

**Bat Monitoring at the
Proposed Conestogo Wind Farm
in Wellington County, Ontario**

Fall 2007

FINAL REPORT

Prepared For:

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and
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EXECUTIVE SUMMARY

Per guidelines set by the Ontario Ministry of Natural Resources (OMNR), FPLE Canadian Wind, ULC has been tasked with performing pre-construction monitoring for at least 15 nights during the months of August and September at the proposed wind farm location; Conestogo Wind Farm in Wellington County, Ontario, Canada. Objectives consisted of documenting baseline bat activity within the project area and examining activity by resident and long-distance migratory bat species.

Acoustic monitoring was performed to address these objectives by using Anabat and Pettersson ultrasonic detectors attached at varying heights to two (2) met towers within the project area. A Pettersson and Anabat unit was placed at each met tower with Pettersson units placed at 20 meters off of the ground while Anabat units were placed at 40 meters off of the ground. A total of 276 bat passes were recorded during the period of 15 August 2007 to 14 September 2007. When bat activity was partitioned between resident and migratory species, activity by resident species was considerably lower than migratory species. Migratory activity was not uniform throughout the monitoring period and resulted in certain days with high activity recorded mostly at heights of 40 meters.

Overall activity levels resulted in 6.00 bat passes/detector/night and 0.50 bat passes/detector/hour for nights solely with recorded data. These activity rates were considered to be low and were lower when compared to hourly rates from a nearby pre-construction monitoring study conducted at a proposed wind farm site in Dufferin County, Ontario. This data is in agreement with the preliminary likelihood assessment and screening report (LGL Limited 2007), which suggested that the habitat within the project area had low potential for bat use especially by resident bat species. Nonetheless, post-construction monitoring should be performed to fully assess whether or not an impact on bats is present by the proposed Conestogo Wind Farm.

INTRODUCTION

Recently, the impact of wind energy projects on bats has become a concern due to an unexpected high number of bat fatalities found at a number of functional wind energy facilities (Arnett 2005; Kunz et al. 2007b). These results have been produced mostly from post-construction mortality surveys performed at a number of wind farms in the eastern United States. Yet, comparable results have also been found in a recent study of agricultural areas in southwestern Alberta, Canada (CWEA 2006; Kunz et al. 2007b). Most of the fatalities from these studies comprised of migratory species and were found during the fall migratory period. Known species included in fatalities at wind projects are big brown bats (*Eptesicus fuscus*), little brown bats (*Myotis lucifugus*), northern long-eared bats (*Myotis septentrionalis*), eastern pipistrelle (*Pipistrellus subflavus*), Mexican free-tailed bats (*Tadarida brasiliensis*) and migratory tree-roosting bats such as; eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), western red bat (*Lasiurus blossevillei*), and Seminole bat (*Lasiurus seminolus*) (Arnett 2005; Johnson 2005; Piorkowski 2006). Questions remain as to how bats are being killed by wind turbines and to what degree bat populations are being affected.

Due to these findings, pre-construction monitoring is essential in understanding the current levels of bat activity as well as in projecting potential levels of bat mortality once pre-construction monitoring has been compared to post-construction monitoring. Per the guidelines of the Ontario Ministry of Natural Resources (OMNR), bat pre-construction monitoring is to be performed during the fall 2007 migratory period at the proposed wind project location; Conestogo Wind Farm in Wellington County, Ontario, Canada, based on the following objectives:

Objective 1. Document baseline use by bats within the Wind Project Area

Objective 2. Partition activity by non-migratory (typically resident) bats from long-distance migratory species

Objective 1 is necessary to document bat activity as it potentially relates to general bat and turbine interactions and site specificity. Objective 2 is necessary because current knowledge based on post-construction mortalities indicate that long-distance migratory species are at the most risk. An initial likelihood assessment of the proposed location of the Conestogo Wind Farm indicates that the site has a low potential for bats (LGL Limited 2007). Nonetheless, the OMNR has suggested pre-construction monitoring be performed to assess the potential bat activity in the area. A total of 8 species of bats occur in Ontario consisting of resident and migratory species (Gerson 1984; Table 1). Of these 8 species, 3 species are considered sensitive/at risk under provincial rankings (S-rank).

