Indiana Bat, FW3 <indiana_bat@fws.gov>

Comment on the Draft Revised Indiana Bat Summer Survey Guidelines (FWS–R5–ES–2012–N195; FXES11130300000–134–FF03E00000)

Michael OMahony <momahony@normandeau.com> Mon, Mar 11, 2013 at 2:55 PM
To: "indiana_bat@fws.gov" <indiana_bat@fws.gov>, "lynn_lewis@fws.gov" <lynn_lewis@fws.gov>
Cc: Jane Rowan <jrowan@normandeau.com>, Christian Newman <cnewman@normandeau.com>, Christine Denny <cdenny@normandeau.com>, Allison Costello <acostello@normandeau.com>, Lauren Hooton <LHooton@normandeau.com>, Michael OMahony <momahony@normandeau.com>

March 11, 2013

Lynn M. Lewis,

Assistant Regional Director

Ecological Services, Midwest Region.

5600 American Blvd. West, Suite 990

Bloomington, MN 55437-1458

Re: Normandeau Associates, Inc. Commentary on US Fish and Wildlife Service 2013 Draft Rangewide Indiana Bat Summer Survey Guidance

Dear Lynn Lewis,

Normandeau Associates, Inc. (Normandeau) appreciates the opportunity to provide technical comments to the United States Fish and Wildlife Service's (FWS)Draft Guidance.

As you may be unfamiliar with our company, we are providing a brief history of our expertise and experience as it relates to bat ecology. In 2007, biologists at Pandion Systems (now Normandeau) developed a bat acoustic monitoring system specifically for use at wind energy facilities. This system uses commercially available full spectrum digital detectors (Binary Acoustic Technology AR 125s). Full spectrum detectors were selected for our

work due to their demonstrated properties of detecting more bat pulses, having fewer call fragments (e.g., unknowns), and higher probability of associating a call with a particular species. This last criterion was important as 7% of the species in North America constitute 80% of the mortality that take place at wind farms, a strong indicator of species-specific drivers underlying the mortality.

Over the last 4 years we have collected over 200,000 hours of acoustic data on bats containing over 1 million bat calls from 18 states. The data are analyzed, in part, using Sonobat acoustic analysis software.

The current bat professionals making up the Normandeau Bat Team include:

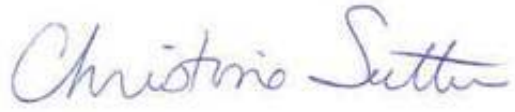
- Christine Sutter, MS in Bat Ecology in 1994
- Allison Poe Costello, MS in Bat Ecology in 2007
- Lauren Hooton, MS in Bat Ecology in 2010
- Michael O'Mahony, BS in Wildlife and Fisheries Science in 1996 and Qualified Indiana Bat Surveyor since the year 2000

The Normandeau Bat Team is dedicated to developing new technology that benefits bat conservation. Our comments included as an attachment to this letter are focused on improving the acquisition and analysis of bat acoustical data so information collected will provide better baseline and impact assessment data.

Please do not hesitate to contact me to further discuss these comments.

We look forward to working with the FWS in developing Guidance that furthers the goal of improving detection of Indiana bats and thereby supporting their conservation and recovery.

Sincerely,



Christine Sutter

Technical Director and Bat Team Lead

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Attachment

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FWS IN BAT ACOUSTIC GUIDELINES- NAI TECHNICAL RESPONSE -final.docx
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Technical Response to the USFWS Draft Rangewide Indiana Bat Summher Survey Guidance Published January 9, 2013

Introduction

The US Fish and Wildlife Service's (FWS) Draft Rangewide Indiana Bat Summer Survey Guidance (Guidance), made available for federal public comment January 9, 2013 (Guidance) covers numerous sampling techniques but we have chosen to limit our comments to the prescribed acoustic sampling protocol, which is mentioned throughout the document but is mainly described in Appendix B and the associated Frequently Asked Questions (FAQ).

As noted by other authors, the use of multiple sampling techniques results in more complete bat inventories than a single technique (Barclay 1999; O'Farrell and Gannon 1999), as is true for other terrestrial small mammals (e.g., Torre et al. 2004). This is true, in part, because each sampling technique has its own limitations.

Thus our concern with the Guidance is not the addition of the acoustic sampling to the existing mist netting technique. In fact, we welcome the addition of the acoustic sampling option for the reasons stated above as well as the opportunity it provides to sample habitats that are not readily sampled by any other method (e.g., the Rotor Swept Area [RSA] of a proposed wind energy facility).

Acoustic Terminology–

Bat detectors currently on the market include the Anabat by Titley Electronics, AR125 by Binary Acoustic Technology, SM2 by Wildlife Acoustics, and various models by Pettersson Electroniks.

These varied brands represent three methods of data collection: full spectrum real time, full spectrum time expansion, and zero-crossing.

Bat acoustic analysis software currently commercially available includes Analook (for use with Anabat) and Sonobat (for use with Binary, Wildlife Acoustics, and Pettersson).

When the General Accounting Office (GAO 2003) assessed the Service's use of "sound science" in making decisions on critical habitat designations, it used the following criteria: "the extent to which (1) the Service's policies and practices ensure that listing and critical habitat decisions are based on the best available science and (2) external reviewers support the scientific data and conclusions that the Service used to make those decisions."

Using these criteria, we are concerned that the Service did not meet criteria (1) using "best available science" when developing the Guidance and related criteria (2) as a significant number of external technical experts and reviewers are not in support of the data used or the conclusion

reached by the Service. We have grouped our concerns into the following three categories and within each of these we provide supportive evidence on what we contend is the lack of sound science.

1. The Guidance is derived from what we perceive as a very narrow reading of the peer-reviewed literature preventing the use of the "best available science" and contravening the opinion of recognized experts;

2. The Guidance appears to include factual errors that demonstrate a lack of use of the best available science and a lack of recognition of the majority of technical expertise provided in the peer-reviewed literature.

3. The stated goals and objectives of the Guidance are not achieved due to selection of technology that does not represent the best available science and does not coincide with the information provided by external technical experts as evidenced by the peer-reviewed literature

Each of these topics is discussed in more detail below.

1. Peer-reviewed Literature

The Guidance FAQs state that

> "While ultrasonic detectors have been around for decades, recent advances in the equipment and quantitative analysis now allows for quantitative analysis of echolocation call data (Britzke et al 2011)."
>
> "With these advancements and since many bat echolocation characteristics are species-specific, bat detectors are now more efficient at documenting individual species presence than the time-consuming and labor-intensive traditional capture techniques such as mist-netting (Murray et al. 1999)."
>
> "Thus, the USFWS' decision to use ultrasonic detectors to determine presence or probable absence of Indiana bats and to focus subsequent survey efforts is a logical use of this technology in the current environment."

