Baseline Bat Acoustic Analysis for the Green River Proposed Wind Energy Site: Summary of 2011 Fall Field Season

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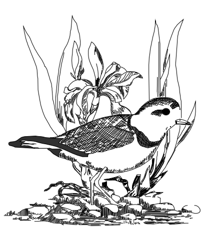

MICHIGAN STATE UNIVERSITY EXTENSION

Executive summary

Many areas in Illinois possess winds adequate for the efficient generation of wind energy. 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 Green River Project Area to better understand the densities of bats, as well as the species composition. These data will help wind energy developers to make appropriate decisions regarding the potential impacts to bats and the methods by which they might reduce those impacts.

In an effort to quantify the bat use of the Project Area, we collected acoustic, echolocation data (via Anabat SD2 units) to estimate the bat densities from 3 July – 21 November 2011. The low frequency bat calls accounted for 96.8% (25,612) of the total calls (26,464) detected, whereas the high frequency calls were 3.2% (852) of the calls. Of those bats qualitatively identified to species the hoary bat was the most abundant (1.57 bats / detector night). The second most abundant were the general myotis group and the big brown/silver-haired bat group (both 0.36 bats / detector night) followed by the Eastern red bat with (0.13 bats / detector night Table 1). While some of the species were consistent with the open / disturbed / agricultural habitats found in the Project Area other species such as the Eastern red bats and hoary bats were likely migrating through the area. Some species of bats are difficult to separate from one another using only acoustic data; therefore, 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, such differentiation was attempted by filtering Myotis calls using ranges of Sc (slope of the body of the call) and SC(OPS) derived from known Indiana bat 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 detected among the acoustic data collected. Based on our review to this level of confidence, the grouping of Myotis general detections were identified as little brown bat or Northern long-eared myotis.

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 most likely experience mortality from the wind turbines include: Eastern red bat, hoary bat, silver-haired bat, and tri-colored bat.

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Introduction

Many areas in Illinois 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 echolocation 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 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

<u>Study site and description</u>

Research was conducted in the Green River Project Area in Whiteside, Lee, and Bureau Counties, located in north-central Illinois, USA (Fig.1). The land use / land cover of the Project Area is predominantly agricultural fields (e.g, corn, soybeans, and wheat), with some grassy pastures and waterways as well as some forest patches, and ponds. The tree species in this area include: maple (*Acer* spp.), oak (*Quercus* spp.), and cottonwood (*Populus deltoides*). The topography is predominantly flat with historic oak savannahs and wetlands now drained for agricultural use. In the center of the Project Area is the Green River State Wildlife Area, which is managed for wetland habitats, as well as grasslands, and savannahs. Along the north-western boundary of the Project Area is the Foley Sand Prairie Nature Preserve and the Sand Prairie Habitat Area.

