

Monitoring Bat Species Diversity in the Northern Thumb Area of Michigan Through the Use of Mobile Surveys



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EXECUTIVE SUMMARY

Many areas in Michigan possess winds adequate for the efficient generation of wind energy. Some of these areas have also been documented to provide habitat for wildlife, including bats. Bat fatalities at wind turbines due to collisions with turbine blades and monopoles, as well as due to barotrauma, have been documented throughout North America, including the Midwestern United States. Wind farm and wind turbine siting and operation decisions, informed by knowledge of the distribution of bats in the landscape, can mitigate bat mortality due to wind energy facilities and argues for the development of bat distribution and activity information in order to inform decision makers.

Mobile surveys, conducted on an approximately weekly basis, for bats along a 22.5 mile route near Pigeon, Huron County, Michigan were conducted in August through October 2013, using an Echo Meter EM3 monitor, manufactured by Wildlife Acoustics, Inc., equipped with an external SMX-US ultrasonic microphone and geographic positioning system. This system allowed not only assessment of bat presence and level of activity in the survey area, but also allowed for geospatial analysis of the calls with respect to associated habitats.

Three bat species were identified from the area: big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*). The majority of bat detections occurred in the early to mid-August timeframe, with few detections in September and October. Geospatial analysis of the calls indicated that bat activity was distributed in proportion to the amount of riparian versus agricultural field habitats contained within the driving route. While this latter finding suggests that the USFWS guidance that siting of wind turbines more than 1,000 feet from known Indiana bat (*Myotis sodalis*) may not be protective of bats in general, this conclusion should be tempered in light of the limited dataset represented by the current study.

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INTRODUCTION

Construction of new wind farms is expected to continue in Michigan and throughout the Midwest not only due to energy portfolio requirements placed on power suppliers, such as the mandatory 10% renewable energy goal by 2015 in Michigan, but also due to the recognition by wind energy developers of the abundance of high wind energy areas throughout the region and the economic opportunities they represent. While wind energy is often considered “green” energy, there are associated environmental impacts. Of great concern is the impact of wind farms on bats, as wind turbines are known to cause mortality due to both collision and decompression (barotrauma)(National Academy of Sciences 2007). Barotrauma occurs when the quickly moving rotors create a low-pressure vortex; bats flying through this zone, or pulled into it, may suffer severe lung damage, resulting in pulmonary hemorrhage (Baerwald et al. 2008).

Based on mortality rates observed at functioning wind farms, as well as the projected increase in number of wind developments, biologists estimate that the number of deaths in the year 2020 for the Mid-Atlantic region alone may be 33,000–110,000 bats. Bat populations are also under tremendous threat due to the recent spread of white-nose syndrome, a fungus which can cause 99% mortality of bats when infecting hibernacula. About half of the approximately 45 species of bat in the United States and Canada are currently considered endangered or threatened at the national or local level, and any further threats to bats are a cause of concern to wildlife biologists. The northern long-eared bat is under consideration for additional protection via the Endangered Species Act in part due to white-nose syndrome.

Nine species of bats live in Michigan: eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), Indiana bat (*M. sodalis*), northern long-eared bat (*M.*

septentrionalis), and evening bat (*Nycticeius humeralis*). Three of these species are rare in Michigan, with the Indiana bat appearing on both the federal and state lists of endangered species, the evening bat appearing on the state list as threatened, and the eastern pipistrelle being considered a “special concern” species. Furthermore, the State of Michigan’s Wildlife Action Plan labels these three species, as well as the eastern red bat, hoary bat, silver-haired bat, and northern bat, as species of “greatest conservation need”. Three of these species are also the most commonly found to suffer mortality due to wind turbines: eastern red bat, hoary bat, and silver-haired bat.

The northern thumb area of Michigan (Huron County) is an area with high quality wind resources and is already the home of two wind farms operated by Exelon Inc., with further wind energy development being planned by Consumers Energy and Invenergy. There is currently a paucity of bat monitoring data for the region and it is important to monitor bat activity in the region to provide useful information for siting wind turbines, as well as monitoring overall bat populations in the face of the WNS threat.