These statements imply that the Guidance document was developed as a result of recent advances and reflect the recent advances in acoustic detection and call analysis. However, an examination of the peer-reviewed literature does not support that theService has availed itself of the best available science regarding bat detector technology and call analysis software.

To evaluate the degree to which the new Guidance reflects the best available science, we conducted a search of peer-reviewed articles within the Web of Science (www.webofknowledge.com) using the search term "bat echolocation" for the years between 1970 and 2011 within the topics of zoology and environmental science. This search returned 953 peer-reviewed articles. Although many researchers have contributed to this topic there is a clear

separation between those researchers who are the major contributors and those who have made more modest contributions to the science of bat echolocation .

To ensure that the articles had potential relevance to the Guidance, those papers that focused on sub-organismal studies (such as ear enervation and physiology) were omitted from consideration. That left over 600 papers. Of these, the top contributors (n=19) together produced 355 (>50%) of these articles (Figure 1) on bat echolocation. However, none of these authors are referenced in the discussion of bat acoustics within the Guidance document.

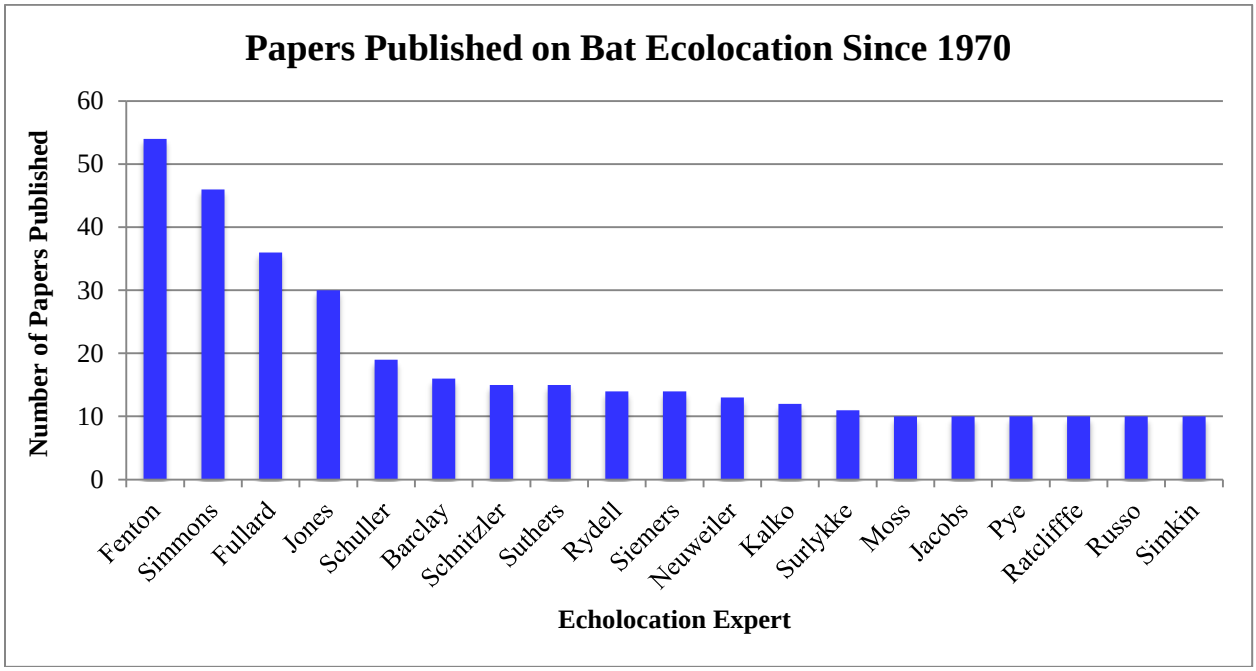

Figure 1. Number of papers published by echolocation experts on bat echolocation since 1970.

We are very concerned that the proposed Guidance developed to address applicable policies on acoustic monitoring of North American bats would be written with little or no mention of the contributed works of some of the most renowned and published bat acoustics scientists, like M. B. Fenton, J. A. Simmons, J. H. Fullard, or R. M. R. Barclay. We note that the commonality these omitted authors share is that they use full spectrum detectors for their work and many have written peer-reviewed papers describing the differences in the data quality between full spectrum and zero-crossing detectors. There is no indication in the Guidance why one type of detector has been selected over another. The lack of synthesis of the existing literature by the Service results in an apparent narrowness and skewed opinion regarding an appropriate methodology to be employed.

We also looked at the peer-reviewed literature in relation to timeliness of the recent advances cited in the Guidance document and FAQ (Figure 2) and find that the citations used to justify the selection of the detection equipment are out of date (e.g., 1998 and 2002) considering that substantial advancements have been made in acoustical analysis of bat calls in just the last few

years. Also, most of the relevant information provided by outside experts via peer-reviewed publications was not utilized when developing these documents.

