

**Baseline Bat Acoustic Analysis for the Proposed Blissfield Wind Energy Project:  
Summary of 2011 Spring Migration Field Season**



Prepared By:  
Joelle Gehring, Ph.D.  
Senior Conservation Scientist-Zoology Leader  
Michigan State University, Michigan Natural Features Inventory  
P.O. Box 30444 Lansing, MI 48909-7944

Prepared For:  
ERM, 3352 Avenue  
Holland, MI 49424-9263

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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 of wind turbines and mitigation can minimize impacts to bats. Due to the potential for bat fatalities at wind turbines, we collected bat acoustic data within the proposed Blissfield Wind Energy Project Area to better understand the densities of bats, 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 from 31 March through 30 June 2011. Low frequency bat calls made up 99% (80,006) of the total calls detected (80,135), whereas the high frequency calls were only 1% (129) of the calls. Of those bats qualitatively identified to species the hoary bat was the most abundant (0.05 bats/ detector night). Three groups had equal abundance for the second most common: big brown bat/silver-haired bat group, Eastern red bat, and myotis general (all 0.01 bats / detector night; Table 1). These species were consistent with the open / disturbed / agricultural habitats found in the Project Area and riverine forested migratory corridors of the Eastern red bats and hoary bats through the Great Lakes. Past studies documented maternity roosts of evening bats and Indiana bats in the Project Area; however, none were detected using the acoustic data. Although no Indiana bats were qualitatively detected among the acoustic data collected, it should be noted that it is possible there may be Indiana bat calls that could not be differentiated and are therefore within the grouping of myotis general detections.

The species expected to be in the Project Area that would be most likely to experience mortality from the proposed wind turbines include: Eastern red bat, hoary bat, silver-haired bat, and tri-colored bat. 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 meters per second that fatalities could be reduced by 43-90% for the cases evaluated in their paper. In addition to changes to cut-in speeds, adherence to the United States Fish and Wildlife Service’s suggestion of buffered riverine areas would likely decrease bat fatalities.

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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, the species composition, and activity patterns. 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 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).