This report is the result of monitoring activities conducted in the late summer of 2013 to assess the presence and relative abundance of bats in general in northern thumb area of the Lower Peninsula of Michigan. These data will help wind energy developers and resource managers to make appropriate decisions regarding the potential impacts to bats and the methods in which they might mitigate those impacts if needed.

STUDY RATIONALE AND FOCUS

The US Fish and Wildlife Service (USFWS) has established operating guidelines with regards to protected bat species and wind farm development. Those guidelines indicate that if wind turbines can be located more than 1,000 feet from foraging or roosting habitat of the Indiana bat it is unlikely that the turbines will impact this endangered species during the summer breeding season (Lori Pruitt,

USFWS, personal communication). This guideline is based on USFWS opinion that the Indiana bat tends to forage within wooded areas, or along the edge of wooded areas, but does not forage or travel across open fields to any appreciable extent. Some support for this guidance was generated from pilot studies by Klatt, et al. (2010), in an area from which both the Indiana bat and the evening bat had been reported. Additional monitoring to further test the soundness of the USFWS guidance was conducted in the summer of 2013, and is reported elsewhere (Klatt and Gehring, 2013). The 2013 studies generally, though not as emphatically as the pilot studies, support the USFWS guidance. While the USFWS guidance was developed for the Indiana bat specifically, it is likely this guidance may be used in a more general manner until, if and when, further guidance for siting turbines is established by the USFWS or state regulatory agencies.

Given the above considerations, this monitoring study was designed with the following goals: 1) provide information on the general level of activity of bats in the study area; 2) provide information on the relative abundance of different bat species in the study area; and 3) use the monitoring data to test the validity of the USFWS guidance related to use of agricultural fields versus riparian areas by bats. Given these goals, bat activity was monitored from early-mid August through the end of October via recording of bat echolocations during a mobile survey. Additionally, by using GPS technology in conjunction with recorded bat calls, it is possible to provide a test of the generality of the USFWS guidance beyond the Indiana bat by comparing the number of bat calls associated with riparian habitats versus agricultural habitats compared to sampling effort in each habitat type.

STUDY SITE DESCRIPTION AND METHODS

Study Site

Monitoring was conducted in the area of the Pigeon River and surrounding agricultural areas, south of Pigeon, Huron County, Michigan (Figure 1). The