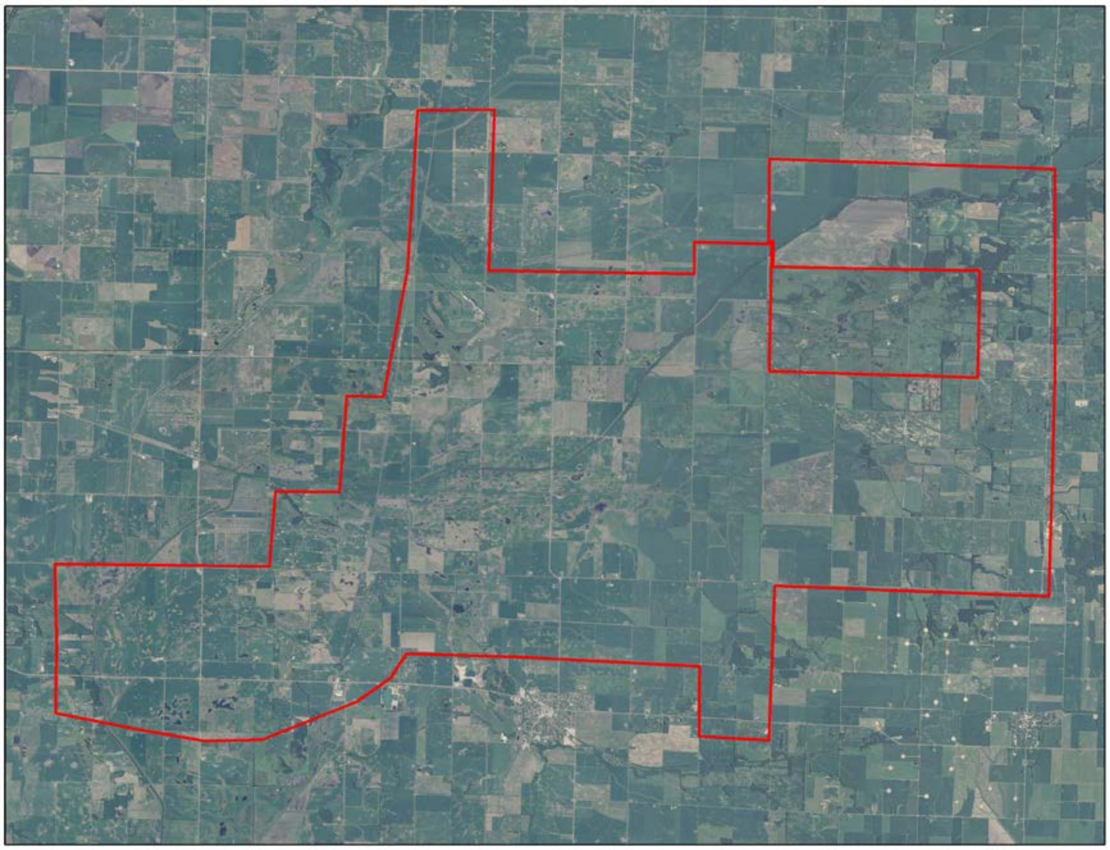

Figure 1. The Green River Project Area in Whiteside, Lee, and Bureau Counties, IL are predominantly agricultural lands with some interspersed grassland and forest woodlot areas.

<u>Bat acoustics data collection</u>

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). The United States Fish and Wildlife Service (USFWS) and the Illinois Department of Natural Resources (IDNR) were consulted regarding the placement of the Anabats within the Project Area to ensure that the locations of the units were appropriate (i.e. areas near wetlands, forests, woodlots, or shelterbelts).

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 tubs with PVC tubes protecting the microphones but allowing sound to be recorded. Weatherized units were elevated above the ground vegetation but placed at ground level. We selected 4 locations for placement of the Anabats that were distributed within the Project Area and in more natural habitats than the landscape of row crops (Fig. 2). The only exception was the Anabat location #4 which included two Anabat units which had microphones mounted on a met tower and was in a corn field. The Anabats' microphones were attached to the met tower and each were 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 microphones to 5m and 75m above ground level (AGL) we were able to collect data on bat species and activity that may not have been detectable from the ground.