Common Name	Species Name	Ontario General Status	G-rank S-rank
Eastern Pipistrelle	<i>Pipistrellus subflavus</i>	Sensitive	G5, S3?
Northern Long-eared Myotis	<i>Myotis septentrionalis</i>	Sensitive	G4, S3?
Eastern Small-footed Myotis	<i>Myotis leibii</i>	May be at Risk	G3, S2/S3
Little Brown Myotis	<i>Myotis lucifugus</i>	Secure	G5, S5
Eastern Red Bat	<i>Lasiurus borealis</i>	Secure	G5, S4
Hoary Bat	<i>Lasiurus cinereus</i>	Secure	G5, S4
Big Brown Bat	<i>Eptesicus fuscus</i>	Secure	G5, S5
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	Secure	G5, S4

Table 1. List of bat species possibly found in the project area with sensitivity status. Status information taken from “Wind Power and Bats: Bat Ecology Background Information and Literature Review of Impacts” (OMNR 2007).

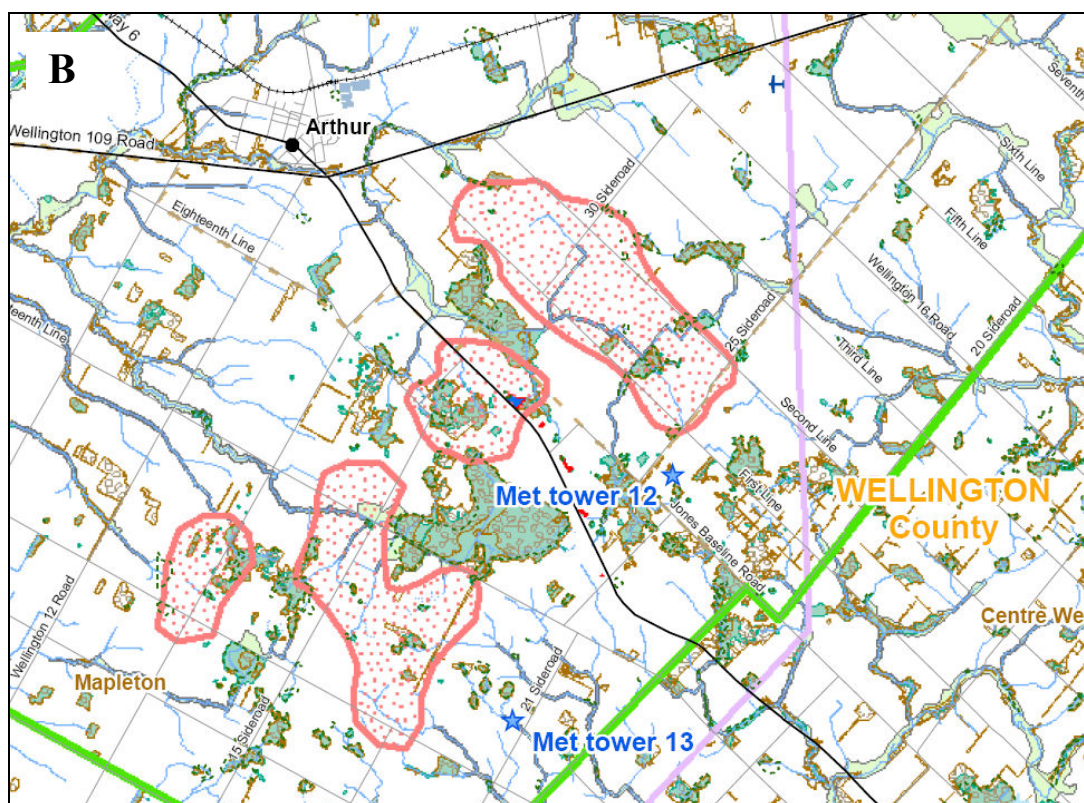
METHODS

Passive Acoustical Monitoring

Passive acoustical monitoring was performed to obtain approximately 15 nights of recording within the months of August and September 2007 according to the guidelines suggested by OMNR by placing bat detectors on meteorological or ‘met’ towers within the project area, as stated in the “Conestogo Wind Farm Proposed Pre-Construction Bat Monitoring Workplan.” The two met towers used in this study were Met Tower 12, which is located near 25 Sideroad and Jones Baseline Road, and Met Tower 13, which is located on 21 Sideroad between Fourteenth Line and Sixteenth Line (Figure 1A and 1B). These two towers are both located in agricultural fields, which is representative of the surrounding area.

Choice of placing the ultrasonic detector on the met tower was made due to the ability to record bat echolocation calls at a level relatively near the potential turbine rotor sweep and to record the activity of potentially migrating bats, since mortalities of migratory species have been found to be highest at wind project sites (Kunz et al. 2007b). In addition, migrating bats have been suggested to fly up to heights of 100 meters and the number of bat fatalities has been shown to increase exponentially with turbine height (Barclay et al. 2007). Site choice was made based upon the location of the met towers, which are in the vicinity of representative habitat types of the project area; agricultural, wooded patches, and water courses. Monitoring within these habitats will essentially provide information on bat activity of these representative areas.

Bat detectors consisted of two types of systems; one (1) Anabat Bat Detection System (Titley Electronics, Ltd.) and one (1) Pettersson D240X (Pettersson Elektronik AB) attached to each met tower for a total of four (4) systems. Although, these two systems provide different methodologies in the acquisition of ultrasonic calls, both have been



