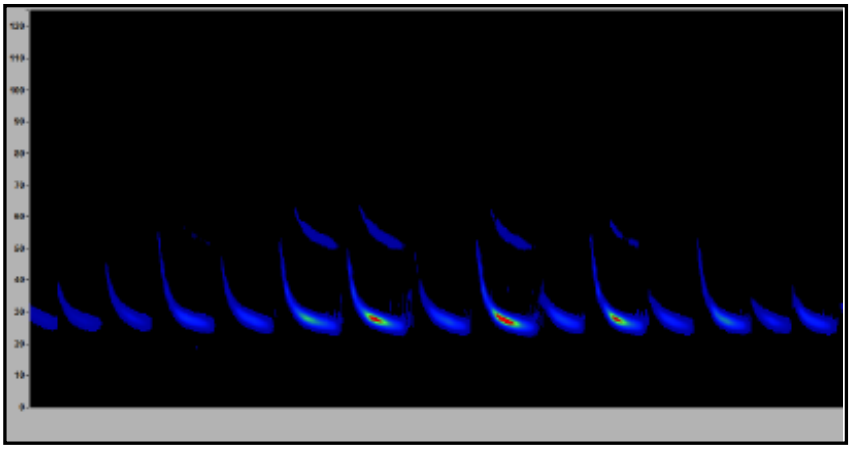
Assessing Bat Community Structure in Riparian and Agricultural Habitats in a High Wind Resource Area of Southeast Michigan – A Preliminary Analysis



Prepared By:
Brian J. Klatt, Ph.D. and Joelle L. Gehring, Ph.D.
Michigan State University, Michigan Natural Features Inventory
P.O. Box 30444 Lansing, MI 48909-7944

Prepared For:
Michigan Department of Natural Resources –
Wildlife Division
Stevens T. Mason Building
530 West Allegan St.
Lansing, Michigan 48933

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Cover photographs by Brian Klatt, Sonogram from Sonobat screen capture.

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 associated with wind turbines have been documented throughout North America, including the Midwestern United States. Preliminary research suggests that informed siting and operation of wind turbines can lower impacts to bats. Siting decisions can be informed by knowledge of the distribution of bats in the landscape in general and in relation to habitat features on a finer scale in particular. These considerations can be particularly important to the conservation of rare species.

An acoustic monitoring effort was conducted in August through October of 2012, in the Palmyra-Blissfield area in Lenawee County, Michigan. The purpose of the monitoring was to assess the bat community in this area of high wind energy, expanding on efforts conducted in the same area in 2011 (Klatt and Gehring 2011). The 2011 effort focused on assessing the presence or likely absence of the federally-endangered Indiana bat (*Myotis sodalis*) and the state-threatened evening bat (*Nycticeius humeralis*), both of which have been reported from this area. A limited amount of acoustic data collected during 2011, indicated that bat species' activity in the area may be closely-associated spatially with wooded, riparian habitat and that bat activity may be very limited in adjacent agricultural fields. This observation supported the US Fish and Wildlife Service's guidance on wind turbine siting with respect to Indiana bat habitat, which states that turbines located more than 1000 feet from foraging or roosting habitat of the Indiana bat is unlikely to significantly impact that species. Consequently, the 2012 monitoring program was designed to not only gather more information on bat diversity and community structure in this area, but also to evaluate the generality of the USFWS guidance as a mitigation measure in siting wind turbines.

The 2012 monitoring approach consisted of establishing transects of acoustic monitors, extending from wooded, riparian areas along the River Raisin, out into adjacent agricultural fields. Six species of bat were detected in the area in 2012: big brown bat (*Eptesicus fuscus*), eastern pipistrelle (*Perimyotis subflavus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), little brown bat (*Myotis lucifugus*), and the silver-haired bat (*Lasionycteris noctivagans*). Between the current effort, as well as that of Klatt and Gehring (2011), and Kurta (MNFI 2011), all nine species of bats known to occur in Michigan have been recently documented for the Palmyra-Blissfield area.

In the current study we delineated the following patterns:

1) Of the three species of bats that account for the majority of bat mortality associated with wind turbines across the country, namely the eastern red bat, hoary bat, and silver-haired bat, the hoary bat is most active over agricultural fields and away from riparian areas; silver-haired bat has activity distributed proportionally to the amount of riparian versus agricultural fields available; and eastern red bat activity is highest in association with riparian habitat and decreases with distance into adjacent agricultural fields.

2) Of the three species detected in this study that have relatively low mortality associated with wind turbines, namely big brown bat, little brown bat, and the eastern pipistrelle, all three species' activity, as measured by number of recorded calls, is highest in riparian areas and decreases with distance into adjacent agricultural fields.

The following conclusions and recommendations are supported by this study:

1. The Palmyra-Blissfield area of Lenawee County, Michigan is an area of high bat species diversity.
2. Those bat species in Michigan that tend to have higher rates of mortality associated with wind turbines across the country have a variety of activity patterns with respect to riparian versus agricultural fields, but in general have higher activity levels associated with agricultural fields than species with lower mortality rates.
3. Those bat species in Michigan that tend to have the lowest rates of mortality associated with wind turbines across the country have activity patterns that peak in riparian habitat and decrease with distance from riparian habitat into adjacent agricultural fields.
4. The apparent seasonal switch in activity of the silver-haired bat with respect to woody, riparian versus agricultural field habitats should be further investigated.
5. It does not appear that the USFWS guidance with respect to wind turbine siting and the Indiana bat can be applied to bat species in general in Michigan as a mitigation measure, especially with respect to the hoary bat and silver-haired bat.
6. Administrative considerations limited the timing of the current study. Data were not collected during the spring or early summer seasons. The efforts reported herein should be expanded to include at least one full year of monitoring for a more complete characterization of the bat activity, especially given the apparent season variation exhibited by the silver-haired bat.

