South Canoe Wind Power Project

2011 PRECONSTRUCTION BAT SURVEY

PROPONENT
MINAS BASIN PULP & POWER
&
OXFORD FROZEN FOODS

REPORT COMPLETED BY:

McCallum Environmental Ltd.

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INTRODUCTION

Minas Basin Pulp and Power ("Minas") has proposed development of the South Canoe Wind Energy Project ("Project") between Chester and Windsor, Nova Scotia. The centre of the project lands are located at approximately 397212.83 m E; 4958626.59 m N (20T; NAD 83).

Minas contracted McCallum Environmental Ltd. to monitor bat activity as part of the pre-development impact assessment. This report includes results of acoustical surveys for bats completed from August to September 2011. The purpose of the program was to determine bat species occurrence, diversity, and activity levels within the Project area. The following report focuses on the fall 2011 bat activity monitoring study and describes the methods used to assess the bat utilization rate in the Project area, presents the results and provides a summary of the findings.

In Nova Scotia there are occurrence records for seven bat species, which include hoary bats (*Lasiurus cinereus*), silver-haired bats (*Lasionycteris noctivagans*), eastern red bats (*Lasiurus borealis*), big brown bat, *Eptesicus fuscus),* tri-colored bat (*Perimyotis subflavus*), northern long-eared bat (*Myotis septentrionalis*) and little brown bats (*Myotis lucifugus*) (Broders, 2011).

Each of these species has been documented to have experienced fatalities at wind turbine sites (Broders, 2011). In North America, large bat fatality events occur primarily in late summer and early fall and the species most affected are the long distance migrant species. However, bat fatalities have also been reported, in smaller numbers for short-distance migrant (or 'resident') bat species (Broders, 2011). Although some mortality has been documented in the spring it is thought that spring migration behavior is scattered and less organized and may occur by different routes compared to fall migration (Broders, 2011).

Studies throughout North America have shown that at some wind energy facilities bats, primarily migratory species, are at risk of being killed by moving wind turbine blades (Arnett *et al.* 2008). Additionally, bats may also be killed from barotrauma associated with moving turbine blades (Baerwald et al., 2008). Beyond these direct effects, loss or alteration of habitat may also affect impact bats in the short- and long-term.

Goal

The goal of the pre-construction survey was to complete sampling of bat activity across the proposed wind energy development project area. This will facilitate future estimates of the relative risk to bats from wind turbines at proposed sites following mortality studies.

Specifically, the recommended surveys were designed to determine:

- Species occurrence and diversity
- Activity levels (e.g., relative abundance, seasonal timing, daily timing)

The principal goal of the bat activity study was to quantitatively describe the bat activity within the Project area during the 2011 fall migration period with the use of nocturnal acoustic detection devices.

METHODS

No published methodologies exist in Nova Scotia for Bat Survey methods however a similar methodology was used for the recent Hampton Mountain Wind Power Project, which was subsequently accepted by the Dept. of Environment, DNR, and the CWS. In addition, the methodologies are adapted from *Bats and Wind Turbines. Pre-siting and pre-construction survey protocols.* May 2006. (Cori Lausen, Erin Baerwald, Jeff Gruver, and Robert Barclay, University of Calgary).

Detection

Bats emit ultrasonic signals in order to echolocate. By emitting a series of discrete calls and listening for returning echoes, bats are able to locate objects, including prey items (Vonhof, 2006). Echolocation signals have frequency, duration, and intensity components associated with them (Vonhof, 2006). All bats in Canada produce FM, or frequency modulated, echolocation calls, where the echolocation calls change in frequency over time. (Vonhof, 2006)

The signal may be narrowband, where the frequencies sweep over a small range, or broadband, with a large change in frequency over time. Most echolocation calls produced while the bats are searching have a characteristic frequency of maximum intensity, where the majority of energy is placed, usually coinciding with the relatively long "tail" of the FM call. Putting the majority of energy in a small frequency range while searching for prey increases the effective range of the calls. The signal may also include additional harmonics in addition to the fundamental (lowest frequency) harmonic. (Vonhof, 2006)

The repetition rate at which calls are given varies with the activity of the bat and provides a means for discriminating between different behaviours in the field (Thomas and West 1989). Commuting bats or bats searching for prey emit approximately 5-10 calls per second. This rate increases to 100 or more calls per second when a potential prey item has been detected and the bat closes in to attack. This characteristic 'feeding buzz' (Griffin 1958) indicates that a bat is foraging in an area (Vonhof, 2006).

Ultrasonic detection involves sampling bats by acoustic means. It is possible to eavesdrop on the vocalizations used during echolocation to detect the presence of bats, assess whether a bat is foraging or commuting, and potentially identify the species emitting the call. Sounds ≥ 20 kHz are termed ultrasonic (beyond the range of human hearing), and the calls of all bat species are restricted to the ultrasonic range. Therefore, we require specialized equipment in the form of ultrasonic bat detectors to monitor them. Unlike netting and trapping, no handling is involved during ultrasonic detection, and therefore disturbance is minimized. However, positive species identification is not usually possible, nor is assessment of age, sex, or reproductive condition. Instead, ultrasonic detectors are used to determine relative levels of bat activity in different habitats (Vonhof, 2006).

Data Collection

Bat surveys were completed between August 12th and September 29th, 2011. This seasonal timing of the sampled period corresponds to the end of the summer residency period and the fall migration period for species in Nova Scotia.

Bats were surveyed for using AnaBat SD1 Detectors (AnaBat; Photo 1). AnaBats detect ultrasonic bat calls through a transducer (microphone) and record them on a compact flash card for later download and analysis.