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widely used in the acoustic monitoring of bats. The Anabat system is comprised of the Anabat II bat detector connected to the Zero Crossing Analysis Interface Module (ZCAIM) to extract frequency and time information of bat echolocation. Long-term use can be obtained by the system's capability to use large 12 Volt batteries and minimal data burden. The Anabat II bat detector is a frequency-division detector which allows for detection of frequencies of 10-200 kHz within the range of 30 meters depending on the quality of the sound. In contrast, the Pettersson D240X is a time-expansion detector that retains the full information of the acoustic signal, yet due to its acquisition technique it may not record every passing bat. The Pettersson D240X is also constrained by limited battery power (one 9-Volt type) and high data burden. The Pettersson D240X has a detection range comparable to that the Anabat system yet sensitivity maybe variable depending on the quality of the sound. The Pettersson D240X is capable of detecting frequencies in the range of 10-120 kHz. Due to the frequency range of both systems, the detection of a diversity of bat species is possible.

Components of the Anabat system, a microphone with a 50 meter audio cable, allow for it to be attached up near 50 meters in height without having to raise and lower the unit. The Pettersson D240X does not allow for a microphone extension, thus the entire unit would have to be raised up to desired heights. Hence, the Anabat system was used to survey at the greater height while the Pettersson unit was used to survey at the lower height. Using a boom/pulley system that was attached to the met tower by GENIVAR personnel, the Anabat units were placed approximately 40 meters off of the ground. Anabat microphones were sheltered from weather and placed pointing downward towards a Lexan polycarbonate plate for reflection of sound. The plate was pointed approximately 45° in reference to the microphone to reflect sound coming generally above the microphone. This placement was used to assist in surveying a greater distance of airspace up towards the theoretical turbine sweep zone. The Anabat system did not have to be lowered in order to acquire the data. Sound files recorded with the Anabat system were stored onto a compact flash (CF) memory card within the ZCAIM. A 256 MB (megabyte) CF card was used to facilitate the collection of bat calls during extended periods of recording. The compact flash card and ZCAIM were programmed to start recording an hour just before sunset and to stop recording an hour after sunrise.