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INTRODUCTION

Many areas in Michigan possess the quality of winds necessary for the efficient generation of wind energy both on-shore and off-shore (Wind Energy Resource Zone Board, 2009; Michigan Great Lakes Wind Council, 2009). Wind energy is considered to be "green" because wind is a renewable resource and lesser amounts of greenhouse gases are associated with its development and operation; in essence, there are no greenhouse gases produced by operating turbines. Despite these positive aspects, construction and operation of wind farms, like any infrastructure project or industrial operation, does have environmental impacts; in the case of wind energy, these include bat mortality.

Bat fatalities at wind turbines in North America have been documented at various rates, depending on the site and situation, with higher rates being reported in the Eastern United States (National Academy of Sciences 2007). Strickland et al. (2011) reviewed reported fatality rates and found them to vary from 0.07-39.7 fatalities/MW/Year, with the highest rates associated with forested, mountain ridge tops. Fatalities can result from either direct interaction with turbines, i.e. bats struck by turbine blades or colliding with monopoles (Kunz et al., 2007; Horn et al., 2008), or from barotrauma, i.e. lung damage resulting from rapid decompression due to turbulence associated with wind turbines (Baerwald et al. 2008).

Of the 45 bat species in North America, 12 have been recovered in searches at wind farms. The most commonly occurring species recovered are the eastern red bat, hoary bat, and silver-haired bat; these species account for approximately 75% of the all the bats recovered (NAS 2007). Other species recovered include, western red bat (*Lasiurus blossivilli*), Seminole bat (*L. seminolus*), eastern pipistrelle (*Pipistrellus subflavus*), little brown myotis (*Myotis lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*Myotis sodalis*), long-eared myotis, (*M. evotis*), big brown bat (*Eptesicus fuscus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*). Thus, the concern regarding bat fatalities due to wind

energy development applies to a variety of bat species, with the long-distance migratory species incurring the highest levels of mortality. The concern regarding bat mortality is of special concern due to their conservation status and the low rates of bat reproduction.

There is a tradeoff between the benefits of wind as a non-fossil fuel, renewable source of energy and the environmental impacts specific to wind energy production. To facilitate development of the wind energy industry in the US, while at the same time being protective of our natural resources, the US Fish and Wildlife Service (USFWS), in cooperation with the wildlife agencies of eight states in the Midwest, including the Michigan Department of Natural Resources – Wildlife Division (WLD), and various wind industry-related companies and organizations, is building a framework for wind energy development with respect to rare species in the Midwest. That framework includes development of a habitat conservation plan (HCP) and associated draft environmental impact statement to address concerns regarding rare species and other aspects of the environment. It is expected that this framework and resultant HCP will set the course for wind energy development with respect to rare species in the Midwest for decades to come. Consequently, it is imperative that the decision makers in this process have the best scientific information available to guide them.

STUDY RATIONALE AND FOCUS

The USFWS has operational guidance regarding wind turbine siting with respect to the federally-endangered Indiana bat (*Myotis sodalis*). That guidance indicates that if wind turbines can be located more than 1,000 feet from Indiana bat foraging or roosting habitat, it is unlikely that the turbines will impact this endangered species during the summer breeding season. This guidance 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. If the USFWS opinion is in fact correct, their guidance can serve as an important mitigation measure for the Indiana bat

when siting wind turbines. Moreover, if this purported behaviour is exhibited by species other than the Indiana bat, the guidance could serve as a more general mitigation measure to reduce bat mortality due to wind turbines.

While assessing the presence or likely absence of the Indiana bat and the state-threatened evening bat in Lenawee County, Michigan, an area from which both Indiana bat and evening bat have been reported, Klatt and Gehring (2011) found support for the idea that USFWS guidance may, indeed, have wider applicability than for just the Indiana bat. In a pilot study using transects of ultrasonic monitors, they found that the number of recorded, ultrasonic bat calls decreased significantly from wooded, riparian areas out into adjacent agricultural fields.

As noted, however, the 2011 results, while suggestive, were considered preliminary due to small sample size. Consequently, in 2012, a project was conducted to expand monitoring in the area to better characterize the species diversity and community structure of bats in Lenawee County (an area of high wind resources (WERZB 2009)), while at the same time collecting additional data on the relative use of wooded, riparian areas versus adjacent agricultural fields. Similar to the 2011 effort, the approach in the current monitoring effort was to establish transects of acoustic monitors, beginning at the edge of wooded, riparian habitats, and extending out into adjacent agricultural fields.

STUDY AREA DESCRIPTION AND METHODS

Study Area Description

Monitoring was conducted in the Palmyra-Blissfield area of Lenawee County, Michigan, located in southeastern Michigan (Figure 1). The land use / land cover of the project area consists mainly of agricultural fields (e.g., corn, soybeans, and

Figure 1. Study Area in the Palmyra-Blissfield Area of Lenawee County, Michigan.

wheat), with some pastures, forested areas, and scattered wetlands. Various streams and drains traverse the project area within the watershed of the River Raisin, which runs through the project area. The natural vegetation in this area is generally described as mesic forests, wet forests, and forested riverine corridors. The forest overstory found in the project area typically includes maple (*Acer* spp.), oak (*Quercus* spp.), hickory (*Carya* spp.), ash (*Fraxinus* spp.), basswood (*Tilia americana*), sycamore (*Platanus occidentalis*), honey locust (*Gleditsia triacanthos*) and cottonwood (*Populus deltoides*), with an understory typical of non-riparian woodlots and floodplains in southeastern Michigan, including: Virginia creeper, (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), enchanter's nightshade (*Circaea lutetiana*), may apple (*Podophyllum*

peltatum), and other herbaceous species (Klatt, et al. 2010). The land type is predominantly Ann Arbor Moraine and Maumee Lake Plain (Albert 1995), which is predominantly 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, but which has been drained for agricultural use (Albert 2008).

Acoustic-Monitoring Protocols

Bat diversity, community structure, and activity patterns were assessed through use of acoustic monitors placed at varying distances from wooded, riparian areas, and agricultural fields during both the summer and migration seasons. Calls were recorded in compressed format using SM2+Bat acoustic monitors equipped with SMX-US Ultrasonic Microphone (Wildlife Acoustics, Inc.). The monitors were programmed to record in a fifteen-minute-on and fifteen-minute-off mode from one-half hour before sunset until one-half hour after sunrise for seven nights.

