Baseline Bat Acoustic Analysis for the Blissfield Proposed Wind Energy Site: Summary of 2010 Field Season

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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 collisions with and fatalities at wind turbines have been documented throughout North America, including the Midwestern United States. At many wind energy projects the frequency of those collisions has been of concern to resource managers. Preliminary research suggests that informed siting and mitigation of wind turbines can minimize impacts to bats. Due to the potential for bat fatalities at wind turbines, we collected bat acoustic data within the Blissfield proposed wind project to better understand the densities of bats in the Project Area, as well as the species composition. These data will help wind energy developers and resource managers to make appropriate decisions regarding the potential impacts to bats and the methods by which they might mitigate those impacts.

In an effort to quantify the bat use and activity of the Project Area, we collected acoustic, echolocation data (via Anabat SD2 units) to estimate the bat densities in early 18 August – 17 November 2010. Low frequency bat calls made up 93% (1,375) of the total calls detected (1,484), whereas the high frequency calls were only 7% (109) of the calls. Of those bats qualitatively identified to species the general Myotis group was the most abundant (0.08 bats/ detector night). The second most abundant was the big brown bat/sliver-haired bat group with (0.04 bats / detector night), followed by the Eastern red bat (0.02 bats / detector night), and the Eastern pipistrelle (0.02 bats / detector night; Table 1). These species were consistent with the open / disturbed / agricultural habitats found in the Project Area and the migratory corridor for bats through the Great Lakes. No Indiana bats were qualitatively detected among the acoustic data collected; however, as previously stated, results should be interpreted with care.

The species expected to be in the Project Area that would be most likely to suffer fatalities at wind turbines include: Eastern red bat, hoary bat, silver-haired bat, and

Eastern pipistrelle. Given the endangered status of the Indiana bat, the ramifications of a turbine-caused fatality are critical. Fatalities can potentially be mitigated using different turbine cut-in speeds during periods of the year with high risk for bat fatalities. Specifically, Arnett et al, (2010) determined that if cut-in speeds were increased to 5-6 m per second that fatalities could be reduced by 43-90%. In addition to changes to cut-in speeds, I recommend that water sources and forest edges be buffered in the micro-siting of wind turbines.

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Introduction

Many areas in Michigan possess the quality of winds necessary 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 in North America have been documented and can be in high frequency, depending on the site and situation. Wildlife that use the airspace within the rotor swept area of a turbine are at risk of a collision and therefore the frequency of bat fatalities at turbine sites can be directly correlated to the density and behavior of bats in the local area.

Due to the potential for bat fatalities at wind turbines we collected bat acoustic data to better understand the densities of bats in the area as well as the species composition. Understanding bat activity patterns in the proposed Project Area will help inform wind developers and resource managers as to the risk of bat fatalities as well as inform the specific placement of turbines within a Project Area. 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 and as needed.

Study Site and Methods

Study site and description

Research was conducted in the Project Area within Lenawee County, located in southeastern Michigan, USA (Fig. 1). The land use / land cover of the Project Area consists mainly of agricultural fields (e.g, corn, soybeans, and wheat), with some pastures, forested areas, and some small wetlands. Various streams and drains traverse the Project Area within the watershed of the River Raisin, which runs partially within and to the north of the Project Area. The natural vegetation in this area is generally described as mesic forests, wet forests and forested riverine corridors. The forest overstory typically includes components of maple (*Acer* spp.), oak (*Quercus* spp.), ash (*Fraxinus* spp.) and cottonwood (*Populus deltoides*) with an understory of bracken fern (*Dennstaedtiaceae* spp.) and other herbaceous plants. The land type is predominantly Ann Arbor Moraine and Maumee Lake Plain (Albert 1995) which is generally flat with some gently sloping areas. Historically, the northern portion of the Project Area was vegetated with beech-sugar maple forest and the southern portion was predominantly mixed hardwood swamp which is now drained for agricultural use (Comer et al. 1995).

Figure 1. The Blissfield Project Area in Lenawee County of southeastern Michigan, is predominantly agricultural lands with some interspersed forested areas.