The Pettersson D240X with accompanying digital recorder (iRiver) was placed approximately 20 meters off of the ground using a semi-permanent housing installation with a pulley system. The housing provided shelter for the unit and the unit was placed pointing downward towards a plexi-glass plate for reflection of sound. The plate was pointed approximately 45° in reference to the microphone to reflect sound coming generally above the microphone. Again, this placement was used to assist in surveying a greater area of airspace. Recording with the Pettersson D240X was performed by connecting it to an iRiver digital recorder. Sound files were stored within the iRiver until retrieval. Due to the constraint of battery power for these systems, they had to be checked more frequently (every 3 days) compared to the Anabat systems. LGL Limited personnel performed the maintenance of all systems, change of batteries, download and maintenance of data.

Data Analysis

Analysis of recorded calls was performed to assess the species composition and relative activity of the bat fauna within the project area. Qualitative analysis of recorded echolocation calls from the Anabat system was performed using AnalookW bat call analysis software, version 3.3m (Corben 2006). Analysis of Pettersson data was performed using Sonobat version 2.5 (DNDesign 2000). Sound files were visually screened to remove files of non-bat calls, so that only suitable bat calls remained. Call files were examined visually, compared to libraries of known bat reference calls, and assigned to species or when a single species could not be deciphered from the call these calls were assigned to species-group categories. Assignment of a call to a species was possible only when clear calls were recorded and only with certain species. Fragmentary, unclear or calls that were assignable to more than 3 species were designated as “unknown.”

To address objective 1, call rates by species, as well as total detections and trends in species’ presence in the data were analyzed. To quantify rates and put call data in a comparable context to other studies, two indices were calculated; an index of average bat passes per night (ABN index) and an index of bat passes per hour (ABH index). Each index was calculated by using only the nights with recorded data and for each individual system. When calculating for bat passes per hour, twelve (12) hours were surveyed per night of data. Additionally, to address objective 2 species were classified as resident or migratory for discrimination between activity rates by these species.

RESULTS

From the combined two (2) Anabat systems and two (2) Pettersson/iRiver setups, a total of 4,405 sound files were recorded within a period from 15 August 2007 to 14 September 2007. Visual examination and filtering of files to eliminate extraneous noise (i.e. wind, insects, etc.) resulted in 276 bat passes between all of the systems at both met towers recorded over 19 nights. The number of bat passes recorded does not necessarily constitute the number of bats present, that is, a single bat could possibly make several passes within a night.

To quantify bat activity rates, the total number of bat passes was divided by the number of nights and the number of hours for nights with recorded data for each individual acoustic unit (ABN index and ABH index; Table 2A and 2B). Comparison between the Anabat and Pettersson systems reveal a drastic difference in the number of bat passes recorded. The low number of calls could be attributed to a combination of the lower number of days that the Pettersson was allowed to record due to battery power limitations, height at which the unit was placed, and difference in way the system acquired data. Based on the Anabat unit results, met tower 13 showed a higher index while based on the Pettersson unit data met tower 12 had a slightly larger value. When

values are averaged for each met tower, met tower 12 has an ABN index of 4.95 and met tower 13 has an ABN index of 7.05. When values are averaged for the overall data, the ABN index is 6.00. ABH index values for overall rates were 0.50, which translates to on average less than 1 bat passing the microphone per hour. Generally, twelve (12) hours were surveyed per night of data.

For general consideration of species composition and migratory activity within the project area, bat passes were classified into the following 8 designations (Figure 2):

HOBRSI – Hoary, brown and silver-haired bat group
HOSI – Hoary and silver-haired bat group
BROSI – Brown and silver-haired bat group
HOAR – Hoary bat
SILVER – Silver-haired bat
RED – Eastern red bat
MYOTIS – Myotis bat group
Unknown – unassignable to species or species group

A - Nightly		Total Bat Passes	No. of Nights Recorded	ABN Index
Anabat	Met 12	71	10	7.10
	Met 13	183	16	11.44
Pettersson	Met 12	14	5	2.80
	Met 13	8	3	2.67