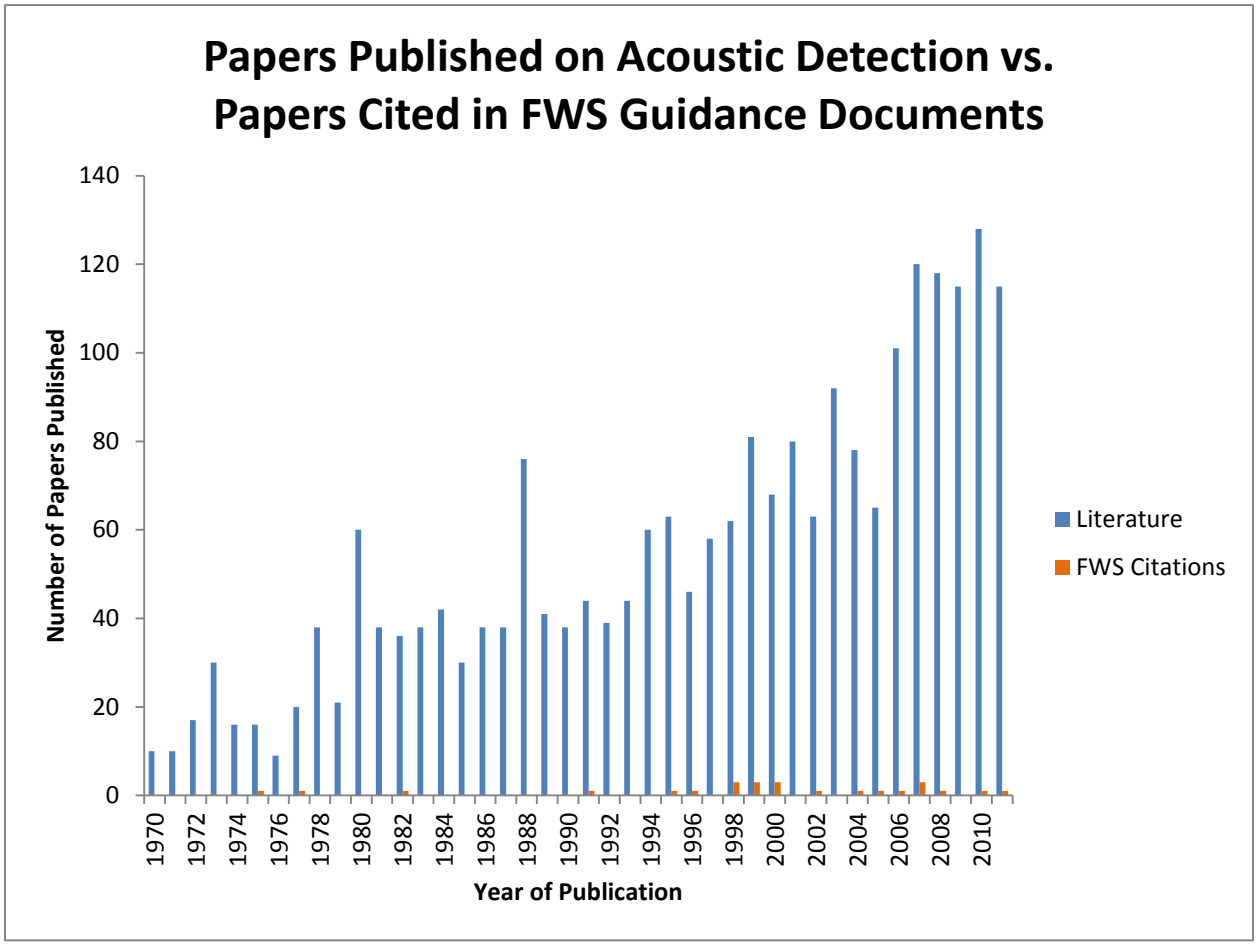

Figure 2. The number of papers published on acoustic detection equipment versus the number of papers cited within the FWS guidance documents.

2. Factual Errors

The Guidance document *Frequently Asked Questions*, Question 1 states:

> "Although ultrasonic detectors have been used for decades, recent advances in the equipment and quantitative analysis now allow for automated analysis of echolocation call data (Britzke et al 2011)."
>
> "With these advancements and since many bat echolocation characteristics are species-specific, bat detectors are now more efficient at documenting individual species presence than the time-consuming and labor-intensive traditional capture techniques such as mist-netting (Murray et al. 1999)."

> "Thus, the Service's decision to use ultrasonic detectors to determine presence or probable absence of Indiana bats and to focus subsequent survey efforts is a logical use of this technology in the current environment."

This series of statements implies that new protocol is leveraging the latest technology in an attempt to improve detection of Indiana bats. Unfortunately the equipment referenced in the above statement was developed 30 years ago and continues to use the same method of data collection (e.g., zero-crossing). The discussion of bat detector efficiency in documenting individual species presence is 14 years old and evolution in call capture and analysis technology that occurred since then as reflected in the more than 1100 bat echolocation papers published since 1999. Therefore the current Guidelines do not reflect advances in equipment or in efficiency the proposed survey efforts and by extension do not represent "a logical use of this technology".

In the 1980s, when zero-crossing technology (referenced by Britzke 2011 and Murray 1999) was developed, researchers were already collecting and analyzing full spectrum bat calls. However, the efficacy of full spectrum in the natural environment was sharply constrained by the digital technology available at the time (Figure 3).

