authors explain that ϕ_{ij} is the probability that an individual of species j is identified as species i. Thus, the uncertainty of the bat call classification software is included in this likelihood formula due to the fact that probabilities of misclassification are identified as nonzero. The probabilities of misclassification are obtained from their cross-validation results in Table 2 of Britzke et al.

The maximum likelihood estimator is the value of **θ** which maximizes the likelihood of obtaining the data that was obtained in the sample. In other words, based on the data observed in the sample, what value of **θ** is the most likely. Here, since **θ** is bold, it actually represents a collection of parameters, $(\theta_1, \theta_2, \theta_3, \theta_4)$, which are the unknown relative frequencies of species 1, 2, 3 and 4, respectively, in the sampled community. In this case, the maximum likelihood estimator will be a collection of estimates since there are four elements of **θ**, one for each of the four species.

The likelihood ratio test, in the context of this problem, is a procedure which is used to test whether there is sufficient evidence to reject the hypothesis that a particular species is absent from the sampled community. The more commonly known test used in this type of problem is the Wald test; however, the Wald test relies on the assumption that the estimator comes from a normal distribution, which is not always the case. It is generally the case that the likelihood ratio approach is preferred over the Wald test (Millar).

Table 3 of the Britzke et al. report presents three samples within which, four likelihood ratio tests were performed. This table serves as an illustration of the likelihood ratio approach, so I will interpret their results. It is important to note that they mention in their

report that the data used for the analysis done in Table 3 is hypothetical data in order to demonstrate "how different samples from a community affected determination of presence/absence at a particular site." Recall the results from Sample 1 in Table 3 of their report:

Table 1: Results from Sample 1 in Table 3 of Britzke et al. report

Species	Number of Individuals in Sample 1	Likelihood Ratio Test p-value
Gray Bat	10	<0.001
Indiana Bat	10	<0.001
Little Brown Bat	2	0.16
Northern Bat	2	<0.001

Now, I will break down the analysis done by the authors in the results shown above. Take the results for the Indiana bat. There were 10 Indiana bats in this specific sample as shown in the Table 1 above. The authors were interested in testing whether there is sufficient evidence to conclude a presence of the Indiana bat in the sampled community. In other words, they were interested in testing whether there is sufficient evidence to conclude that θ_2 is greater than 0. Based on the sampled number of bats within each of the four species, (not just for the Indiana bat) the likelihood function is computed. Now, the only term in the likelihood function that is unknown is $\boldsymbol{\theta}$, the true relative frequency of each species of bat in the sampled community. (Recall $\boldsymbol{\theta}= (\theta_1, \theta_2, \theta_3, \theta_4)$.) The authors then take the likelihood function and compute the values of $\theta_1, \theta_2, \theta_3, \theta_4$ that maximize the likelihood function. This set of four estimated values is called the maximum likelihood estimator(s). Now, to test whether there is sufficient evidence to conclude a presence of the Indiana bat in the sampled community, the authors perform a likelihood ratio test. In order to do this, they must first compute the following:

i. The likelihood function evaluated at the maximum likelihood estimates of $\theta_1, \theta_3, \theta_4$, while constraining θ_2 to equal 0
ii. The likelihood function evaluated at the maximum likelihood estimates of $\theta_1, \theta_2, \theta_3, \theta_4$
iii. The ratio i/ii which we call λ

Now, the test statistic to perform the Likelihood Ratio test is:

$-2\log(\lambda)$ (where "log" refers to the natural logarithm)

For a very large sample size, this test statistic follows a chi-squared distribution with one degree of freedom, so the p-value corresponding to the Indiana bat (shown in Table 1 above) was obtained by assuming a large sample size and treating the above test statistic as a realization of a chi-squared random variable.

The likelihood ratio tests for each of the other three species were done in a parallel manner; however, instead of constraining θ_2 to equal 0, the appropriate θ_k was constrained to 0.

2.2 Assumptions/appropriateness of the maximum likelihood estimator and the likelihood ratio test

This section will outline the major assumptions of the maximum likelihood estimation/ likelihood ratio test methodology.

First, this method assumes that the observed sample of bat calls is a random sample from all possible bat calls (Millar). It is a bit more complicated in this case since the bat calls are observed and then identified using a model which has some uncertainty. I discuss this assumption further in Section 2.3.

Second, this method requires a sufficiently large sample size in order for it to outperform other procedures. The likelihood ratio test relies on a large enough sample size in order to approximate the test statistic as a realization from the chi-squared distribution. If the sample size is not large enough, it might not be reasonable to approximate a chi-squared distribution, and the p-values could be inaccurate. This sample size issue is discussed further in Section 2.3 as well.