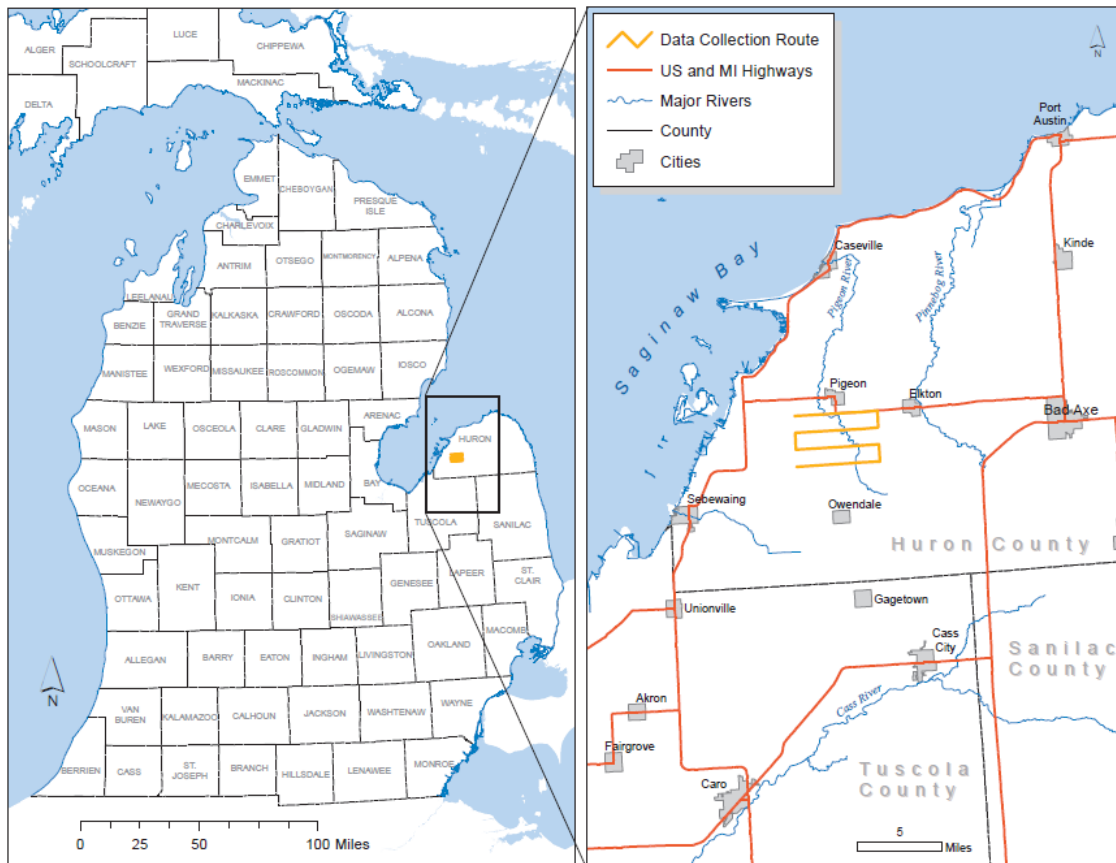


Figure 1. Project location.

project area was selected due the following characteristics: 1) it is located in an area of potential high wind energy (Wind Energy Resource Zone Board 2009); 2) it is located near both existing and proposed wind farms; and 3) it contains primarily a mixture of agriculture fields traversed by wooded, riparian areas. The project area is located in Sub-subsection VI.5.1 Sandusky Lake Plain of the landscape ecosystem classification of Albert (1995). This sub-subsection consists of a mixture of broad, level lake plain, with narrow till plains and some

end moraines. Soils range from sands to clays to peat. Historically, the project area was vegetated with cedar swamp, mixed-hardwood swamp, black ash swamp, and hemlock-white pine forest (Albert 2008). However, most of the area has been ditched or tilled and constitutes some of the most important agricultural land in the state today. As a consequence, the pre-settlement forests are all but gone and the character of the remaining forests has changed dramatically from the original conifer forests. Today the project area consists mainly of agricultural fields, with some forested areas, and riparian galleries along the Pigeon River, which meanders through the project area.

Monitoring Methods

Bat activity was monitored by recording ultrasonic calls along a designated driving route (Figure 2). The route was approximately 22.5 miles long and was designed to pass through both wooded, riparian and agricultural habitats. Approximately 15% of the length of the route was within 1000 feet of riparian habitat, while 85% was greater than 1000 feet from riparian habitat and thus considered as associated with agricultural habitats. Calls were recorded using an Echo Meter EM3 (EM3) monitor produced by Wildlife Acoustics, Inc., equipped with an external SMX-US ultrasonic microphone and optional geographic positioning system (GPS). The EM3 was set for a 384kHz sampling rate, providing an effective 192kHz band width. Recordings were made in full spectrum mode, but recorded in compressed format. GPS waypoints were automatically recorded every 13 seconds.

Monitoring sessions were started within one half hour after sunset and the route was traveled at a maximum of 15 miles per hour. To maximize likelihood of bat activity during monitoring sessions, surveys were attempted only on evenings with low wind and no rain. To avoid time bias in sampling, the starting point of each monitoring session was altered between the “start” and “finish” of the route between each survey. While this project was originally planned for driving the route once per week for 5 weeks, twice during the summer season (prior to 15

August, consistent with USFWS guidance) and three times during the migration season (15 August and subsequently), the route was driven eight times taking advantage of meteorological conditions conducive to bat activity. The monitoring dates were: 8, 13, 21, and 28 August; 6, 11, 20, and 26 September; and 1 and 24 October, 2013.



Figure 2. Driving route and bat call locations.

Acoustic data analysis

Compressed field recordings (WAC format) were converted to WAV audio files using Wildlife Acoustics, Inc.'s Kaleidoscope (v 0.3.1) software. To insure compatibility of WAV files with Sonobat call analysis software, Kaleidoscope software was set to the following: files were split into a maximum of 8 second segments and noise files were scrubbed using a "signal of interest" of 8-120 kHz and 1-500 milliseconds.