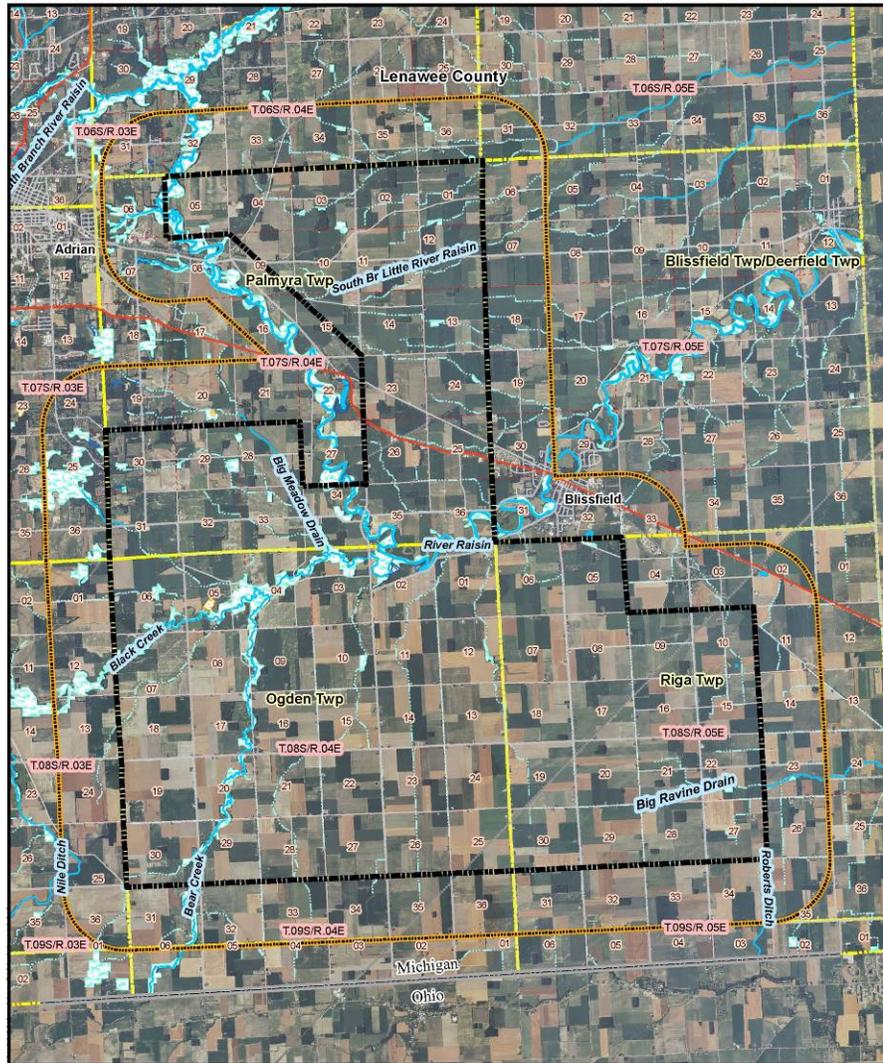
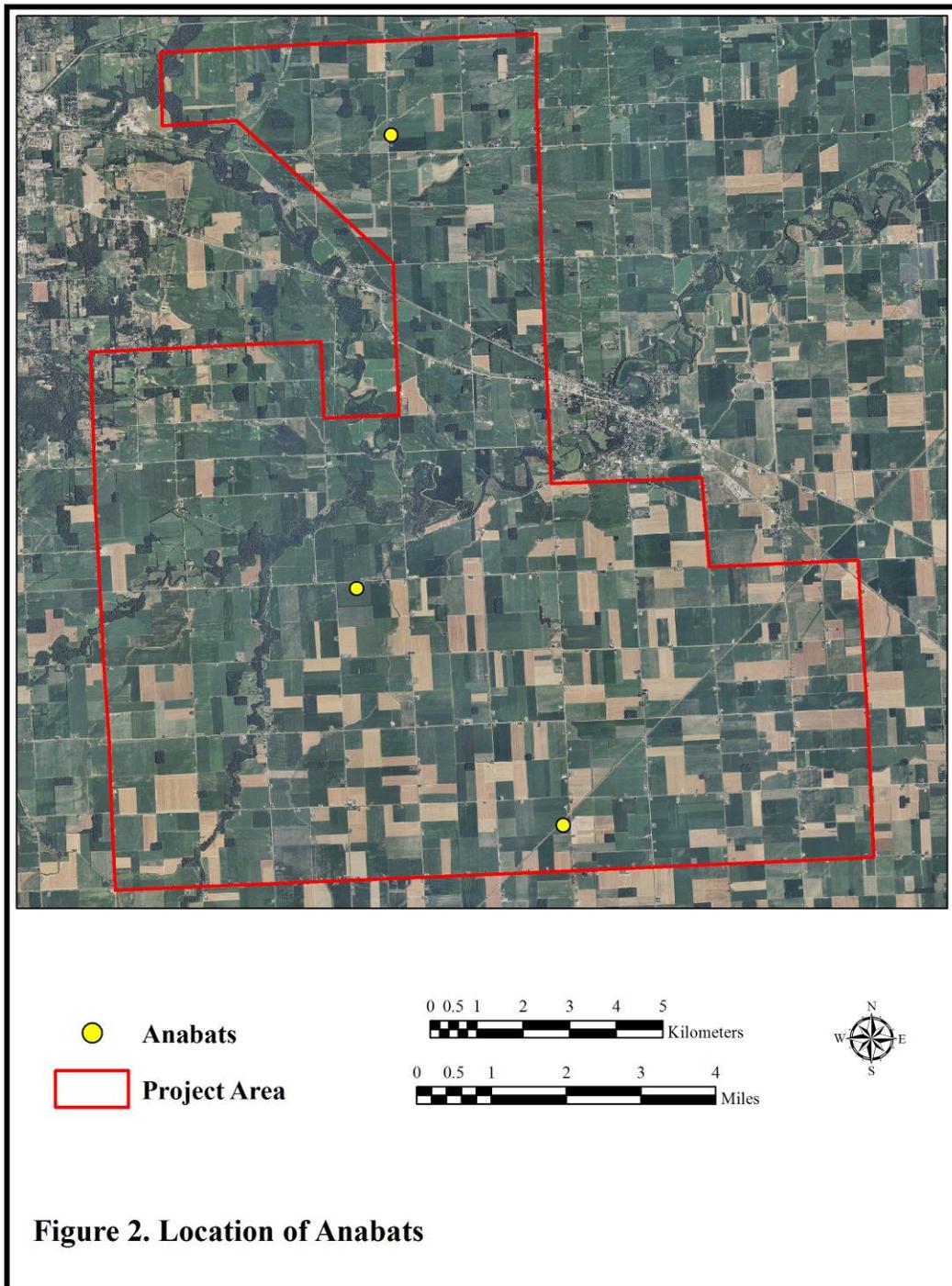