B - Hourly		Total Bat Passes	No. of Hours Recorded	ABH Index
Anabat	Met 12	71	120	0.59
	Met 13	183	192	0.95
Pettersson	Met 12	14	60	0.23
	Met 13	8	36	0.22

Table 2. Overall bat activity indices. (A) Bat activity based upon number of bat passes and number of nights solely with recorded data. (B) Bat activity based upon number of bat passes and number of hours for nights with solely recorded data. “Total Nights Surveyed” and “Total Hours Surveyed” includes nights that were monitored and did produce any recorded data. Twelve (12) hours were surveyed per night.

Bat passes were put into the most specific category when possible as sufficient data allowed, for example a bat pass with specific enough data could be put into the category HOSI rather than HOBRSI. Percent species/species group composition from the combined data of the two met towers was as follows from highest to lowest; HOBRSI (n = 84), HOAR (n = 84), BROSI (n = 18), HOSI (n = 10), MYOTIS (n = 6), SILVER (n = 4), and RED (n = 2) (Figure 2). Unknown calls represented 25% (n = 68) of the total detections due to a large number of fragmentary calls.

To examine activity between resident and migratory species, species or species groups were classified as 'Resident' or 'Migratory' (Figure 3). Residents consisted of the MYOTIS, while 'Migratory' were made up of HOAR, HOSI, SILVER, and RED. The 'Resident/Migratory' category consisted of HOBRSI, BROSI, and Unknown. These groupings contained species that are either resident or migratory, because insufficient data to distinguish between the species. Peak activity was found on 5 nights; 15, 18, 23, 27, and 29 August 2007 (Figure 3) and commonly at heights around 40 meters in the vicinity of met tower 13 (Anabat units; Figure 4). Activity on these nights can be attributed to bat passes recorded from migratory species and species categorized within the 'Resident/Migratory' group. These migratory species consist primarily of hoary bats (HOAR; HOBRSI) and potentially silver-hair bats (HOBRSI) (Table 3).