Non-noise files were batched analyzed using Sonobat 3.1 NNE. The Sonobat software attempts to classify calls of sufficient quality either by species, or as “High” or “Low” frequency calls, using a discriminant function analysis and expert opinion approach. The bat species occurring in Michigan that would be included in the high frequency calls include: little brown bats, eastern red bat, Indiana bat, eastern pipistrelle, and northern long-eared bat. Conversely, bat species with low frequency calls include: big brown bat, silver-haired bat, hoary bat, and evening bat.

To insure at least attempted classification of all but the most low quality non-noise files, Sonobat acceptable call quality was set to 0.20. However, to insure only those calls with highest level of confidence were tallied as to species, the probability threshold for classification was set to 0.90 and only calls classified by “consensus” were tallied to species.

With respect to the relative use of wooded, riparian areas versus adjacent agricultural fields, the following hypothesis was statistically tested: “Bat activity, as measured by the frequency of recorded bat echolocations, does not differ between riparian areas versus adjacent agricultural areas after adjusting for sampling effort in each habitat type”.

RESULTS AND DISCUSSION

Some species of bats are difficult to separate from one another using acoustic data; of particular note, the calls of the little brown bat, northern long-eared bat, and Indiana bat overlap in many quantitative call measurements and may not be separable, as might the calls of the silver-haired and big brown bats. As the overlap of call characteristics makes unambiguous classification of these species difficult, and hence it is difficult for Sonobat to reach “consensus”, the abundance

of these species' calls may be underestimated, with the calls simply classified as "high" or "low" frequency.

Surprisingly few bat echolocations were recorded during the monitoring; Table 1 presents a summary of the calls recorded. Only three species were unambiguously detected: big brown bat, hoary bat, and silver-haired bat; accounting for 13 of the total 21 calls recorded. Of the total 21 calls, all were classified as low frequency. A particularly surprising result was that all but two of the calls were recorded in August, with one call being recorded in each of September and October. While bat migration is generally considered as beginning toward the end of July, it typically continues into September. Indeed, USFWS guidance suggests that migratory monitoring should be continued through October. However, given the limited amount of time during which the monitoring was conducted (approximately 1.5 hours, once per week) and the vagaries of bat activity in general, the rapid drop in detections going into late August may not be that surprising.

Table 1. Classification of recorded calls and associated habitats.				
	Call Classifications			
Habitat	Big brown bat	Silver-haired bat	Hoary Bat	All Calls*
<i>Riparian</i>	2	1	0	4 (3)
<i>Agricultural</i>	3	1	6	17 (18)
Totals	5	2	6	21
* Includes those calls for which a species consensus was not reached by Sonobat. Numbers in parentheses indicate the number of calls expected in each habitat based on the percentage of the monitoring route associated with each type of habitat.				

As noted in the Monitoring Methods section, 15% of the monitoring route was within 1000 feet of wooded, riparian habitat and 85% was located more than 1000 feet from wooded, riparian habitat and consequently considered as associated with agricultural fields. A Chi-square test on the frequencies of all calls associated with riparian versus agricultural areas indicated that observed

frequencies did not differ significantly from those expected based on the proportions of habitat represented by the sampling route (Chi-square = 0.27, df=1, P=0.603). Thus, the results of this monitoring do not support the general applicability of USFWS wind turbine siting guidance. However, again, firm conclusions should be drawn cautiously given the limited size of the dataset in the current study. It is interesting to note that the hoary bat appears to exhibit a preference for agricultural areas. This observation is in agreement with more extensive data collected in 2012 in the Palmyra-Blissfield area of Lenawee County (Klatt and Gehring 2013).

CONCLUSIONS

Three bat species were identified from the monitoring area: big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*). The majority of bat detections occurred in the early to mid-August timeframe, with few detections in September and October. Geospatial analysis of the calls indicated that bat activity was distributed in proportion to the amount of riparian versus agricultural field habitats contained within the driving route. While this latter finding suggests that the USFWS guidance that siting of wind turbines more than 1000 feet from known Indiana bat (*Myotis sodalis*) may not be protective of bats in general, this conclusion should be tempered in light of the limited dataset represented by the current study.

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