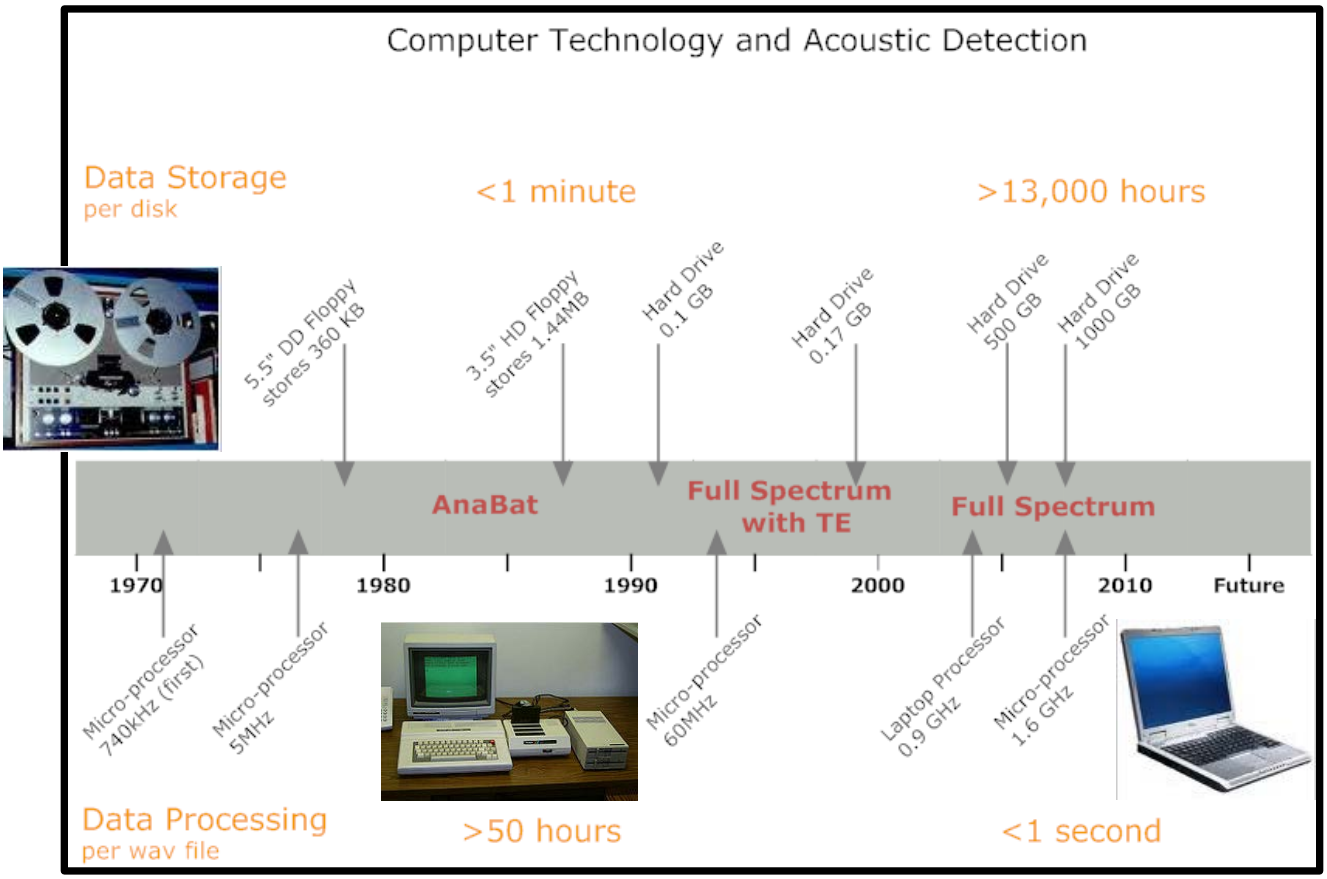

Figure 3. Timeline of computer technology and acoustic detection.

For example, in the 1980s, when floppy disks were the standard for data storage and the Commodore 64 computer was cutting edge, the floppy would have held less than 1 minute of bat pulses and the Commodore 64 would have required 50 hours to process a single 1.7 second full spectrum bat pulse. In the 1980s digital collection of full spectrum calls was clearly unrealistic.

Therefore, in the 1980s and much of the 1990s bat biologists collected full spectrum bat calls using high speed reel-to-reel analog tape recorders (for example, the Racal tape recorded described in much of Fenton's work). However, such a setup was cumbersome and unsuitable for most fieldwork due to the awkward nature of the equipment and the lack of weather resistance. Thus full spectrum data collection was mainly limited to the lab or fixed locations in the field.

For bat biologists wanting to locate and track bats in their natural environment, the development of a highly portable zero-crossing detector provided new opportunities. The mobility was the result of a tradeoff in which portability was achieved by reducing the data demands. This was primarily accomplished by moving away from full spectrum and towards sampled data (sampling the call every time it crossed the zero line) that could be readily processed and stored given the computing power available at the time. This continues to be the data sampling and collection process used by zero-crossing technology (Figure 4) which is referenced by Britzke 2011 and Murray 1999. This does not represent an "advancement in the equipment" as stated in the Guidance, rather a tradeoff between data quality and portability. A tradeoff that is no longer needed.

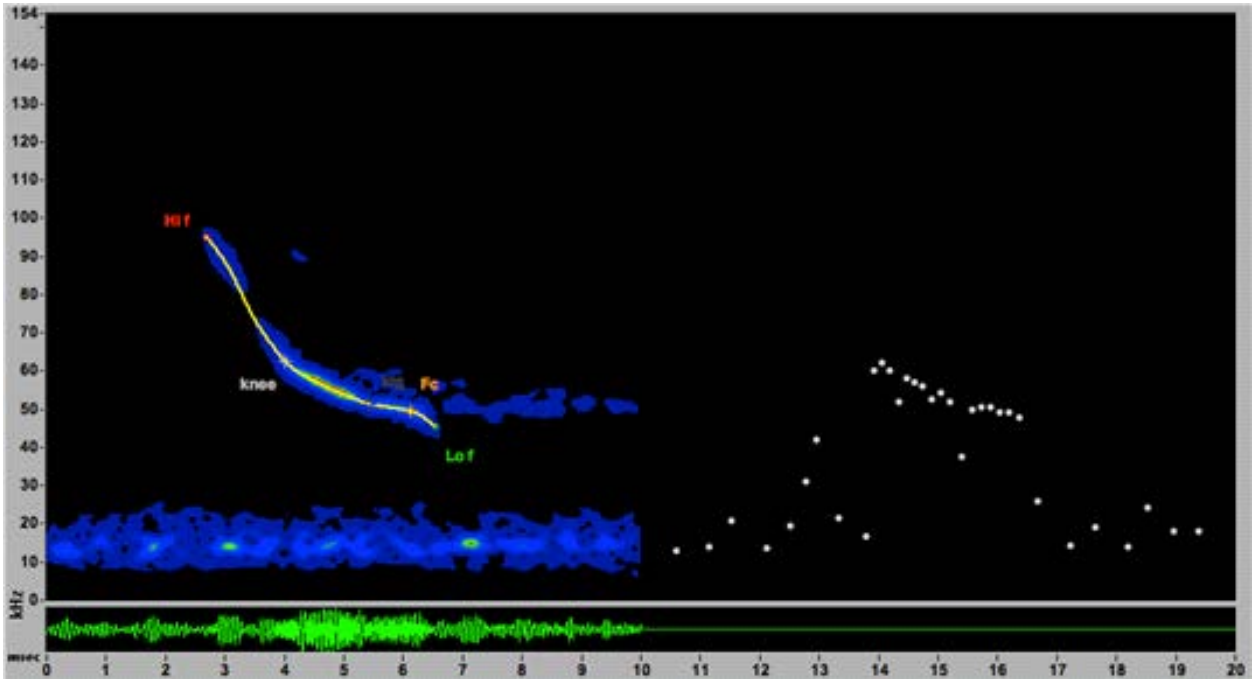

Figure 4. The tradeoff for portability. A comparison of the data collected by a full spectrum detector (left) vs. a zero-crossing detector (right) when simultaneously recording the same bat. Notice that the full spectrum display

includes the entire frequency range which is critical for call analysis and correct classification of calls to species.

By the mid-1990s, bat echolocation research had returned to its roots of full spectrum call detection and analysis only now in a portable digital format. This return to full spectrum is largely a result of the digital revolution lead by the development of personal computers and the ever increasing data processing speeds and plummeting data storage costs. Such advancements have allowed for full spectrum monitoring of complete bat echolocation calls in the natural environment and thus the need to sample the calls (e.g., zero-crossing) is no longer necessary.