Bat acoustics data collection

In an effort to quantify the bat activity and species composition of the Project Area, we collected data using methods similar to those used in studies at other wind energy projects (Fiedler 2004, Gruver 2002, Jain 2005). Data were recorded using Anabat SD2 zero-crossing ultrasonic detectors synchronized and programmed to start recording 15 minutes before sunset until 15 minutes after sunrise, thereby focusing on the nightly periods of bat activity (Titley Electronics Pty Ltd, Ballina, NSW Australia). We calibrated the sensitivity of the Anabats as suggested by Larson and Hayes (2000). Units were secured and weatherized in plastic containers with PVC tubes protecting the microphones but allowing sound to be recorded. One weatherized unit (Anabat #1) was elevated above the ground vegetation but placed at ground level near the site where a meteorological monitoring tower was planned for erection. Two other Anabats were installed at an existing meteorological tower with 1 microphone at 5 m above ground level (AGL; Anabat #2) and another microphone at 55 m AGL (Anabat #3; Fig. 2). The Anabats microphones attached to the tower were each weatherized using a microphone holder and angled Plexiglas to reflect the sound up into the microphone (i.e., “bathats”, EME Systems, Berkeley, CA; Fig. 3). By elevating the microphone we were able to collect data on bat species that may not have been detectable from the ground.

Figure 2. Three Anabats were installed to collect bat acoustic data in the Blissfield Project Area in Lenawee County of southeastern Michigan. Anabat #1 was located on the ground level, Anabat #2 was attached to a meteorological monitoring tower at 5 m above ground level, and Anabat #3 was attached to a meteorological monitoring tower at 55 m above ground level,

Bat acoustic data analysis

We used the data analysis techniques and definitions suggested by Hayes (2000), Sherwin et al. (2000), and Gannon et al. (2003). Specifically, a “call” was defined as a sequence with duration greater than 10 milliseconds (ms) and including >2 individual calls (Thomas 1988, O’Farrell and Gannon 1999, and Gannon et al. 2003); and calls were considered to be separate events and independent.

Data from the entire survey period were downloaded and processed. Before analysis began all non-bat ultrasonic detections were eliminated from the data set using

Analook filters. Remaining data were then separated into two groups based on their minimum frequency of the call; with high frequency calls defined as >35 kHz and low frequency calls defined as <35 kHz calls. These Analook filters were developed by Britzke and Murray (2000) and included a Smoothness value of 15 and a Bodyover value of 240 which assisted in removing additional noise in the data such as echoes, extraneous noise (Smoothness), and pulse fragments and feeding buzzes (Bodyover). The species in this region that would be included in the high frequency calls include: little brown bats (*Myotis lucifugus*), Eastern red bat (*Lasiurus borealis*), Indiana bat (*Myotis sodalis*), Eastern pipistrelle (*Pipistrellus subflavus*), and Northern myotis *(Myotis septentrionalis).* Conversely the bat species with low frequency calls include: big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), and evening bat (*Nycticeius humeralis*). Although many species of bats are difficult to separate from one another using only acoustic data we qualitatively identified species or groups based on duration, minimum frequency, interpulse interval, and the shape of the pulse (via frequency-versus-time curve; O'Farrell et al. 1999). The calls of the little brown bat, Northern myotis, and Indiana bat overlap in many quantitative call measurements are extremely difficult to differentiate. This should be considered when interpreting the results presented in this report (Kurta and Tibbels 2000, Tibbels 1999). Within the low frequency calls the silver-haired bat and big brown bat are not able to be effectively separated and were therefore grouped together (Betts 1998). The species or groups that were qualitatively identified include: Eastern pipistrelle, Eastern red bat, hoary bat, Myotis general, Indiana bat, big brown bat/silver-haired bat, and evening bat.

Figure 3. Two bathats were installed to house Anabat microphones and to collect bat acoustic data at 5 m and 55 m AGL in the Blissfield Project Area in Lenawee County of southeastern Michigan.

Results and Summary

We detected a total of 1,484 bat calls from all 3 detectors from 18 August through the 17 November 2010. Although bats were detected in November 2010, most of the bat detections were in August through October of our sampling period (Fig. 4). This is relatively consistent with other studies of a similar topic and design (Fiedler 2004, Gruver 2002, Jain 2005). Figures 5-7 detail bat activity in relation to the time of the night for the individual bat detectors. In general, more bat activity was detected immediately after sunset and decreased in the middle of the night followed by a slight rise before dawn.