Specific monitoring sites were selected based on the following criteria: 1) they contained wooded, riparian habitat along the River Raisin; 2) the riparian habitat was adjacent to open, agricultural fields; 3) a monitoring line could be established such that the monitor furthest from the monitor at the riparian habitat was at least 400 meters from other riparian habitat or woodlots; and 4) land owner permission for site access was obtained. At each monitoring site, one acoustic monitoring station was established at the tree-line of the riparian area with two additional monitors extending out into the adjoining agricultural fields. Monitors were spaced 150 meters apart. Given that the monitoring units have an effective detection radius of approximately 100 meters, this arrangement would result in a potential detection range of 400 meters out into the agricultural field from the riparian area. Five separate monitoring lines were established and sampled for one week during both the summer (pre-15 August) and migration (post-15 August) periods for a total of 210 detector-nights.

Acoustical Analysis Procedures

Compressed field recordings were converted from WAC format to WAV format using Wildlife Acoustics, Inc.'s Kaleidoscope (v 0.3.1) software. To insure compatibility of WAV files with subsequent Sonobat call analysis software, Kaleidoscope was specified to split the files 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 duration.

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. While recorded calls were identified to species if possible, many 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. Species classifications were accepted if Sonobat indicated a "consensus" as to the call, otherwise classification was limited to high or low frequency, if Sonobat reached consensus with respect to frequency. If consensus was not reached with respect to species or frequency classification, the call was not tabulated. The species in this region that would be included in the high frequency calls include: little brown bats, northern red bat, Indiana bat, eastern pipistrelle, and northern long-eared bat. Conversely the bat species with low frequency calls include: big brown bat, silver-haired bat, hoary bat, and evening bat.

Classified calls were tabulated and summarized as to species and frequency group. The high and low frequency groups were also aggregated into an "All Calls" group for analysis. Chi-square analyses were performed separately for each species, High frequency group, Low frequency group, and All Calls, to test whether the number of calls recorded were evenly distributed across monitoring station position (i.e. riparian, first agricultural field station, second agricultural field

station). These analyses were also performed separately for summer and migration seasons, as well as for the entire monitoring period.

RESULTS AND DISCUSSION

Bat Species Diversity and Community Structure

Sonobat was used to attempt classification of a total of 39,668 (summer - 23,402, migration – 16,266) acoustic files that contained "signals of interest", and which were not classified as noise by the Kaleidoscope software. Of these, 16,672 files were classified as belonging to either the "High" or "Low" frequency groups and 8,582 files were classified as to species (note: files classified as to species may also be also classified as High or Low; thus, high and low counts also include calls classified to species). Table 1 presents the results of the classification.

Table 1. Number of classified calls by species, frequency group, and totals, presented by sampling period.

Species	**Species Code**	**# Calls – Summer (% of Species)**	**# Calls – Migration (% of Species)**	**Total # Calls (# of Species)**
Big brown bat (*Eptesicus fuscus*)	EPFU	2,570 (39%)	551 (28%)	3,121 (36%)
Eastern pipstrelle (*Perimyotis subflavus*)	PESU	36 (<1%)	63 (3%)	99 (1%)
Eastern red bat (*Lasiurus borealis*)	LABO	1,047 (16%)	271 (14%)	1,318 (15%)
Hoary bat (*Lasiurus cinereus*)	LACI	857 (13%)	88 (4%)	945 (11%)
Little brown bat (*Myotis lucifugus*)	MYLU	124 (2%)	94 (5%)	218 (3%)
Silver-haired bat (*Lasionycteris noctivagans*)	LANO	1,969 (30%)	912 (46%)	2,881 (34%)
Group		**# Calls – Summer (% of Group)**	**# Calls – Migration (% of Group)**	**Total # Calls (% of Group)**
High Frequency		2,696 (22%)	1,725 (37%)	4,421 (26%)
Low Frequency		9,290 (78%)	2,961 (63%)	12,251 (74%)
All Classified Calls		11,986	4,686	16,672

As indicated by Table 1, calls of six species were detected during the monitoring effort. In addition to the species detected in 2012, Klatt and Gehring (2011) mist-netted or detected the northern long-eared bat and the evening bat in the project area. While not detected by Klatt and Gehring in either 2011 or 2012, Allen Kurta of Eastern Michigan University, reported the occurrence of the Indiana bat in the Blissfield area in 2006-2007 (MNFI 2011). Thus, all 9 bat species found in Michigan have been reported from the Palmyra-Blissfield area of Lenawee County area within the last 5 years, with the big brown bat and silver-haired bat being the two most abundant species based on the number of recorded calls in 2012.