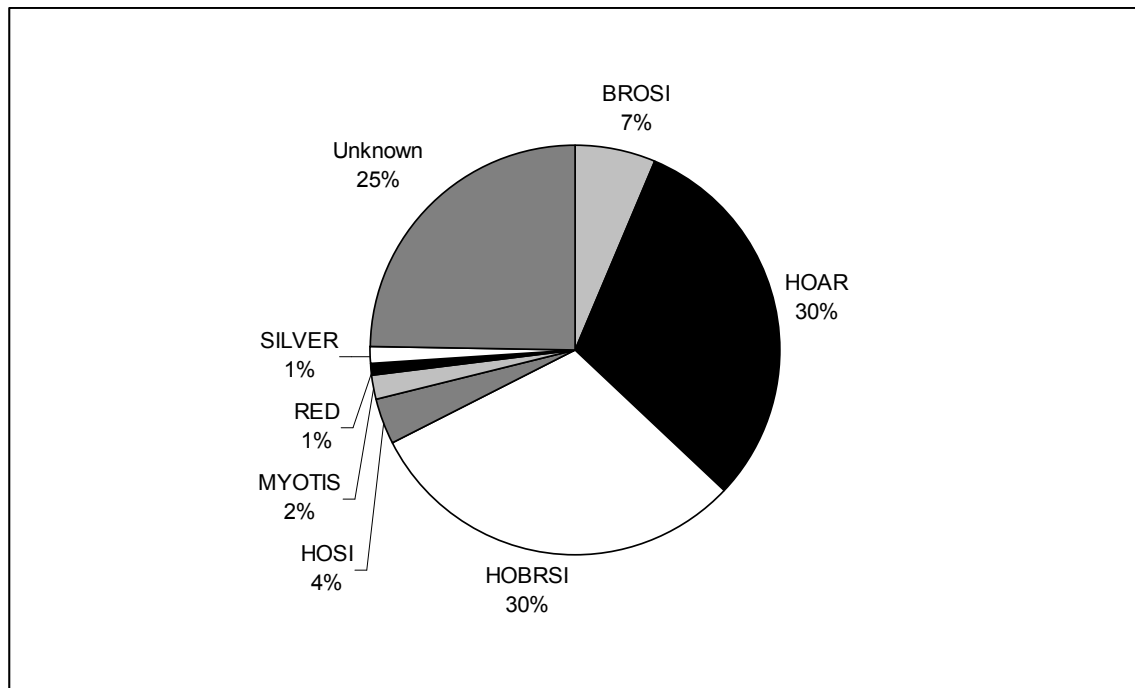


Figure 2. Percent composition of species and species groupings from overall bat passes.

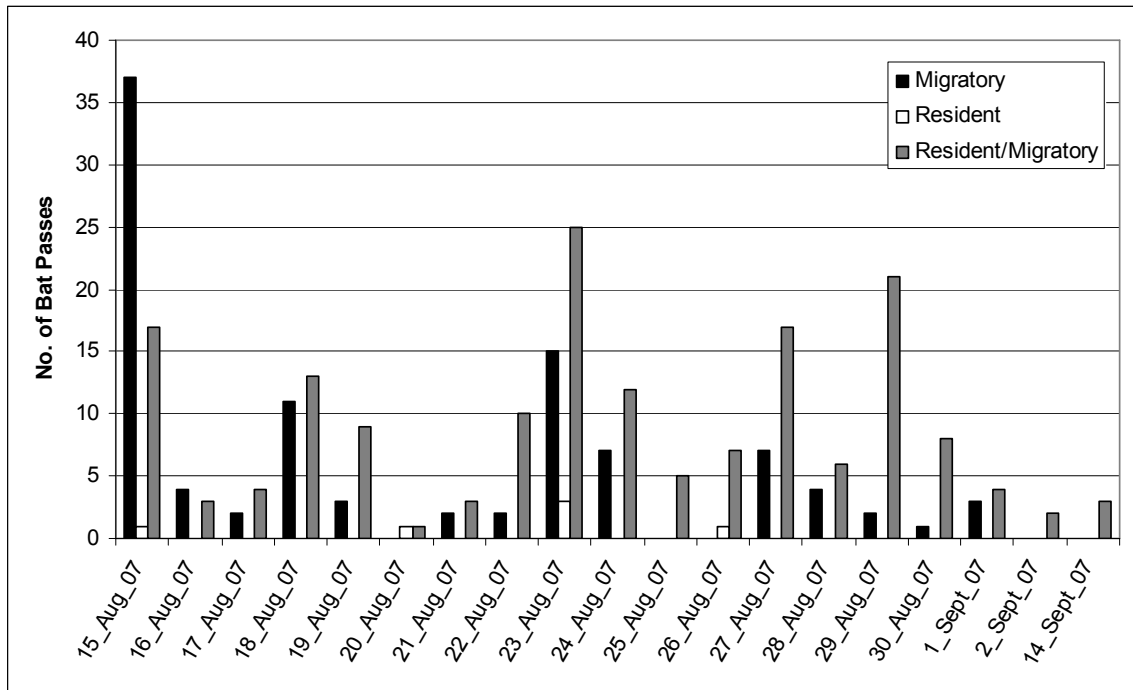


Figure 3. Nightly total of bat passes classified into resident or migratory.