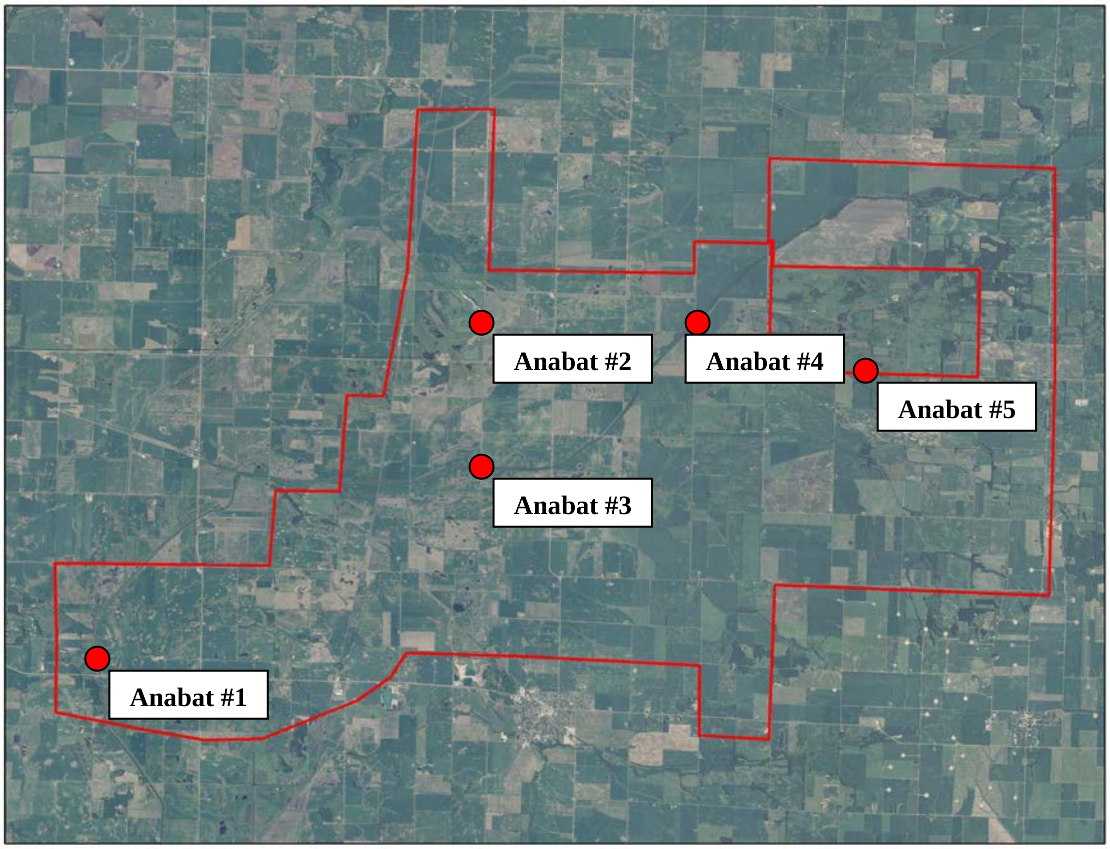

Figure 2. Anabat sites were established in the Green River Project Area. Data were collected from these sites from 3 July through 21 November 2011.

Figure 3. Two bathats were installed to house Anabat microphones and to collect bat acoustic data at 5 m and 75 m AGL in the Green River Wind Energy Project Area in Illinois.

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 a 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 Northern long-eared 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). 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, such differentiation was accomplished 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.

Results and Summary

We detected a total of 26,464 bat calls from all of the detectors from 3 July through 21 November 2011. More bat activity was detected at approximately 10 PM and decreased after midnight (Fig. 4). Bats were detected throughout the sampling period; however, the most bat activity was detected in August (Fig.5). This is relatively consistent with other studies of a similar topic and design (Fiedler 2004, Gruver 2002, Jain 2005).

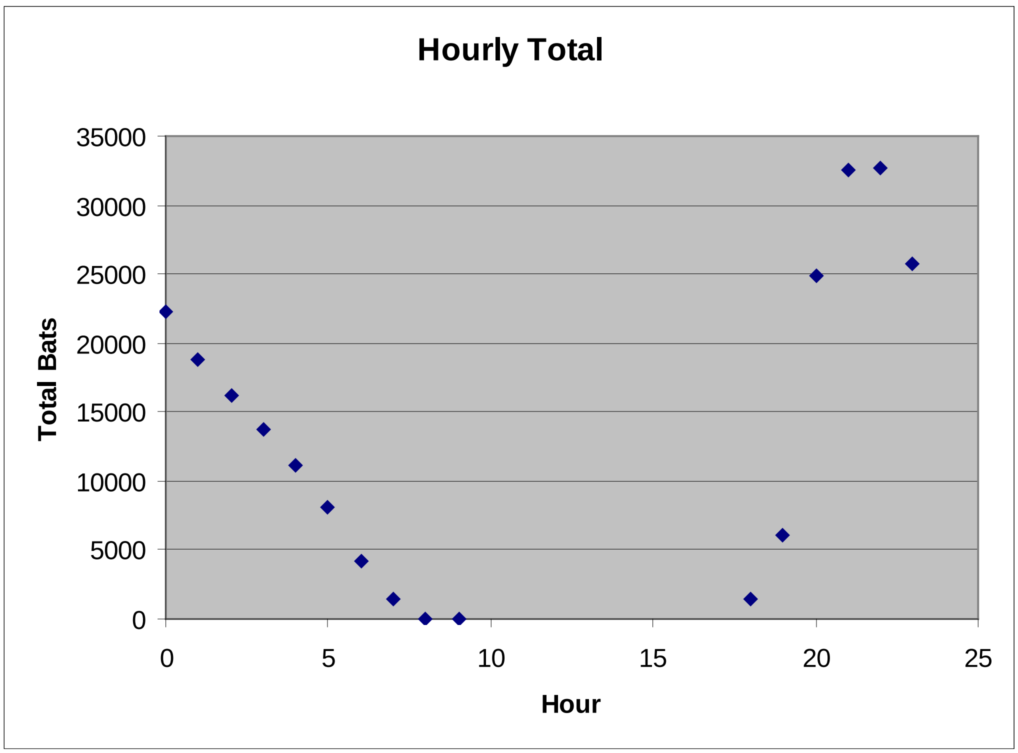

Figure 4. The number of bat calls by the time of night from 3 July through 21 November 2011 in the proposed Green River Project Area, in west-central Illinois.