Bat Activity Patterns in Relation to Habitat

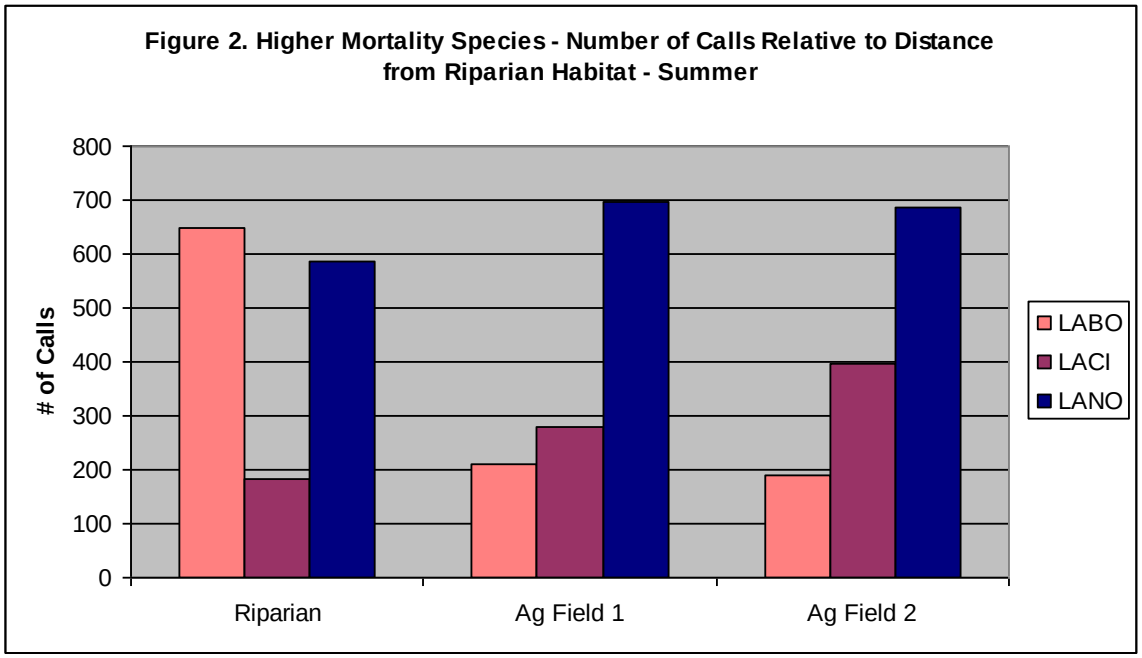
Table 2 and Figures 2-4 (see Table 1 for "species codes" as they appear in figure legends) present the analysis of detected calls with respect to proximity to wooded, riparian habitat during the summer (pre-15 August) period. All species, groups, and total bat calls differed significantly from a uniform distribution across monitoring stations. For those species with the highest mortality based on carcass recovery near wind turbines ("higher mortality species") the hoary bat and the silver-haired bat showed increasing activity with distance from riparian habitat. That is, a disproportionate number of calls were recorded over agricultural fields relative to riparian habitat. However, the eastern red bat, also a high mortality species, exhibited the opposite trend, i.e. eastern red bat activity was greater at riparian habitats and decreased with distance from riparian habitat.

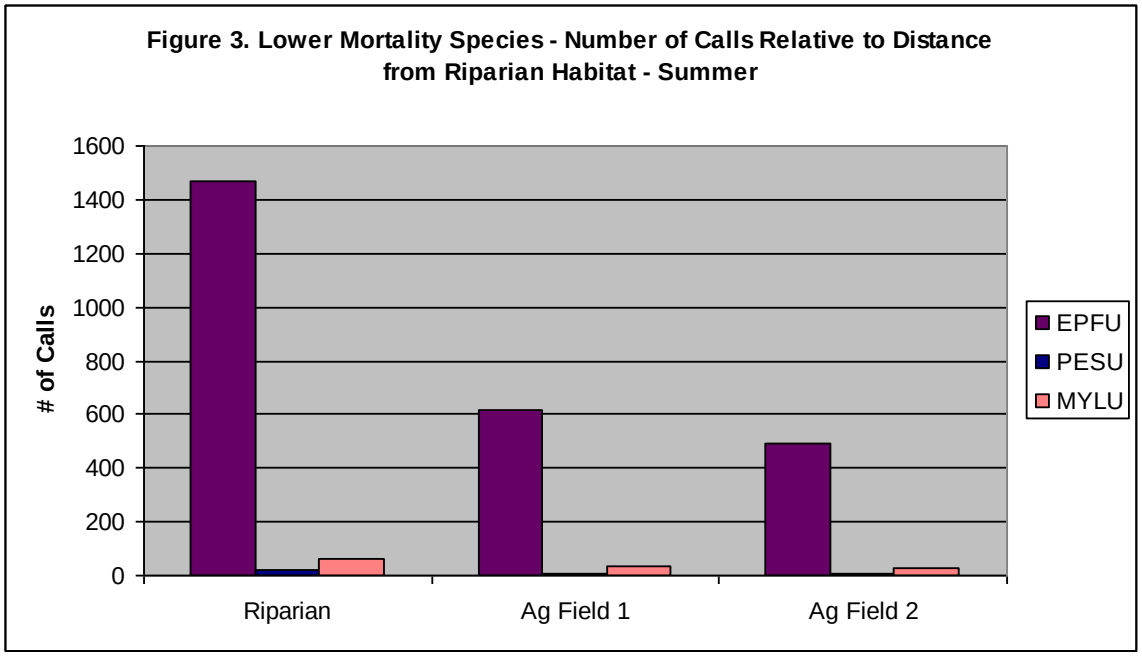
For those species considered as having lower mortality rates based on recovery of carcasses at wind farms, i.e. big brown bat, eastern pipistrelle, and little brown bat, all exhibited lower activity over agricultural fields relative to riparian habitats. In the case of the big brown bat and little brown bat, there was a clear trend of decreasing activity with distance from riparian habitat.

The pattern exhibited for the lower mortality species, i.e. decreasing activity with distance from riparian habitat, also held when considering the high and low call frequency groups and all calls combined. However, it should be obvious that considering aggregate groups, the patterns exhibited by the individual species is masked.

Table 2. Comparison of number of detected calls relative to distance from riparian habitat – summer sampling period (pre-15 August).