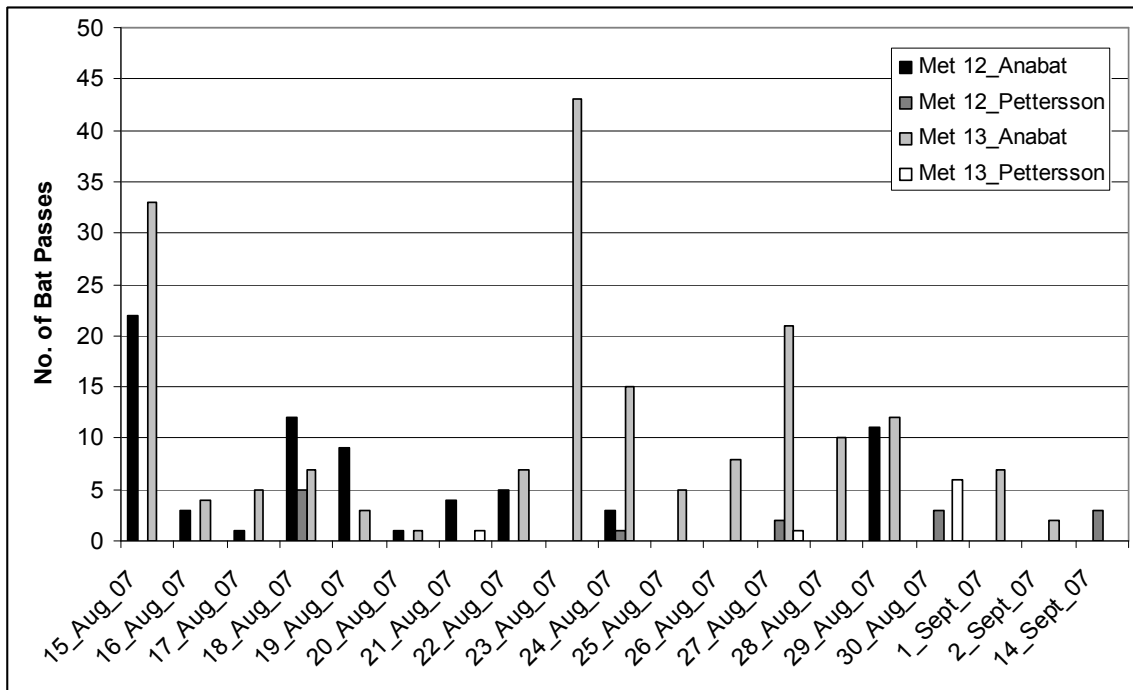


Figure 4. Nightly total of bat passes per individual detector unit.

Dates	Species/Species Group Categories								TOTAL
	BROSI	HOAR	HOBRSI	HOSI	MYOTIS	RED	SILVER	Unknown	
15-Aug-07	4	35		1	1		1	13	55
16-Aug-07		4	1					2	7
17-Aug-07		2						4	6
18-Aug-07	4	10	3			1		6	24
19-Aug-07	1	3	1					7	12
20-Aug-07	1				1				2
21-Aug-07		2						3	5
22-Aug-07		2	6					4	12
23-Aug-07		9	23	6	3			2	43
24-Aug-07		5	11	1			1	1	19
25-Aug-07			3					2	5
26-Aug-07			1		1			6	8
27-Aug-07	2	4	8	2			1	7	24
28-Aug-07		4	4					2	10
29-Aug-07		2	15					6	23
30-Aug-07	5		3				1		9
1-Sep-07		2	2			1		2	7
2-Sep-07			1					1	2
14-Sep-07	1		2						3

Table 3. Number of bat passes per species/species group on dates with recorded data.

DISCUSSION

In accordance with the objectives, acoustical monitoring during the fall 2007 season was performed to document baseline bat activity in the project area of the proposed Conestogo Wind Farm in Wellington and Dufferin Counties, Ontario, Canada. Species (described by species group) that were detected in this study consisted of species that potentially occur in the project area based on existing distributional records (Gerson 1984; OMNR 2006). In Ontario, three bat species (eastern pipistrelle, northern long-eared myotis, and eastern small-footed myotis) have a sensitive/at risk status by provincial rankings. None of these species were specifically detected in the study, yet a trivial number of bat passes ($n = 6$) were detected and classified to the MYOTIS group. These calls could possibly be due to the more common little brown bat. The majority of calls detected in this study were by species not labeled as sensitive by provincial rankings.