2.3 Potential drawbacks associated with this procedure

There are several inherent drawbacks associated with using the maximum likelihood estimator / likelihood ratio test. In Casella and Berger (2002), the authors discuss one of these drawbacks: the numerical sensitivity of the maximum likelihood estimator, and by consequence, the likelihood ratio test. In this context, numerical sensitivity is the idea that minor differences between two samples could result in very different p-values associated with the likelihood ratio tests. In maximum likelihood estimation, it is possible that a slightly different sample could produce vastly different results. Casella and Berger (2002) discuss that numerical sensitivity can happen "when the likelihood function is very flat in the neighborhood of its maximum or when there is no finite maximum." They further discuss that if the maximum likelihood estimator can be found explicitly, this is not typically an issue; however, in instances when the estimator cannot be solved for explicitly and must be solved by numerical methods, Casella and Berger recommend that "it is often wise to spend a little extra time investigating the stability of the solution." In the Appendix of the Britzke et al. report, the authors discuss that a closed form solution of the denominator of the likelihood ratio test statistic is available (i.e. a maximum likelihood estimator can be solved explicitly); however, the authors further discuss that there is not a closed form solution for the numerator (i.e. a maximum likelihood estimator after restricting θ_k to 0 must be solved by numerical methods). This is an instance where there might be concern for numerical sensitivity. The authors do address this issue of numerical sensitivity in Table 3 of their report. I will recall their findings for Samples 2 and 3 from their Table 3.

Table 2: Samples 2 and 3 results from Table 3 of Britzke et al. report

If the tests for the three speci with identical counts result i drastically different p-values when comparing Sample 2 to Sample 3, this suggests a numerical sensitivity issue. T is not the case here, but furth comparisons should be done ensure no issue with numeric

	Sample 2		Sample 3	
Species	N	P-value	N	P-value
Gray Bat	10	<0.001	10	<0.001
Indiana Bat	2	0.52	5	0.01
Little Brown Bat	10	<0.001	10	<0.001
Northern Bat	10	<0.001	10	<0.001

We can observe that the only difference between these two samples is that there were 2 Indiana bats observed in Sample 2 and 5 Indiana bats observed in Sample 3. The numerator of the likelihood ratio test statistic is the piece of the test which is computed using numerical methods, rather than explicit methods, so this is the area we would potentially be concerned with regarding numerical sensitivity. In the test for the Indiana bat, the numerator of the likelihood ratio test statistic forces θ_2 to be 0 (as explained in Section 2.1), so we would not be able to compare this particular species test across the two samples for the investigation of numerical sensitivity. We can, however, compare the p-values for the remaining three species which have equivalent counts in each of the two samples shown above. After accounting for the minor differences between the Indiana bat counts in the two samples, we see that the p-values for the Gray bat, Little Brown bat, and Northern bat are aligned across the two samples. This table does not suggest any numerical sensitivity issues; however, in order to be very sure that numerical sensitivity is not an issue here, it would be beneficial to reproduce this analysis for three other samples. Britzke et al. do make a note in their report that "Number of species included in each sample was arbitrary and simply for illustrative purposes;" however, I suggest that anyone reproducing this analysis should choose their species counts with more precision in order to further evaluate the sensitivity of this testing procedure. Each sample should only allow one of the species counts to change slightly. I include a proposed table of hypothetical species counts in order to investigate this issue of numerical sensitivity further.

Table 3: Proposed Additional Samples to be Compared to Sample 2 from Britzke et al.

Species	Proposed Sample 4	Proposed Sample 5	Proposed Sample 6	Sample 2 from Britzke et al
Gray Bat	8	10	10	10
Indiana Bat	2	2	2	2
Little Brown Bat	10	8	10	10
Northern Bat	10	10	8	10

In Table 3, for each proposed sample, I allow only one species count to differ from the Sample 2 from Britzke et al. This allows for two-way comparisons between each proposed sample and Sample 2 from Britzke et al., where only one species count differs. In each comparison, if the p-values for the species with identical counts do not change drastically in each case, this is evidence that there is not a numerical sensitivity issue, and this likelihood ratio test can be trusted on real data.

Another potential drawback of the maximum likelihood estimation/ likelihood ratio testing approach is the issue of sample size. For the maximum likelihood estimator to perform well (i.e. have the smallest variance among all possible estimators and have small bias), a large enough sample size must be used in the estimation. The sample sizes used in the Britzke et al. article range from 24 to 35 total bats which are relatively small sample sizes. In order to increase the performance of the maximum likelihood estimator, it would be beneficial to increase the sample sizes (i.e. the number of call sequences recorded).