Figure 1. The Proposed Blissfield Wind Energy Project Area Boundary. The Blissfield Project Area in Lenawee County of southeastern Michigan is predominantly agricultural lands with some interspersed forested areas. The black line is the project area boundary and the orange line is a 1 mile buffer to the project area boundary.

### **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 30 minutes before sunset until 30 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. Microphones were installed and elevated on 3 meteorological towers at 5 m above ground level (AGL) and at 55 m AGL (Fig. 2). The Anabat's 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 and activity that may not have been detectable from the ground.



**Figure 2. Location of Anabats**

Figure 2. Six Anabats were installed to collect bat acoustic data in the Blissfield Project Area in Lenawee County of southeastern Michigan. Each location included 2 Anabats with microphones at 5 and 55 m height 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*), tri-colored bat (*Pipistrellus subflavus*), and long-eared bat (*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). Although the calls of the little brown bat, long-eared bat, and Indiana bat overlap in many quantitative call measurements are extremely difficult to differentiate, we attempted to differentiate them by filtering myotis calls using ranges of Sc (slope of the body of the call) and SC(OPS) derived from known *Myotis sodalis* calls (Kurta and Tibbels 2000, Tibbels 1999). This allowed evaluation for the presence of myotis calls separate from other species to a reasonable level of confidence. 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 whose potential presence was qualitatively

evaluated include: tri-colored bat, 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 Wind Energy Project Area in Lenawee County of southeastern Michigan.

### **Results and Summary**

We detected a total of 80,135 bat calls from all 6 detectors from 31 March through 30 June 2011. With exception of a few peaks in bat activity, most of the bat detections were during the end of May and beginning of June (Fig. 4). This is relatively consistent with other studies of a similar topic and design (Fiedler 2004, Gruver 2002,

Jain 2005). There were more bats calls detected during the spring of 2011 compared to the fall of 2010. This is likely due to the fact that there were more bat detectors deployed in the Project Area and they were located closer to the River Raisin, which is thought to concentrate bat activity. The survey period not only includes spring migrants but also resident bat activity in the area (June). Figure 5 details bat activity in relation to the time of the night. 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. Hoary bat, a species sensitive to turbine fatalities, concentrated its activity after the middle of May and through June. This temporally specific information can be useful in mitigation of the impacts to this species which is typically sensitive to wind farm development. For example, potential economic loss due to increasing the cut-in speeds of turbines can be specifically limited to the time periods when bats are most active.