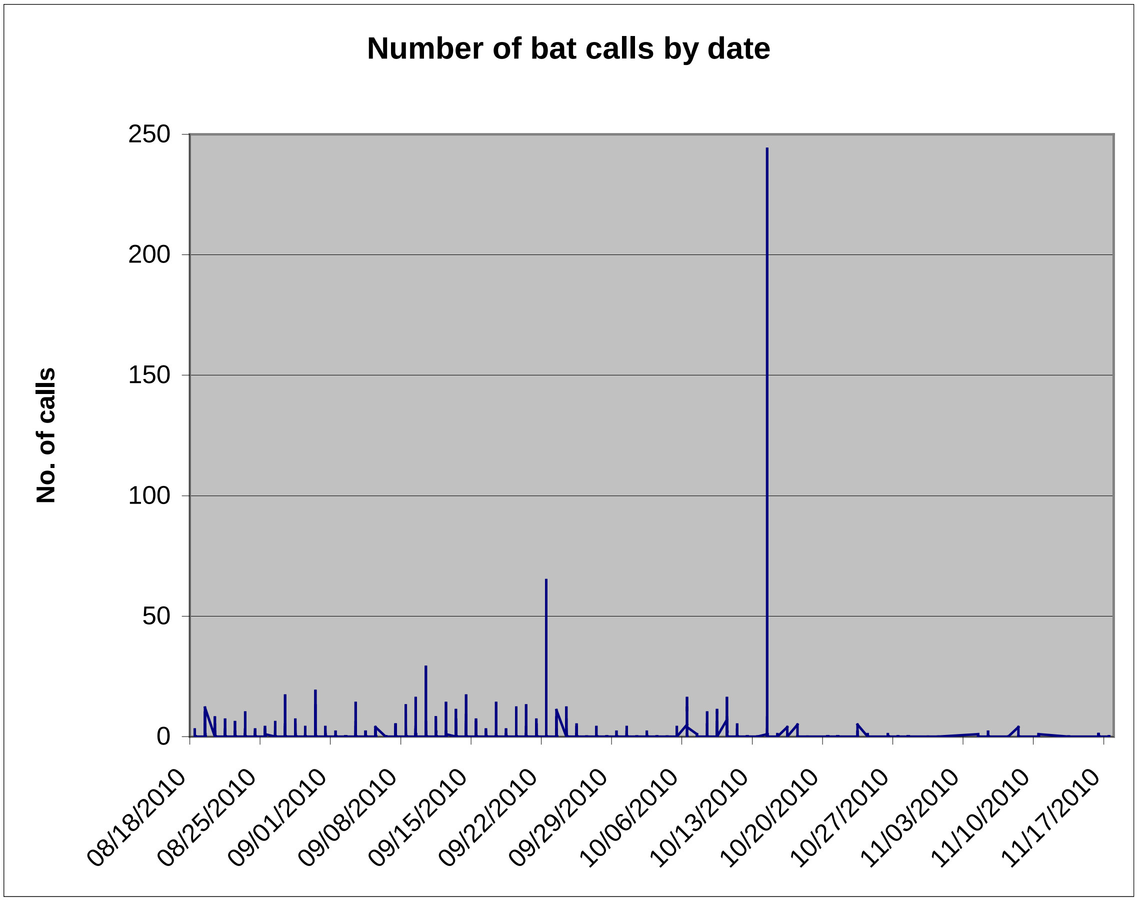

Figure 4. The number bat calls by the night of the field season August – November 2010 in the proposed Blissfield Project Area, in southeastern Michigan.