	Riparian	Ag Field-1	Ag Field-2	Chi-square	P(Chi), *df=2*
big brown bat *(Eptesicus fuscus*)	1467	614	489	661	P<0.01
eastern pipistrelle (*Perimyotis subflavus*)	20	7	9	8	P<0.05
eastern red bat (*Lasiurus borealis*)	650	209	188	390	P<0.01
hoary bat (*Lasiurus cinereus*)	184	278	395	78	P<0.01
little brown bat (*Myotis lucifugus*)	61	32	31	14	P<0.01
silver-haired bat (*Lasionycteris noctivagans*)	585	698	686	12	P<0.01
High frequency group	1560	636	500	740	P<0.01
Low frequency group	3777	2939	2574	246	P<0.01
All calls (high + low)	5337	3575	3074	707	P<0.01





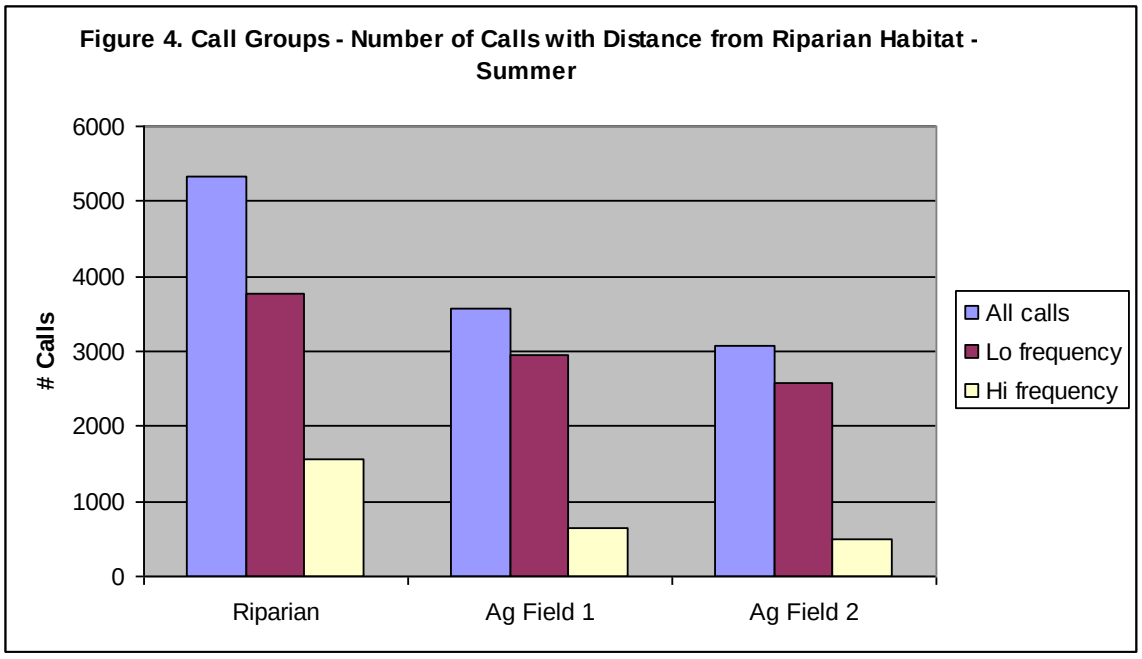
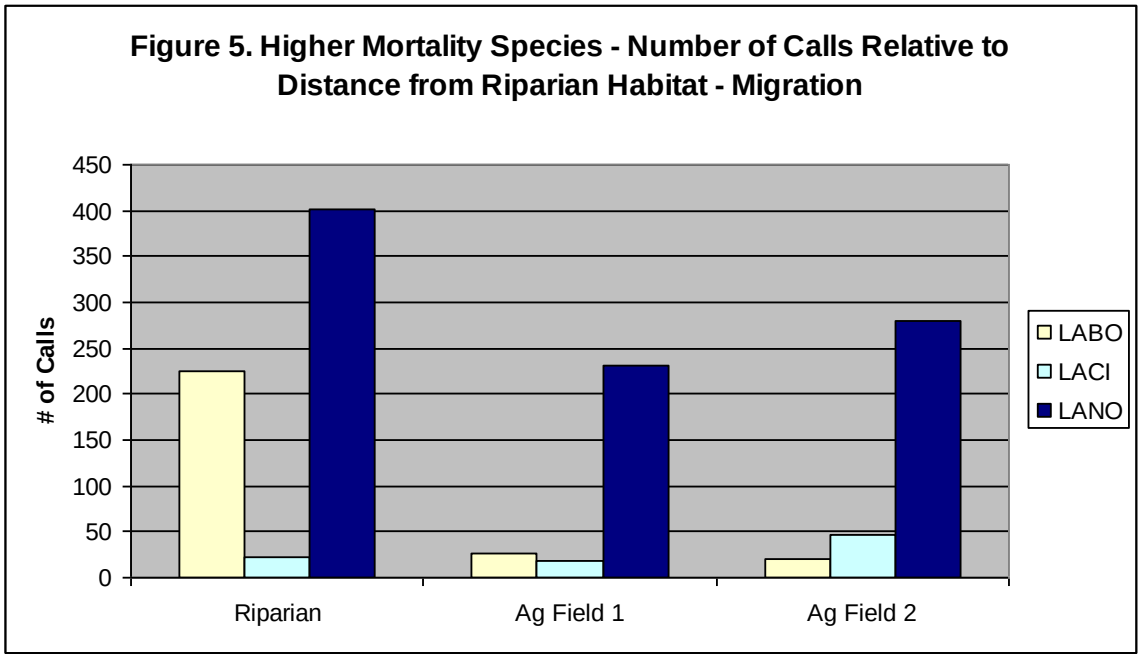