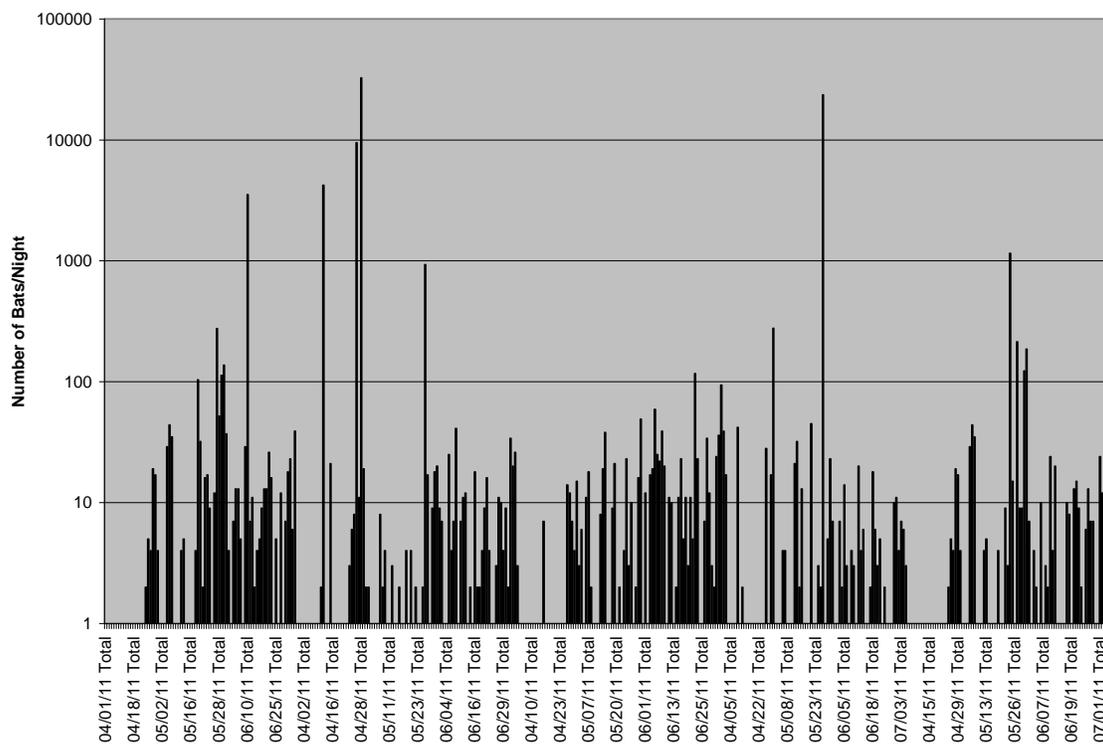


Figure 4. The number bat calls by the date of the field season 31 March – 30 June 2011 in the proposed Blissfield Wind Energy Project Area, in southeastern Michigan.