Initially time-expansion detectors (e.g., the Pettersson detectors) were developed that were able to detect and record full spectrum calls but could not both detect and record at the same time due to the extreme processing demands of these two tasks, which could not be met by the digital technology of the time. However, by the early 2000s the processing speed of digital technology had progressed to the point that full spectrum calls could be both detected and recorded simultaneously, leading to real-time full spectrum bat acoustic monitoring (e.g., Binary Acoustic Technology, some Pettersson models, Wildlife Acoustics). Finally, 70 years after the recording of the first bat echolocation call by Griffin, bat biologists could collect full spectrum bat calls in the natural environment.

3. <u>The stated goals and objectives of the Guidance document may not be achievable</u>

The Guidance document, as currently written, states its objectives to be "standardize range-wide survey procedures", "maximize the potential for detection/capture of Indiana bats at a minimum acceptable level of effort", and " ensure the survey results are sufficient to be accepted by the USFWS for regulatory purposes". These goals are predicated on a series of assumption about acoustic monitoring and its benefits without also considering and enumerating the limitations of this methodology, which are influential in achieving the stated objectives. These assumptions are

1. The Guidance assumes that acoustic monitoring detects all bats,
2. Assumes Indiana bats can be reliably acoustically distinguished from other species ("since many bat echolocation characteristics are species specific" attributes to Murray et al. 1999),
3. Assumes standardization among acoustic surveys, which will result in comparable level of effort and comparable results.

Each of these three assumptions, and their impact on achieving the Guideline's goals are described more fully below.

Assumption 1: The Guidance assumes that acoustic monitoring detects all bats

We fundamentally disagree with this assumption. The advancement in acoustic monitoring equipment over the past 70 years has improved dramatically from the first "bat detector" used by Donald Griffin in the 1930s. The use of acoustic monitoring and eavesdropping on free flying bats has advanced knowledge in ways data from captures alone could not. As recognized in the

Guidance document, several studies have examined the efficacy of acoustic monitoring versus traditional capture methods (mist netting, harp trap, etc.) in describing bat communities, and found that acoustic monitoring allows for the detection of a greater diversity of bat species compared to the diversity of species captured with mist nets (Robbins et al. 2008; Kunz and Brock 1975; Kuenzi and Morrison 1998; Murray et al. 1999; O'Farrell and Gannon 1999; Flaquer et al. 2007). However, none of these papers suggest replacing capture surveys with acoustic surveys, but instead acknowledge that acoustic monitoring in conjunction with data collected from capture surveys yields the most robust results in describing a bat community.

The complementary nature of these two methodologies results from the fact that both are biased but in opposing ways. The bias is that certain species tend to be over- or underrepresented when sampled using a given methodology (Flaquer et al. 2007). These biases arise from the ecological differences between species.

In mist net surveys and traditional capture surveys, some species (big brown bats, eastern red bats) may be overrepresented (captured in a higher proportion than they are present) because these species typically fly at lower heights and exploit habitat that is conducive to mist net deployment (wooded and/or riparian corridors). Other species (.e.g. Hoary or Tadarida) may be underrepresented in mist net surveys because these species are agile fliers and/or typically fly in open habitats in which mist nets are inefficient.

Acoustic surveys also have inherent bias in regards to species detection. A species' echolocation call characteristics are adapted to the species foraging strategy, foraging habitat, prey items, and other life history constraints. For example, bat species that typically forage in less complex habitats (e.g. low clutter) typically emit calls that are lower in frequency and have a narrower frequency range. Such calls attenuate less quickly, traveling over a farther distance, and as a result these bat species are typically overrepresented in acoustic surveys. In contrast bats that foraging in more complex (e.g., cluttered) habitats typically operate at a smaller spatial scale and their echolocation calls reflect this. Such calls are typically of higher frequency, have a wider frequency range, and a shorter duration. These calls are more susceptible to atmospheric attenuation (Griffin 1971) and dissipate more quickly. Because of this, high frequency echolocators, such as Indiana bats, typically need to be closer to a bat detector in order to be detected and are thus typically underrepresented in acoustic surveys.

Additionally, calls detected from *Myotis* are often of poor quality because of atmospheric attenuation, echo interference, and low signal to noise ratio, and are therefore difficult to assign to species. Therefore, the use of acoustic monitoring alone is likely to be unsuccessful in accurately determining Indiana bat presence and is counter to the stated goal of "maximize the potential for detection" of Indiana bats with a minimum acceptable level of effort.

Therefore, guidance that allows for the application of both mist netting capture surveys and acoustic surveys to be used in combination would provide the most robust data set possible to determine presence or possible absence of Indiana bats. This strategy would also reflect the best available science and the current understanding of bat detection as expressed by the peer-reviewed literature. Results of acoustic surveys alone are not sufficient to detect presence and are

not sufficient for "USFWS regulatory purposes" if that purpose it to assess the likelihood of take, as defined by the Endangered Species Act.

Assumption 2: Indiana bats can be reliably acoustically distinguished from other species ("since many bat echolocation characteristics are species specific" attributes to Murray et al. 1999)

Not only are some bat species more challenging to detect acoustically, but some species, once detected, are more difficult to reliably separate acoustically. Intraspecific variation in bat echolocation calls has been documented (Figure 5) and is a function of an individual bat changing the structure of its echolocation call to gain more meaningful information based on the task at hand (Obrist 1995; Barclay et al. 1999).