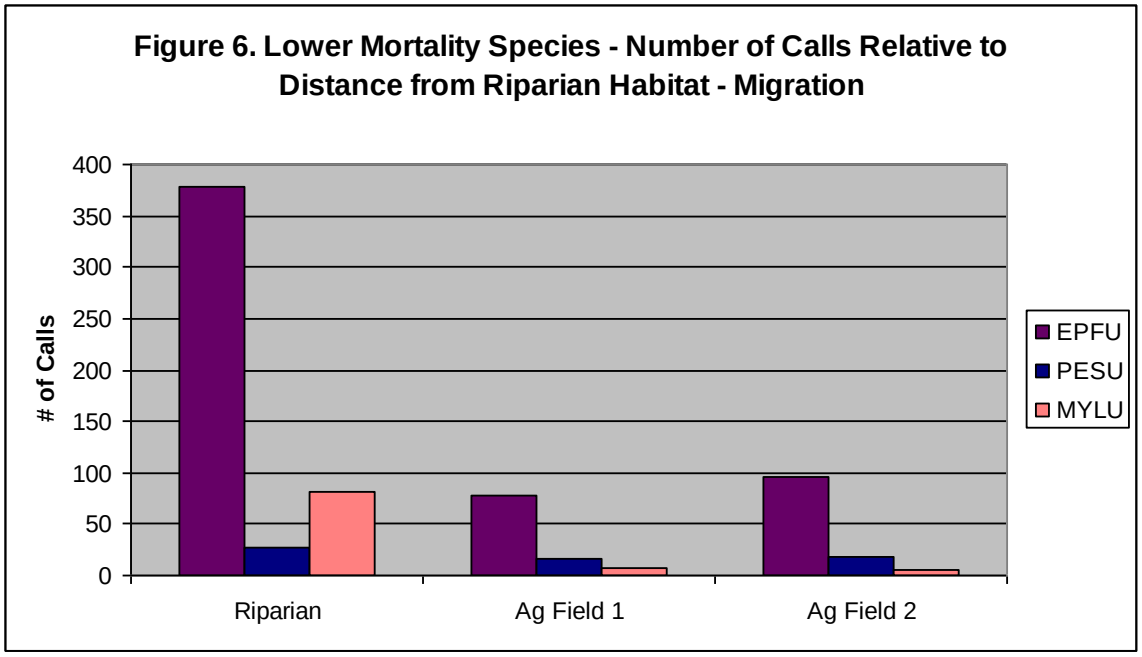
Table 3 and Figures 5-7, present the results of the monitoring for the migration period. The results for the migration period differed from the summer period in two respects. First, the silver-haired bat, which exhibited a tendency for greater

activity over agricultural fields than near riparian habitat, reversed this trend. Secondly, while the eastern pipistrelle continued to exhibit a trend of higher activity near riparian habitat than over agricultural fields, this trend was not statistically significant for the migration period.

Table 3. Comparison of number of detected calls relative to distance from riparian habitat – migration period (post-15 August).

	Riparian	Ag Field-1	Ag Field-2	Chi-square	P(Chi), *df=2*
big brown bat *(Eptesicus fuscus*)	378	77	96	309	P<0.01
eastern pipistrelle (*Perimyotis subflavus*)	28	17	18	4	P>0.05
eastern red bat (*Lasiurus borealis*)	224	26	21	297	P<0.01
hoary bat (*Lasiurus cinereus*)	23	19	46	14	P<0.01
little brown bat (*Myotis lucifugus*)	81	8	5	118	P<0.01
silver-haired bat (*Lasionycteris noctivagans*)	401	231	280	50	P<0.01
High frequency group	1454	131	140	2015	P<0.01
Low frequency group	1714	495	752	837	P<0.01
All calls (high + low)	3168	626	892	2499	P<0.01