The last potential drawback I will discuss is the issue of a non-random sample. The authors do discuss this caveat in detail in the Britzke et al. report; however, I include this discussion in my report for reinforcement. They mention that their model for identifying calls is based on a specific structure of calls typical of animals flying over open areas. Further, they discuss that the model does not contain calls from two additional species of Myotis. Since the model is the means of classifying bats into each species category, it is possible that the final data set of bat call identifications is not a true random sample from all bat call identifications. This could potentially create bias in the maximum likelihood estimator which affects the likelihood ratio test.

3. Discussion

I have presented you with a description of the maximum likelihood estimation procedure/ likelihood ratio testing procedure, along with the assumptions and potential drawbacks of this approach. I hope that this report will assist you in evaluating the statistical component of the acoustic sampling methodology of the third party organization.

Thank you for the opportunity to work on this project with you.

Sincerely,

Nicole Khoury
Graduate Consultant
Statistical Consulting Center

References

Britzke, Eric R., Kevin L. Murray, John S. Heywood, and Lynn W. Robbins. *Acoustic Identification*. Tech. N.p.: n.p., n.d. Print.

Casella, George, and Roger L. Berger. *Statistical Inference*. Australia: Thomson Learning, 2002. Print.

Millar, R. B. *Maximum Likelihood Estimation and Inference: With Examples in R, SAS, and ADMB*. Chichester, West Sussex: Wiley, 2011. Print.

Attachment B

NEBWG Email

From: King, Andrew andrew_king@fws.gov via wpunj.edu

To: Northeast, Mike, Robyn

February 8, 2013

Dear Interested Parties,

The U.S. Fish and Wildlife Service (Service) recently received several similar letters requesting a 60-day extension to our current 30-day public comment period to allow more time to review and prepare comments on the Draft Revised Rangewide Indiana Bat Summer Survey Guidelines and related documents. While we recognize the hardship an extension at this time will cause many of you that are preparing bids and planning schedules for the 2013 summer survey season, the Service also must ensure that all stakeholders have time to prepare and submit their comments. Therefore, we have decided to extend the public comment period for these documents for an additional 30 days. This extension was formally announced in the Federal Register today, February 8th, and will extend the comment period through **March 11, 2013**. The FR notice can be accessed at http://www.gpo.gov/fdsys/pkg/FR-2013-02-08/pdf/2013-02889.pdf.

The Service and U.S. Geological Survey are continuing to develop the test call library designed to evaluate automated acoustic ID software programs submitted for use with the revised guidelines. We acknowledge that a significant amount of additional time will likely be needed to 1) test/approve automated acoustic ID software programs and 2) review and consider forthcoming public comments given the 30-day extension. Therefore, we have decided that we will implement a contingency plan for the 2013 field season. A draft of the 2013 Contingency Plan is currently available for public comment. However, we are interested in modifying the plan to allow for options to incorporate mist-netting at a level that would result in similar probabilities of detection as acoustics and establish presence/probable absence of Indiana bats in summer habitat. Currently available information suggests a netting level much higher than the 2007 mist-netting protocols will be needed to adequately detect Indiana bats in many locations (e.g., areas of the range impacted by white-nose syndrome [WNS] and heavily forested landscapes). We request any pertinent data that you may have that would assist with finalizing this level of effort, particularly from areas affected by WNS.

Given the decision to move forward under a contingency plan, we encourage you to use some of the additional review time to prepare constructive comments and ideas for improving this draft document. We recognize the need to have final guidance in place for the 2013 field season as early as possible to allow survey planning to take place. With this in mind, our goal is to have the 2013 Contingency Plan finalized no later than April 1, 2013. In order to meet this goal, while fully incorporating your input, we respectfully request that reviewers not wait until the very end of the extended comment period to submit their comments. We will attempt to post new comments to our website as they

are received. Throughout 2013, we will continue to work towards finalizing the Draft Revised Rangewide Indiana Bat Summer Survey Guidelines and plan to have a final version of them for use during the 2014 field season.

The draft documents are still available for review and comment on the Service's Indiana Bat Summer Survey Guidelines web page.
http://www.fws.gov/midwest/Endangered/mammals/inba/inbasummersurveyguidance.html

Please feel free to share this announcement with others that may be interested.

Lastly, to help improve the efficiency of our review, we would greatly appreciate receiving your comments in a spreadsheet format with each unique comment entered on a separate row. Please feel free to use the attached Excel file as a template and to send them to us via email (Indiana_bat@fws.gov). This is an optional format/request.

Thank you,

Andy King, Mike Armstrong and Robyn Niver

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