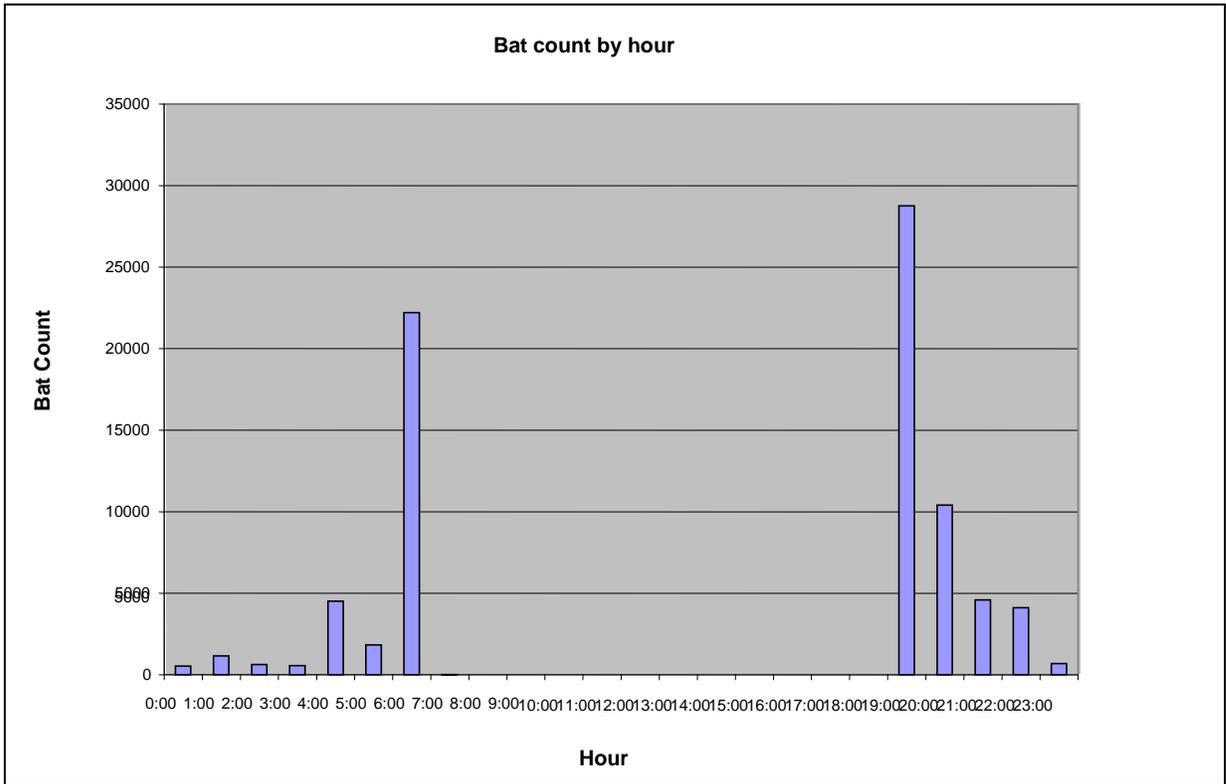


Figure 5. The number of bat calls by the time of night from 31 March – 30 June 2011 in the proposed Blissfield Wind Energy Project Area.

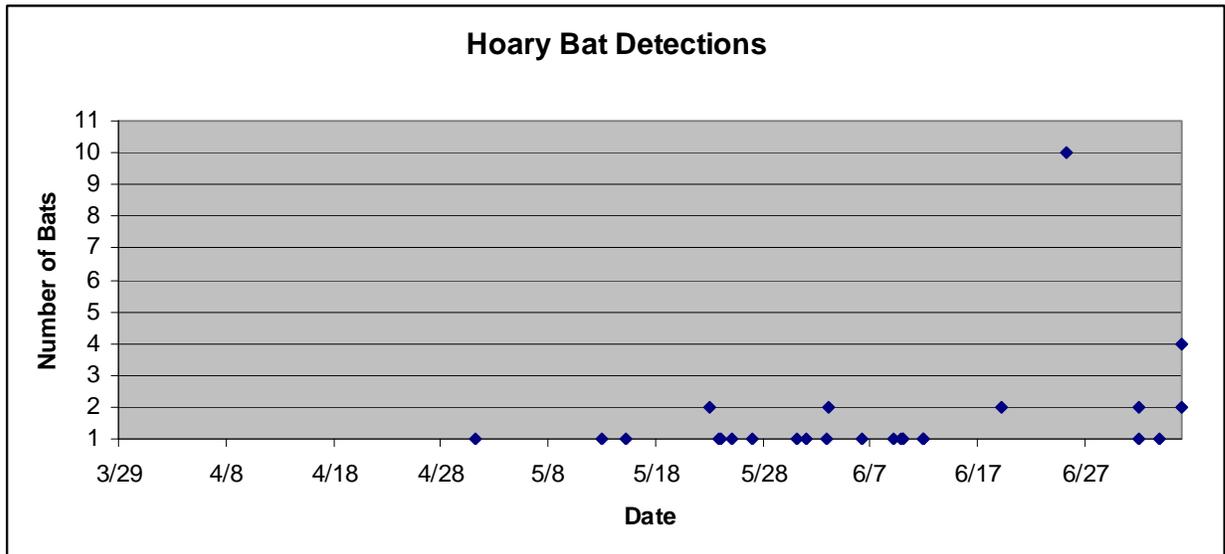


Figure 6. The number hoary bat calls by the night of the field season 31 March – 30 June 2011 in the proposed Blissfield Project Area, in southeastern Michigan.