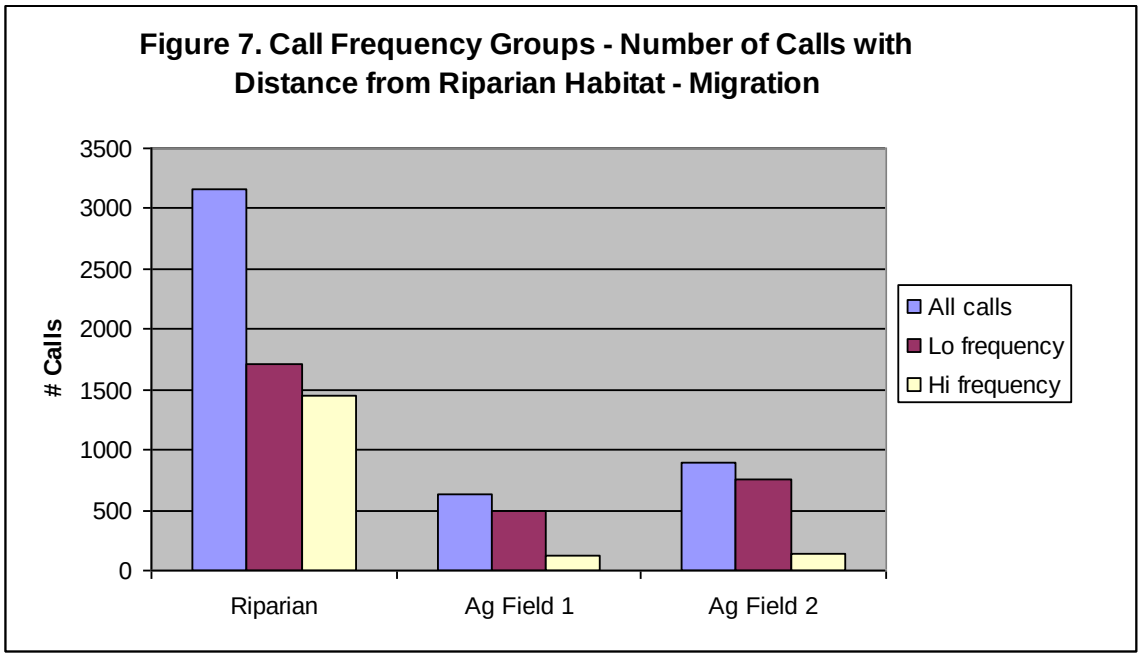


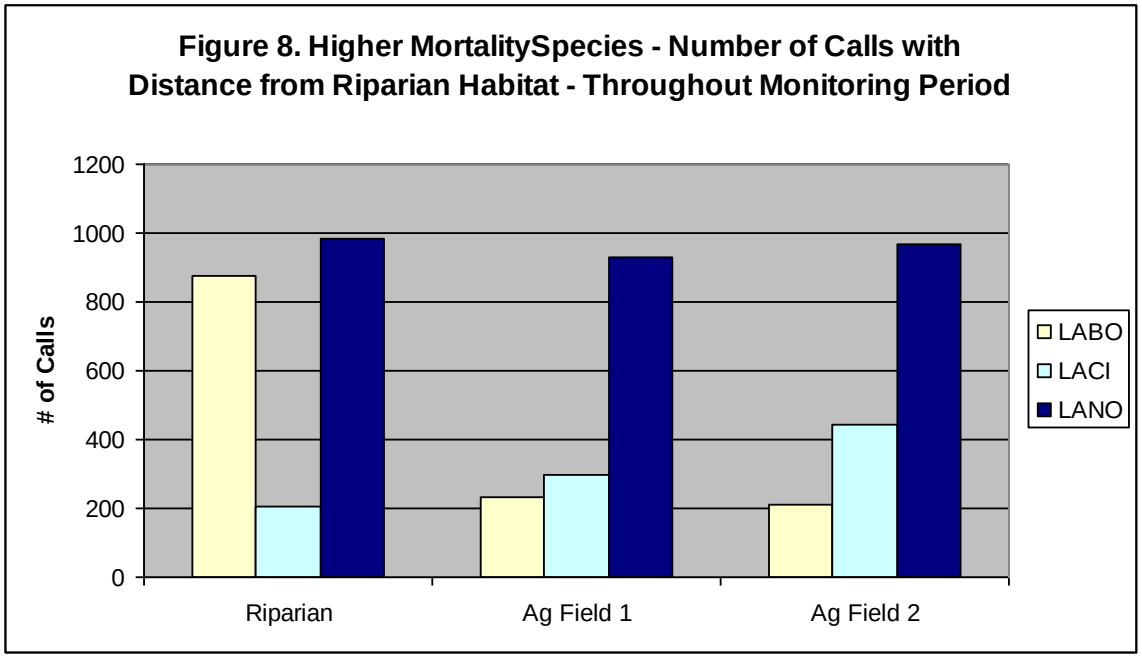
Table 4 and Figures 8-10 present the call analysis with respect to riparian versus agricultural fields across the entire monitoring period. When bat activity is considered over the entire period, the three higher mortality species exhibited a diversity of behaviour. The eastern red bat exhibited a significantly higher affinity

for riparian habitat and decreased activity levels over agricultural fields. The hoary bat exhibited a significantly lower affinity for riparian habitat and higher activity levels over agricultural fields. Silver-haired bat activity was evenly distributed among monitoring stations irrespective of habitat.

It is interesting to note that all lower mortality species exhibited a significant trend of higher activity associated with riparian habitat and decreasing activity with distance from riparian areas.

Table 4. Comparison of number of detected calls relative to distance from riparian habitat – across all sampling dates.

	Riparian	Ag Field-1	Ag Field-2	Chi-square	P(Chi), *df=2*
big brown bat *(Eptesicus fuscus*)	1845	691	585	939	P<0.01
eastern pipistrelle (*Perimyotis subflavus*)	48	24	27	10	P<0.01
eastern red bat (*Lasiurus borealis*)	874	235	209	646	P<0.01
hoary bat (*Lasiurus cinereus*)	207	297	441	88	P<0.01
little brown bat (*Myotis lucifugus*)	142	40	36	99	P<0.01
silver-haired bat (*Lasionycteris noctivagans*)	986	929	966	2	0.42
High frequency group	3014	767	640	2420	P<0.01
Low frequency group	5491	3434	3326	729	P<0.01
All calls (high + low)	8505	4201	3966	2350	P<0.01



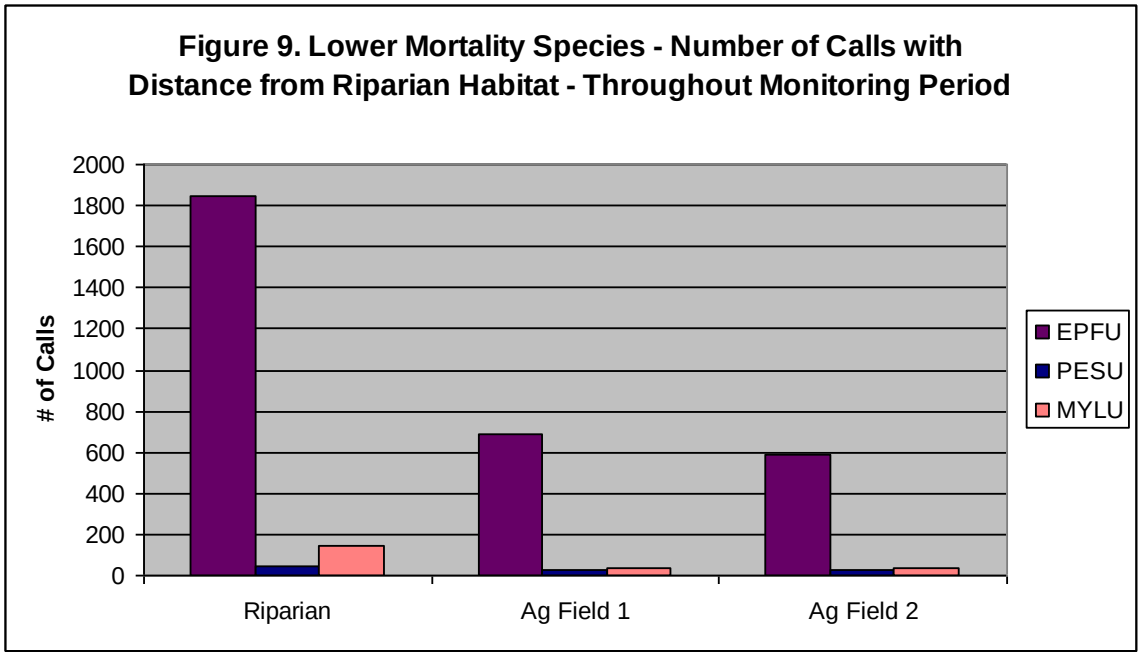


Figure 9. Lower Mortality Species - Number of Calls with Distance from Riparian Habitat - Throughout Monitoring Period
# of Calls
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Riparian
Ag Field 1
Ag Field 2
EPFU
PESU
MYLU