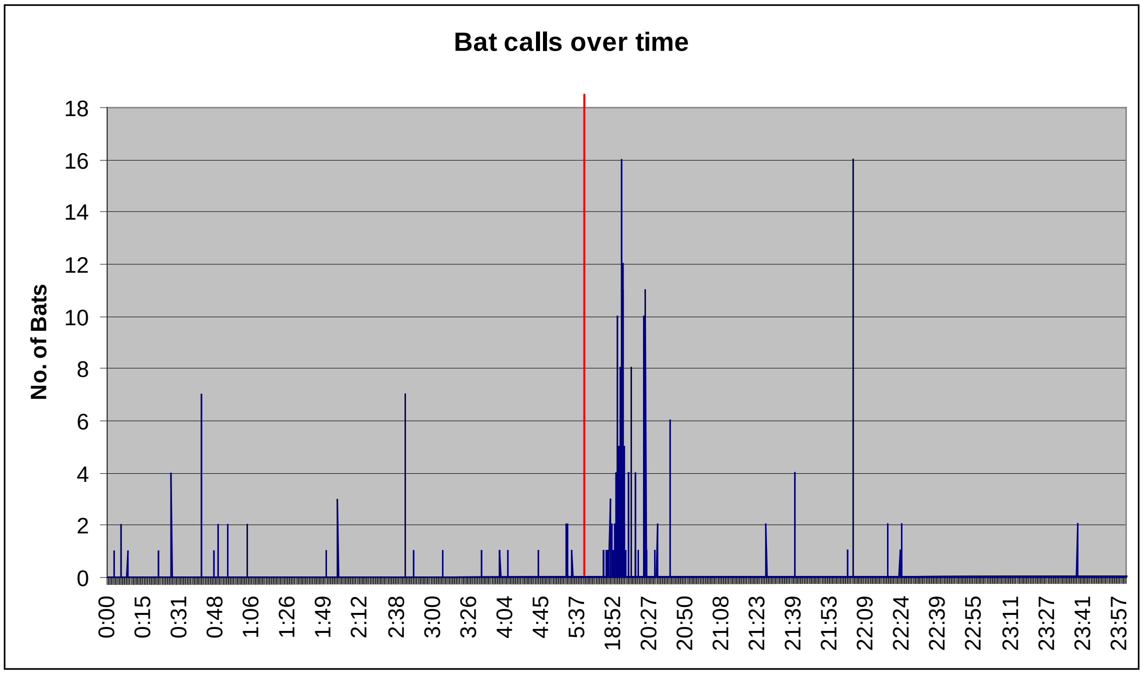

Figure 5. The number of bat calls by the time of night from mid-August – mid November 2010 at the Anabat location #1 in the proposed Blissfield Project Area. The red line delineates the end of one night of data collection and the beginning of another night of data collection.

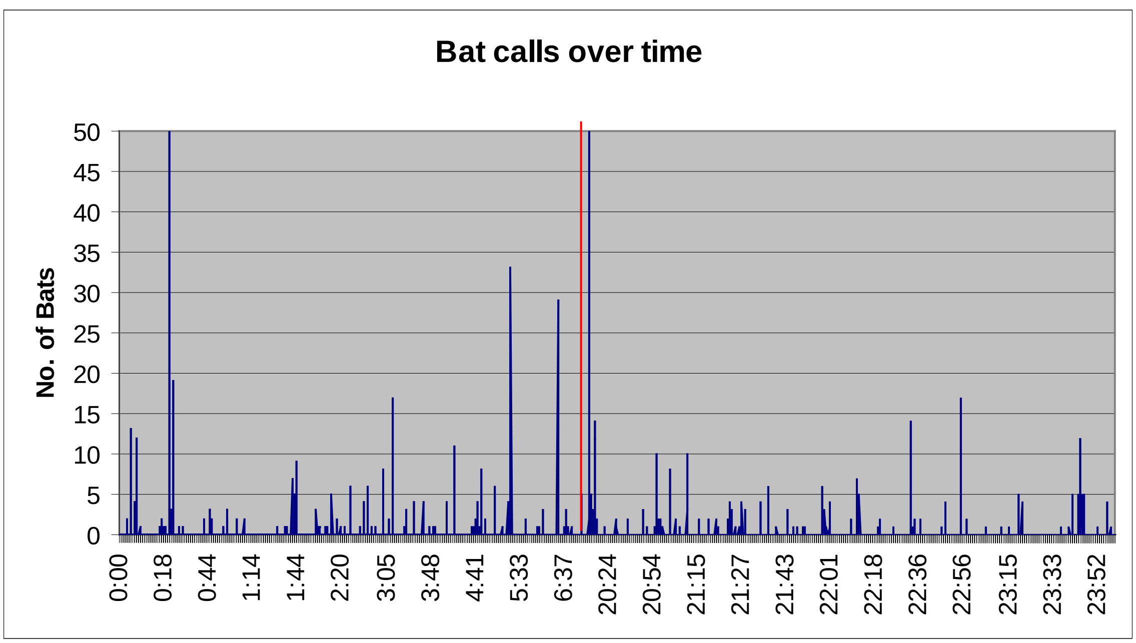

Figure 6. The number of bat calls by the time of night from mid-August – mid November 2010 at the Anabat location #2 in the proposed Blissfield Project Area. The red line

delineates the end of one night of data collection and the beginning of another night of data collection.