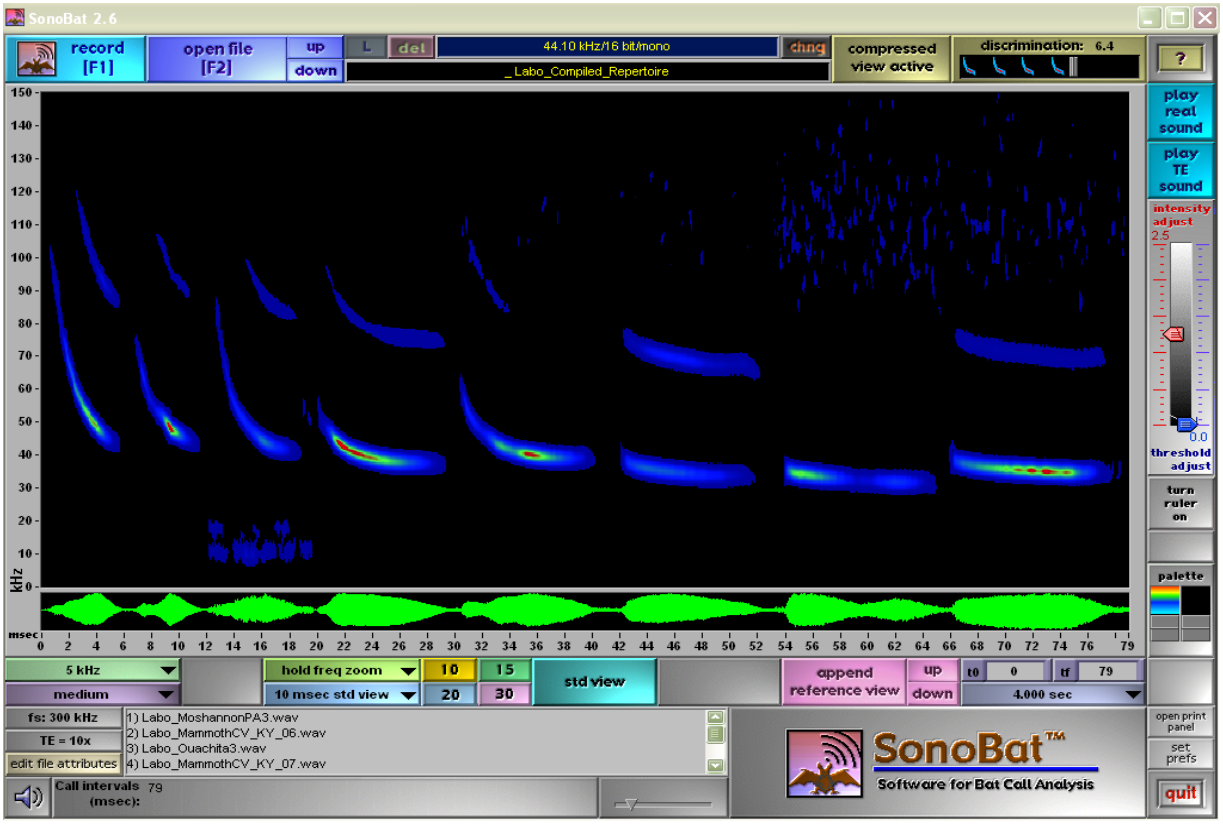

Figure 5. Variation in call structure within a single species (Eastern Red Bat, *Lasiurus borealis*). Source: Sonobat.com

Not only do calls within a species vary dramatically based in the circumstance but similar call structures are used by different species when under similar circumstances. This convergence results in considerable call overlap between species. Many bat communities contain such acoustically overlapping species. Indiana bat echolocation call characteristics share a substantial amount of overlap with the echolocation call characteristics of little brown bats (Figure 6). In fact, the degree of overlap is such that only a very small portion of their repertoires may be

acoustically distinguished when pairs of call parameters are considered (Szewczak, 2012). Again this indicates that acoustic monitoring alone is likely to be unsuccessful in accurately determining Indiana bat presence and is counter to the stated goal of "maximize the potential for detection" of Indiana bats. The use of acoustics and mistnets together maximizes potential for detection.

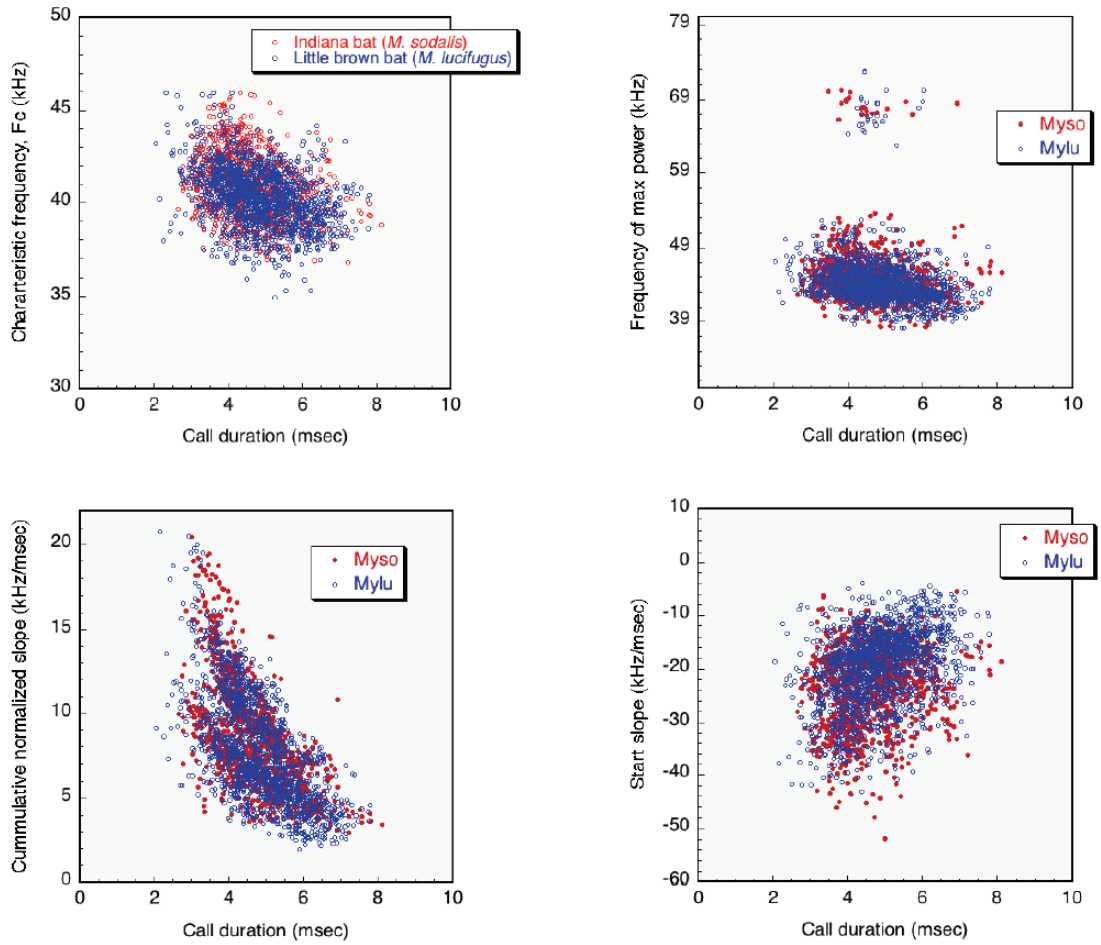

Figure 6. Indiana bat and little brown bat echolocation call characteristics overlap along numerous axes (from Szewczak, 2012).