The resulting level of bat activity was variable depending on detector type. In the case of detector type and location of the detector, low number of recorded bat passes by the Pettersson units is complicated by a combination of recording on fewer nights, height placement, and possibly lower sensitivity of the detector. Yet, higher activity recorded

by the Anabat units (those placed at greater heights) could be the result of higher activity of migrating bats since migrating bats are believed to fly at heights up to 100 meters (Barclay et al. 2007). In general, bat activity was similar in the proximity of met towers 12 and 13 with slightly more bat passes detected at met tower 13 on a per night basis.

When acoustic data was partitioned between resident and migratory species, this suggested that the majority of activity was more attributable to migratory species which mainly consisted of the HOAR and HOBRSI groups. A considerable number of bat passes were recorded for hoary bats (HOAR) alone. The group HOBRSI consisted of hoary, big brown and silver-haired bats. Hoary and silver-haired bats are species considered to exhibit long-distance migratory behavior (OMNR 2006). Both species are among the most reported in fatalities from wind energy facilities in the United States (Kunz et al. 2007b). Alternatively, big brown bats were also included in this grouping (HOBRSI) and have made up a small percentage of those found among the reported fatalities (Kunz et al. 2007b). Nonetheless, migratory activity appeared episodic and resident activity was considerably low which is in agreement with the preliminary likelihood assessment and screening report (LGL Limited 2007), which suggested that the habitat within the project area had low potential for use by resident bat species.

The overall rates of bat activity detected in the present study reveal relatively low activity. The monitoring results demonstrate that on average between 3 and 11 bat passes could be detected during the night (ABN index; Table 2) and between 0 and 1 bat passes could be detected during an hour (ABH index; Table 2). These rates are lower than rates (average of 1.5 passes/hour with highest rate of 2.7 passes/hr) detected in a nearby pre-construction monitoring study for a proposed wind farm in the Township of East Luther Grand Valley, Dufferin County, Ontario (Environmental Business Consultants 2008). A projection of expected post-construction bat activity and/or mortality could not be determined because of the current lack of data. To date, a thorough study has not been completed to demonstrate the correlative nature between pre-construction acoustic bat pass rates and post-construction mortality rates.

Given the make up of the habitat in the project area, bat use could be variable. The majority of the project area is made up of agricultural open areas. Hoary and big brown bats could potentially forage in this area, since they have been known to forage in open areas (OMNR 2006). Additionally, a large percentage of a hoary bat's diet is made up of moths, which some moth species are considered agricultural pests. Hoary bats have been suggested to consume these moth species in agricultural areas (Tuttle 1995). A dearth of knowledge is known on bat use in agricultural areas, yet some studies have shown some considerable levels of activity (Cleveland et al. 2006; Gehrt and Chelsvig 2003). The presence of woodlands can potentially provide foraging and roosting habitat for all 8 species of bats expected in the project area. Riparian and aquatic areas also provide considerable habitat for all 8 species as potential foraging and drinking sites. Buildings, such as barns and houses, may provide habitat for big brown, little brown, and eastern small-footed bats, since these species have been known to roost in man-made structures (OMNR 2006). Yet, based on the preliminary likelihood assessment and screening

report, woodlands, riparian/aquatic, and buildings were considered to provide low habitat use by bats in the project area (LGL Limited 2007). Nonetheless, turbine placement should be determined with distances away from woodland and riparian/aquatic habitat since these areas can potentially provide the habitat with the most use by bats.

The detailed post-construction monitoring protocol will be developed in discussions with MNR.

CONCLUSION

In accordance with the preliminary likelihood assessment and screening report, bat use is considered low for the project area. Rates of bat activity detected in the project area indicate lower rates than those reported in a nearby pre-construction monitoring study conducted at a proposed wind farm site in Dufferin County, Ontario. Bat activity as determined by this acoustic monitoring survey suggests the majority of activity is by migratory species recorded at heights approximately at 40 meters and that activity by migratory species is episodic. Post-construction monitoring should be performed to fully assess whether or not an impact on bats is present by the proposed Conestogo Wind Farm.

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