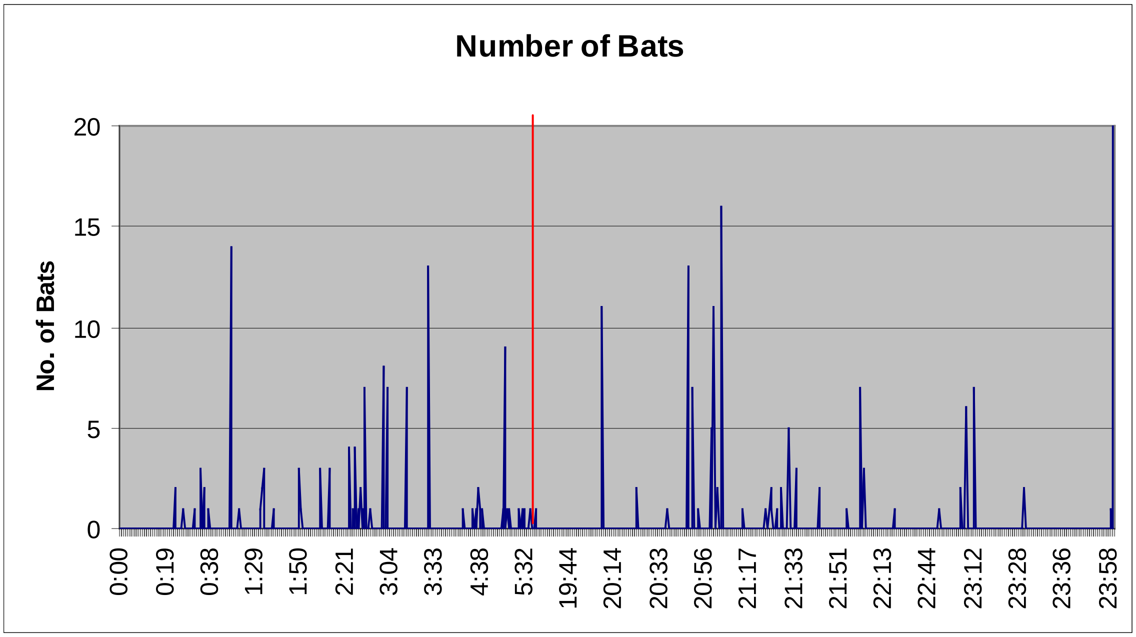

Figure 7. The number of bat calls by the time of night from mid-August – mid November 2010 at the Anabat location #3 in the proposed Blissfield Project Area. The red line delineates the end of one night of data collection and the beginning of another night of data collection.

Comparison of bat vocalization frequency

Low frequency bat calls made up 93% (1,375) of the total calls detected (1,484), whereas the high frequency calls were only 7% (109) of the calls. Of those bats qualitatively identified to species the general Myotis group was the most abundant (0.08 bats/ detector night). The second most abundant was the big brown bat/sliver-haired bat group with (0.04 bats / detector night), followed by the Eastern red bat (0.02 bats / detector night), and the Eastern pipistrelle (0.02 bats / detector night; Table 1). These species were consistent with the open / disturbed / agricultural habitats found in the Project Area and the migratory corridor for Eastern red bats through the Great Lakes. No Indiana bats were qualitatively detected among the acoustic data collected; however, as previously stated, results should be interpreted with care.

Several of the species observed in the Project Area have been detected as bat fatalities at existing wind farms in the United States (Fiedler 2004, Gruver 2002, Jain

2005). Those species expected to be in the Project Area that would be most sensitive to wind turbine fatalities include: Eastern red bat, silver-haired bat, and Eastern pipistrelle. The hoary bat also suffers fatalities at wind turbines; however, our detection method did not identify this species in the Project Area during the sampling period.

Table 1. Mean bat detections in the Blissfield Project Area proposed for the development of wind energy in southeastern Michigan. Data were collected between 18 August and 17 November 2010.

Species	Mean Abundance [a]
Big brown/silver-haired bat	0.04
Eastern pipistrelle bat	0.00
Evening bat	0.00
Hoary bat	0.00
Indiana bat	0.00
Myotis general bat	0.08
Red bat	0.02

[a] Mean Abundance = mean number of individuals observed per detector night

Conclusions

The Blissfield Project Area land cover is predominantly agricultural fields (e.g, corn, soybeans, and wheat), with some small grassy pastures and waterways as well as some small forested areas. Natural habitats are not readily available in the Project Area, which reduces the likelihood of the presence of rare species of bats, such as the Indiana bat. No qualitative evidence of the presence of Indiana bat was documented during the 2010 bat echolocation field season. Preliminary data suggest that bat fatalities at wind farms are positively correlated with seasonal densities of bats using the wind farm; however, nightly variation in fatalities was not always correlated with the numbers of detections at a particular turbine (Fiedler 2004, Gruver 2002, Jain 2005). Recent data suggest that increasing the height AGL of bat detectors results in more complete data and an increased level of correlation between bat detections and bat fatalities. These data provide useful information on the bat activity and species diversity in the Blissfield Project Area. Future efforts in the Project Area will further add to our knowledge and estimation of risk.

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