### **Comparison of bat vocalization frequency**

Low frequency bat calls made up 99.8% (80,006) of the total calls detected (80,135), whereas the high frequency calls were only 0.2% (129) of the calls (Table 1). Table 2 further describes the calls identified to species. The filters used to identify bat calls from noise are more general than those filters used to identify bat species. Not all calls are of a high enough quality to be identified to species. The following factors may have reduced the quality of calls and prevented species specific categorization: wind noise, distance to the bat from the microphone, humidity, etc. Of those bats qualitatively identified to species the big brown bat/sliver-haired bat group was the most abundant (0.14 bats/ detector night). The hoary bat was the second most common bat species detected (0.08 bats/ detector night). Two groups had equal abundance for the third most common: Eastern red bat and myotis general (all 0.01 bats / detector night; Table 2). These species were consistent with the open / disturbed / agricultural habitats found in the Project Area and riverine forested migratory corridors of the Eastern red bats and hoary bats through the Great Lakes. Although some 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). Although calls of the little brown bat, Northern long-eared myotis, and Indiana bat overlap in many qualitative call measurements and are extremely difficult to differentiate, we attempted differentiation by filtering Myotis calls using ranges of Sc (slope of the body of the call) and SC(OPS) derived from known *Myotis sodalis* calls (Kurta and Tibbels 2000, Tibbels 1999). This allowed evaluation for the presence of Myotis calls separately from other species to a reasonable level of confidence. No Indiana bats were qualitatively detected among the acoustic data collected. However, it should be noted that it is possible there may be Indiana bat calls that could not be differentiated and are therefore within the grouping of myotis general detections. Efforts were made to document the presence of Indiana bats in the Project Area using USFWS mist-netting protocols (see October 2011 report, *Mist-net and Acoustic Assessment of Indiana Bat (*Myotis sodalis*) and Evening Bat (*Nycticeius**

*humeralis*) Presence/Absence in the Vicinity of the Proposed Blissfield Wind Energy Site: Summer 2011).

Several of the species expected to be present 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: hoary bat, Eastern red bat, silver-haired bat, and tri-colored bat (Johnson and Strickland 2004, Kerns and Kerlinger 2004).

Table 1. Mean bat detections in the Blissfield Wind Energy Project Area proposed for the development of wind energy in southeastern Michigan. Data were collected between 31 March and 30 June 2011.

Species	Mean Abundance <sup>a</sup>
Low frequencies (<35 kHz)	141.9
High frequencies (>35 kHz)	0.23

<sup>a</sup>Mean Abundance = mean number of individuals observed per detector night

Table 2. Mean bat detections by species in the Blissfield Wind Energy Project Area proposed for the development of wind energy in southeastern Michigan. Data were collected between 31 March and 30 June 2011.

Species	Mean Abundance <sup>a</sup>
Big brown/silver-haired bat	0.14
Tri-colored bat	0.00
Evening bat	0.00
Hoary bat	0.08
Indiana bat	0.00
Myotis general bat	0.01
Eastern red bat	0.01

<sup>a</sup>Mean Abundance = mean number of individuals observed per detector night

## Conclusions

The Blissfield Wind Energy 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 limits the use of the area by rare species of bats, such as the Indiana bat and evening bat. The riverine corridors of the River Raisin within the Project Area

have been documented to support the maternity roosts of both of these rare and protected species (MNFI database, Munzer 2008). No qualitative evidence of the presence of Indiana bat was documented during the 2011 bat echolocation spring migration field season. However, it should be noted that it is possible there may be Indiana bat calls that could not be differentiated and are therefore within the grouping of *Myotis* general detections. 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 above ground level of bat detectors, (i.e., the 55-m AGL mounting of microphones in this study) 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 Wind Energy Project Area.

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