Additionally, there is a high probability that such an "acoustics only" scenario can create a data set that is misleading in regards to the species biology. The potential for error is high when relying solely on acoustic surveys to accurately assess Indiana bat presence or absence, even with the implementation of statistical measures like "maximum likelihood analysis." False positive (Type I) errors may create a misleading impression of what constitutes Indiana bat habitat. For example, if the presence of an Indiana bat maternity colony is assumed based on acoustic data alone, this could lead to incorrect inference regarding Indiana bat habitat use, maternity colony roost selection, species summer distribution, etc. False negative (Type II) errors, in which Indiana bats are present on site, but not acoustically detected, would result in no

additional surveys (mist netting) being conducted and thus the species remains undetected and consequently potential impacts are likely to remain undetected. A more robust (fewer Type I or Type II errors) sampling strategy is expected from a combination of mist netting and acoustic surveys. This complementary strategy is more likely to achieve stated objectives to "maximize the potential for detection/capture of Indiana bats at a minimum acceptable level of effort", and "ensure the survey results are sufficient to be accepted by the USFWS for regulatory purposes".

Assumption 3: Assumes standardization among procedures and tools employed for acoustic surveys is achieveable through modification or clarification, and will result in comparable results.

We do not believe standardization of techniques and tools is achievable because there are too many inherent variations among and within equipment types, and the Guidance does not address ways to correct for them. One of the stated goals of the Guidance is to "standardize range-wide survey procedures." Typically a standardization of technique is desired when comparisons between data sets are expected and subsequent judgments or valuation are planned (e.g. this site is "better" than that site). Such standardization requires rigorous attention to the tools and techniques underlying the data collection and data analysis procedures since each step or decision point provides an opportunity for deviation from the standard thereby invalidating the comparisons.

Such deviation appears to be explicitly allowed by the Guidance document when it states that some "Indiana bat surveys will require modification (or clarification) of the Guidance". Such modifications can be expected to undermine the goal of standardization. Therefore, indicating what sort of modification the Service anticipates for "some projects" (number of acoustic monitoring stations, duration, weather proofing options, etc.) is important in the establishment of the Guidance.

Even without such allowed deviations, there are many potential sources of variation among acoustic monitoring surveys that are not adequately addressed in the Guidance each of which could erode the integrity of a data that is presumed to be standardized and directly comparable. Such difficulties are exemplified by the Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement Second Summary Report (2011). In Pennsylvania, as part of the Wind Energy Cooperation Agreement, specific acoustic monitoring protocols were established, and expected to be carried out accordingly. However, according to this report "Acoustic monitoring has proven to be the most problematic. Many issues have occurred during the data collection and reporting process, making data analysis extremely challenging."

This challenge was succinctly stated by Kunz and Brock (1975), "Other limitations include differential sensitivities and detection limits when two or more detectors (of the same or different types) are being used; furthermore, the possibility exists that detectors may fail to register all or some bat sounds since the latter are known to vary in frequency and pattern under different conditions (Griffin, 1958, 1971)."

There are several aspects of acoustic detector setup that are either not mentioned in the proposed Guidance, or are not given adequate explanation and clarification yet all effect the data collected and specifically the sampling volume of a detector. Statements about number of calls per

detector-night are making an implicit assumption that a detector-night represents a standard measure of sampling effort. For acoustic sampling, the sampling effort is best expressed as sampling volume. The sampling volume of detectors should be similar if comparisons are to be made between detectors at the same site (or between project sites).

Assuming the detection area is a cone (which it approximates) then the equation to calculate volume is

$$V = 1/3\pi r^2 h$$

The volume is therefore very sensitive to changes in the detection distance (h). For example, if a cone has a radius of 25 feet the sampling volume will increase by at least 50% for every 10 foot increase in detection distance (Table 1). Therefore small changes in detection distance (due to microphone sensitivity, atmospheric conditions, etc) have large effects on sampling volume. This in turn has a large impact on the interpretation of the abundance indices typically reported by acoustic monitoring studies.

Table 1. Detection distance and sampling volume of bat detectors.

Detection Distance (ft)	Volume samples (ft^3)	Volume difference from the 20 ft detection distance (ft^3)	Percent difference from the previous detection distance (%)
20	13083.32	0	NA
30	19624.98	6541	50 %
40	26166.64	13083	67 %
50	32708.3	19625	75 %
60	39249.96	26166	80 %
70	45791.62	32708	83 %
80	52333.28	39250	86 %

For example, there are two proposed projects that are near each other, of nearly identical size, and based on the Phase I habitat assessment are potentially suitable for Indiana bats, and both followed the Draft Guidance document to acoustically assess Indiana bat presence. At proposed Project 1 zero (0) Indiana bat calls per detector-night are reported and at proposed Project 2 one (1) Indiana bat call per detector night is reported.

On the surface it would appear that Project 2 has Indiana bats and the potential to impact them whereas Project 1 does not. This statement is predicated on both exerting an equal sampling effort (as per the Draft Guidance) and thus had an equal likelihood of detecting Indiana bats if they are present. However, because of the detector setups used, the sampling effort at Project 1 was less than half of that of Project 2. At Project 1 the sampling distance for the detector is 30 feet (19,642 cubic feet) whereas at Project 2 the detector sampled out a distance of 60 feet (39,249 cubic feet). Project 2 sampled effort was more than twice that of Project 1 and therefore Project 2 was twice as likely to detect Indiana bats if present. Such differences in sampling

volume between detectors has many sources, as presented below, but in all cases the end result is that assumptions about equal sampling effort and therefore equal likelihood of detection are violated. These differences also undermine the stated goals of the Guidance to "standardize range-wide survey procedures" and to "ensure survey results are sufficient to be accepted by the USFWS for regulatory purposes" since Project 1 has the potential to "take" Indiana bats under the ESA but will not be subject to the regulations of the ESA.

Sources of Variation in Sampling Volume which undermine sampling standardization

Detector Sensitivity

As expressed by one of the equipment manufacturer "The sensitivity of the detector also has a major influence on detection distance, and while there is always some variability in sensitivity among units, the biggest influence is the setting of the sensitivity control." (http://titley-scientific.com/anabat-bioacoustics-anabat-support#1) This sensitivity control is achieved through the gain setting.

In addition to affecting the sampling volume, altering the gain setting can influence the quality of data a given detector will record. Setting the gain too high, and the detected echolocation calls could be masked by noise, whereas setting it too low could lead to call fragments instead of detecting the entire call (Figure 8). These effects primarily occur when using a zero-crossing detection system since only the "loudest" sound can be detected. The effects are less problematic for a full spectrum system since the entire soundscape is recorded and thus "loud" noise such as insects can occur at the same time as "quieter" bat calls and the bat calls will still be detected.