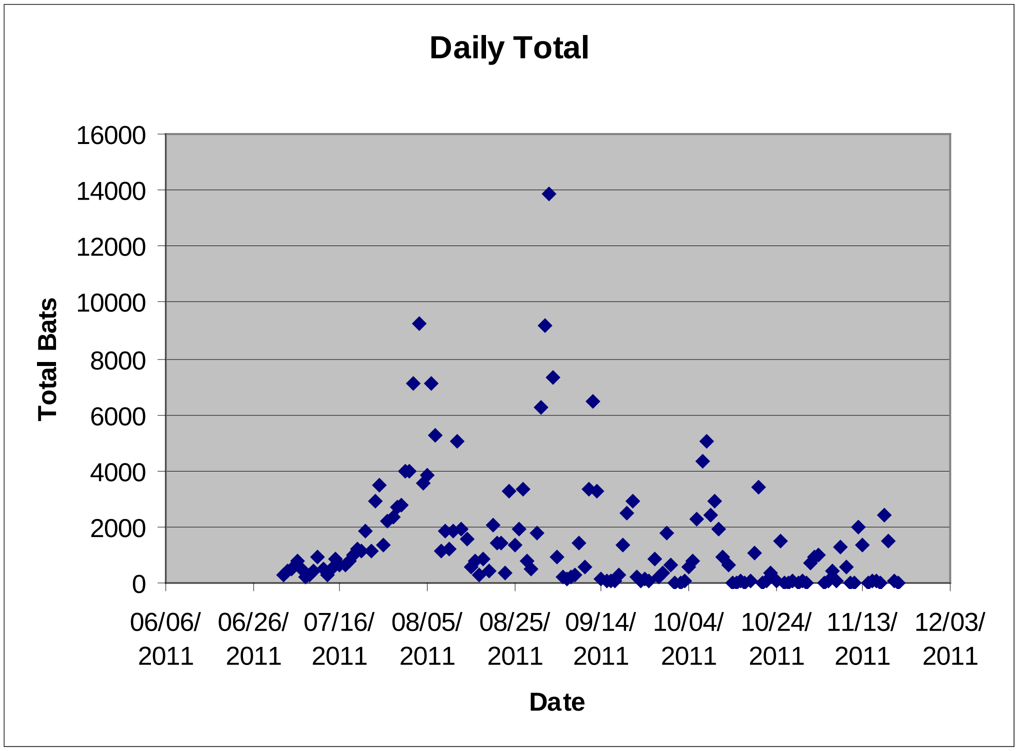

Figure 5. The number of bat calls from 3 July through 21 November 2011 in the proposed Green River Project Area, in west-central Illinois.

Comparison of bat vocalization frequency

The low frequency bat calls accounted for 96.8% (25,612) of the total calls (26,464) detected, whereas the high frequency calls were 3.2% (852) of the calls. Of those bats qualitatively identified to species the hoary bat was the most abundant (1.57 bats / detector night). The second most abundant were the general myotis group and the big brown/silver-haired bat group (both 0.36 bats / detector night) followed by the Eastern red bat with (0.13 bats / detector night Table 1). 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, such differentiation was attempted 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 detected among the acoustic data collected. Based on our review to this level of confidence, the grouping of Myotis general detections were identified as little brown bat or Northern long-eared myotis.

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, hoary bat, silver-haired bat, and tri-colored bat.

Table 1. Mean bat detections in the Green River Project Area proposed for the development of wind energy in west-central Illinois. Data were collected between 3 July and 21 November 2011.

Species	Mean Abundance [a]
Big brown/silver-haired bat	0.36
Tri-colored bat	0.01
Evening bat	0.02
Hoary bat	1.57
Indiana bat	0.00
Myotis general bat	0.36
Eastern red bat	0.13

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

Conclusions

The Green River Project Area land cover is predominantly agricultural fields (e.g, corn, soybeans, and wheat), with some grassy pastures and waterways as well as some woodlots, and ponds. Although natural habitats are present to the west of the Project Area (Green River State Wildlife Area and Foley Sand Prairie Nature Preserve/ Sand Prairie Habitat Area, respectively), the agricultural landscape in the Project Area, reduces the likelihood of the presence of rare species of bats, such as the Indiana bat. However, the neighboring Green River Wildlife Area, Foley Sand Prairie Nature Preserve and the Sand Prairie Habitat Area does contain high quality habitat for a variety of native wildlife species. No evidence of the presence of Indiana bat was documented during the fall

2011 bat echolocation field season. 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, such differentiation was attempted 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 detected among the acoustic data collected. Based on our review to this level of confidence, the grouping of Myotis general detections were identified as little brown bat or Northern long-eared myotis.

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). Those species expected to be in the Project Area that would most likely experience mortality from the wind turbines include: hoary bat, Eastern red bat, silver-haired bat, and tri-colored bat. Given that the majority of bat detections were before midnight and in the month of August, efforts to minimize the risk of wind turbine related fatalities should be focused on this period of the fall migration.

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