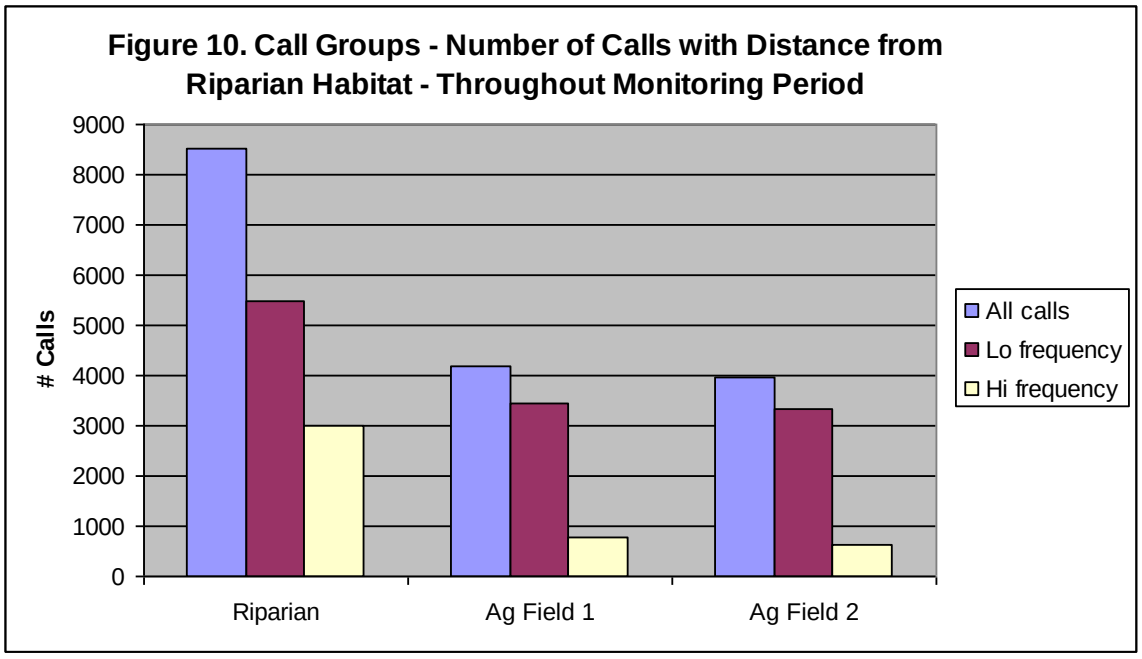


Figure 10. Call Groups - Number of Calls with Distance from Riparian Habitat - Throughout Monitoring Period
Calls
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Riparian
Ag Field 1
Ag Field 2
All calls
Lo frequency
Hi frequency

As noted in the section on rationale and approach, this project had as its primary purpose to assess the bat species diversity and community structure in the Palmyra-Blissfield area of Lenawee County. The Lenawee County area is mapped as an area of high wind resources; two wind farms have been proposed for the area, but to date have not proceeded. Additionally, the federally-endangered Indiana bat and the state-threatened evening bat have been reported from the area by Kurta (MNFI 2007). Due to the combination of high wind resources, wind developer interest, the relationship between bat mortality and wind turbine operation, and the presence of rare species, it is important to characterize the bat community of this area and the information and trends reported here should inform decision makers regarding wind development and turbine siting.

The current monitoring study builds on the efforts of Klatt and Gehring (2011), which began to characterize the bat community of this area through a combination of mist-netting and acoustic monitoring. With completion of the current monitoring effort, the combined efforts of Klatt, Gehring, and Kurta, have documented for the Palmyra-Blissfield area the presence within recent years of all nine species of bats that presently occur in Michigan. Thus, this area should be considered a hot spot of bat species diversity for Michigan, and probably the entire Midwest.

While the current effort focused on monitoring species diversity, the design of the study also allowed for evaluating the generality of USFWS guidance on wind turbine placement. The USFWS guidance indicates that since Indiana bats are known to frequent wooded areas and treelines, and do not cross or use to any appreciable extent open areas, siting of wind turbines at least 1000 feet from such habitat will be protective of the Indiana bat. In the current study we delineated the following patterns:

1) Of the three species of bats that account for the majority of bat mortality associated with wind turbines, namely the eastern red bat, hoary bat, and silver-haired bat, the hoary bat has its highest activity level over agricultural fields and away from riparian areas; silver-haired bat has activity distributed proportionally to the amount of riparian versus agricultural fields available; and eastern red bat activity is highest in association with riparian habitat and decreases with distance into adjacent agricultural fields.

2) Of the three species detected in this study that have relatively low mortality associated with wind turbines, namely big brown bat, little brown bat, and the eastern pipistrelle, all three species' activity, as measured by number of recorded calls, is highest in riparian areas and decreases with distance into adjacent agricultural fields.

The finding that the majority of hoary bat activity occurs over agricultural fields in Southeast Michigan is in agreement with findings by Klatt and Gehring (2013) from mobile surveys in the thumb area of Michigan also conducted in the 2012 field season.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are supported by this study:

1. The Palmyra-Blissfield area of Lenawee County, Michigan is an area of high bat species diversity.
2. Those bat species in Michigan that tend to have higher rates of mortality associated with wind turbines across the country have a variety of activity patterns with respect to riparian versus agricultural fields, but in general have higher activity levels associated with agricultural fields than species with lower mortality rates.

3. Those bat species in Michigan that tend to have the lowest rates of mortality associated with wind turbines across the country have activity patterns that peak in riparian habitat and decrease with distance from riparian habitat into adjacent agricultural fields.

4. The apparent seasonal switch in activity of the silver-haired bat with respect to woody, riparian versus agricultural field habitats should be further investigated.

5. It does not appear that the USFWS guidance with respect to wind turbine siting and the Indiana bat can be applied to bat species in general in Michigan as a mitigation measure, especially with respect to the hoary bat and silver-haired bat.

6. Administrative considerations limited the timing of the current study. Data were not collected during the spring or early summer seasons. The efforts reported herein should be expanded to include at least one full year of monitoring for a more complete characterization of the bat activity, especially given the apparent season variation exhibited by the silver-haired bat.

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