Variation in the sensitivity setting is explicitly allowed within the current Guidelines (see Appendix B report item #6). All of these effects of the gain setting undermine the stated goals of the Guidance to "standardize range-wide survey procedures."

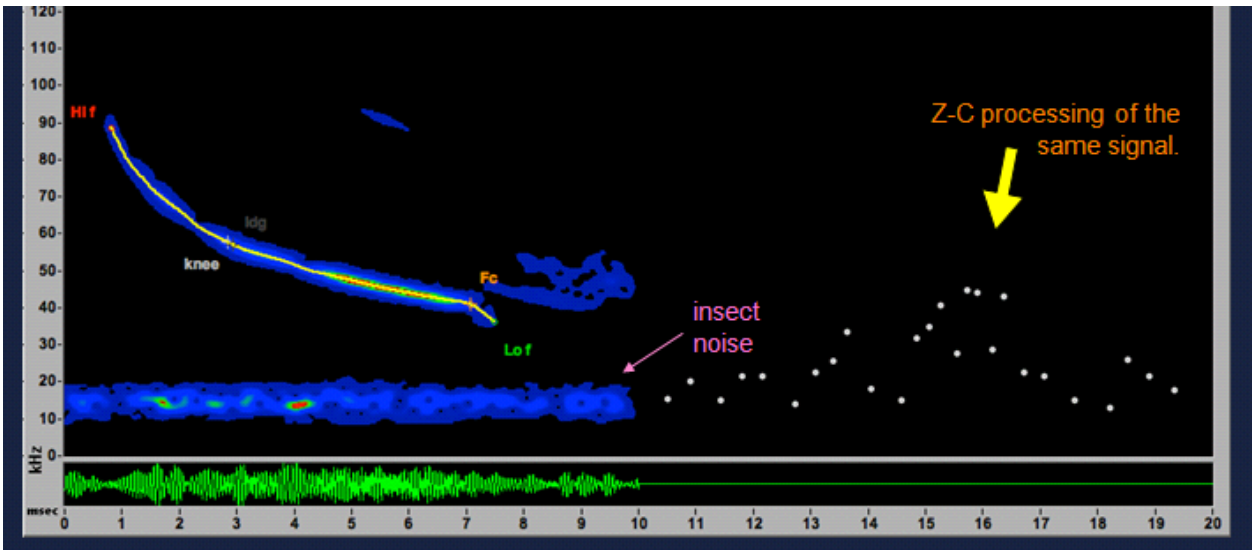

Figure 8. Simultaneous recording of a bat in a noisy environment.

Full spectrum (left) is able to record both the "louder" insect noise and the "quieter" bat call whereas zero-crossing data (right) records the "loudest" sounds and cannot readily separate the insect noise from the bat call

Detector Power Supply

The power source for a bat detector may influence the sensitivity of the detector. This has been demonstrated with Anabats, in that as battery power decreases over time, the detection range and volume also decreases (Lausen et al, 2006). Since the batteries voltage does not decline at a constant rate or evenly across detector, a correction factor cannot be readily calculated. Therefore, detectors that depend on batteries (or even undersized solar panels) can experience undocumented and uncorrectable loses in volume preventing comparisons across detectors and undermining one of the stated goals of the Guidance to "standardize range-wide survey procedures."

Weatherproofing

While it has been suggested by the Guidance document that detectors in PVC weather proofing perform similarly in regard to number of files recorded and the number of pulses per file, Britzke et al. 2009 determined that Indiana bats were not detected as readily by detectors enclosed in PVC weatherproof containers compared with a bare microphone positioned at 45º. Therefore, it may be assumed that surveys conducted without weatherproofing may be more likely to detect Indiana bats than surveys conducted with weatherproofing. Allowing for surveys to be conducted with either PVC weather proofing or without weather proofing (bare microphone), may lead to inconsistent results among acoustic surveys, and detector setups without weather proofing may be more likely to detect Indiana bats (or high frequency echolocating bats). This difference undermines the stated goals of the Guidance to "standardize range-wide survey procedures."

Microphone Selection and Maintenance

Microphones vary between detectors and may also be interchangeable for a given detector. Each microphone has a different sampling volume due in part to their differential sensitivities to various frequencies.

To provide one example, there are two microphone options typically used with an Anabat (HiMic and Standard Mic). The Hi Microphone can be used both on the detector as well as on an extension cable where the microphone is separated from the detector body. The Standard Microphone is for use when the microphone will be attached directly to the detector body and it draws 1/3 less current than the other microphones. This microphone cannot be attached to an extension cable without a loss of sensitivity, especially at higher frequencies.

Additionally, Lausen et al (2006) reported that discoloration of the microphones results in decreased sensitivity of Anabat detectors.

However, the current Guidance does not address these two major sources of variation in sampling volume thereby undermining the stated goals of the Guidance to "standardize range-wide survey procedures."

Data Cable Impedance

All data cable experience impedance, which is the opposition that a circuit presents to the passage of a current at a given voltage. Corben (no date) describes how the standard microphone showed no loss of sensitivity with a 1 m cable, but approximately a 5 dB loss above 20 kHz with a 7m cable. Further, Lausen et al (2006) reported that for Anabat "Microphone cables exceeding 60m in length should be avoided as they can interfere with proper signal transmission"

Cable impedance does not affect sampling volume of a detector but it does have a similar affect in that it can have unappreciated consequences on the data set by underreporting bat activity. If the impedance is too high then the calls will simply not be received by the data storage device and thus there will not be a record (e.g. bat call) of the detection event. Loss of such data during transmission again undermines the stated goals of the Guidance to "standardize range-wide survey procedures" and to "maximize detection".

Conclusion

We recognize that some of the above noted discrepancies in the proposed Guidance can be corrected for to some degree. We support the Service's plan for future training/certification in acoustic surveys. We agree that acoustic data collection should be added to survey guidelines. However, we believe that there are poorly applied requirements that lack documentation in the literature, violate the stated goals of the proposed new guidelines, and may result in unreliable assumptions regarding the presence of sensitive bat species.

Please consider the following: There is a serious lack of support for the currently proposed changes to the Indiana bat survey guidelines. The Service stated, at bat working group conferences, that they intend to develop a certification program for acoustic surveyors in the next year. There is very little time between now and when the 2013 summer bat survey season begins, severely constraining the ability of surveyors to deal with the logistical and extreme financial requirements of the addition of a major acoustical component to bat surveys. Therefore, we hope that there will be no enforced changes to the Indiana bat summer survey guidelines until the Service has sufficient time to fully review and act on the public comments as well as enact a certification program for acoustic surveys.

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