Photo 1. AnaBat acoustical bat detector.

AnaBat detectors were calibrated by adjusting sensitivity settings on each unit until a constant 40 kHz tone could be detected at 30 m with a minimum of static interference. We marked that setting on the unit dial for both STI™ (standard) and Hi-mic (designed to boost audio signals through a longer cable for remote mounting) microphones.

Four (4) detectors were deployed at ground level. Although a single Meterological Tower (MET Tower) was present within the Project area, no hoisting equipment was present on the MET Tower, and no acoustic monitoring equipment could be placed above ground level.

All units were placed in a weather proof casing with the microphone protected inside an angled PVC conduit such that the angle of reception to the microphone was approximately 45 degrees to the ground and oriented parallel to the forest edge. Because bats generally echolocate as they fly, microphones sensitive to the frequency of sounds that bats use (ultrasound) can provide a measure of bat activity in an area. Although there are a variety of bat detectors available on the market, currently only one type allows for high capacity storage of echolocation data required for the prolonged monitoring recommended in this protocol. AnaBat with a Compact Flash Storage Zero Crossings Analysis Interface Module (CF-ZCAIM) digitally records echolocation sequences. Sensitivity of the AnaBats can be adjusted, and when deploying the detectors, we adjusted the sensitivity setting of each AnaBat unit based on the laboratory calibration, and further adjusted the setting by hand if static was audible at the calibrated level.

The AnaBat (with the timer function "on") together with the CF-ZCAIM draw little power, and will operate properly for 2 weeks or more running on an external 24 amp-hour 12-volt battery. However, because AnaBat sensitivity decreases as battery power decreases, the battery were monitored and recharged as necessary. A solar panel was installed to keep the external battery charged. The AnaBat, CF-ZCAIM and battery was stored in a waterproof container to ensure rain did not come in contact with the electronics. Even though the number of bat passes in a monitored area may be small, use of a high capacity (512 MB or larger) flash card was used, because wind noise and other types of interference often trigger the system, resulting in a large number of "noise" files being stored on the card. Each echolocation sequence is represented as a unique file, with year, date, and time of the bat pass comprising the file name.

- Bat detectors were programmed to record calls from 1900 until 0630 daily.

We downloaded data and checked the function of all AnaBat detectors at approximately 4-day to 1-week intervals during the study period.

AnaBat Locations

The detector locations were selected based on regional distribution, topographic position (i.e., ridgetops, level terrain), access permission, adjacent habitats, detector security (i.e., proximity to public roads), and supportive structures (i.e., meteorological (met) tower). During initial AnaBat deployment, AnaBat locations were also chosen based upon proximity to turbine locations as provided by Minas. As of the date of this report a final layout has not been provided and it is unknown how the sampling locations fit within the final layout.

As no MET towers with bat hoists were available in the Project area, we mounted all AnaBat detectors at ground level. AnaBat detectors were moved during the study to attempt to cover a broader area within the Project. This was not deemed to be a separate deployment for study purposes as the intent of the study was not to determine bat movement through a specific area within the Project (i.e. a valley for example), but to determine numbers of bat passes.

Table 1. AnaBat Deployment Information

AnaBat #	AnaBat Location	Coordinate NAD83 UTM Zone 20T	Date Deployed	Date Removed	Notes
AnaBat 1	On eastern access road adjacent to Big Otter Lake	398753.00 m E 4959690.00 m N	August 14, 2011	September 15, 2011	Moved 700 m north on Sept 15. No data past Sept 15 as the detector and housing were stolen after that date. At both locations the Anabat was located in mature mixedwood forest along a road edge.
AnaBat 2	At MET tower (no hoist present on tower- placed on the ground)	394013.00 m E 4958517.00 m N **Then:** 394270.00 m E 4957944.00 m N	August 14, 2011	August 30, 2011	Originally deployed near the MET tower in a shrubby open area where it was twice vandalized by bears. It was moved to a young forested edge habitat, before it was vandalized by bears again and removed from the property as it was damaged. Data from Aug 15 to 30.
AnaBat 3	Western extent of property	391170.00 m E 4957892.00 m N **Then**: 391985.11 m E 4958494.36 m N **Then**: 398848.48 m E 4956620.09 m N	August 14, 2011	October 14, 2011	Placed near the western extent of the property (moved locally due to property boundary updates) in forested edge habitat near an access road. It was then moved east 600 m on Aug 16 (upon request from the client) and situated at the edge of a wetland complex and clear cut area just south of Joe Long Lake. Data from Aug 14 to 15. No data

					from Aug 16 to 18 (problem with microphone connection). Data from Aug 19 to Sept 29.
AnaBat 4	Southwestern extent of property. Moved to central access road south of MET tower	392496.00 m E 4957241.00 m N **Then:** 395255.00 m E 4958319.00 m N	August 14, 2011	October 14, 2011	Moved from southwest extent of property to central access south of MET tower Due to property boundary updates, it was moved to a central location south of the MET tower on Aug 16 and placed in a shrub open area near forested habitat and a small access road. This system was stolen from this location. Data from Aug 14 to Sept 29. Stolen in field before Oct 14.

All AnaBats were deployed along the edges of regrowth forests near access roads at a height of 1 m above grade. We were unable to place any systems at higher heights as the one MET tower present on the site did not have a hoist for a bat system.

Photo 2. AnaBat #1 deployed along forest edge habitat.

Photo 3. AnaBat 2 deployed adjacent to MET Tower in regrowth area.

Photo 4. AnaBat #3 deployed in regrowth area.

Photo 5. AnaBat #4 deployed adjacent to trail in 10-15 year old mixedwood re-growth.

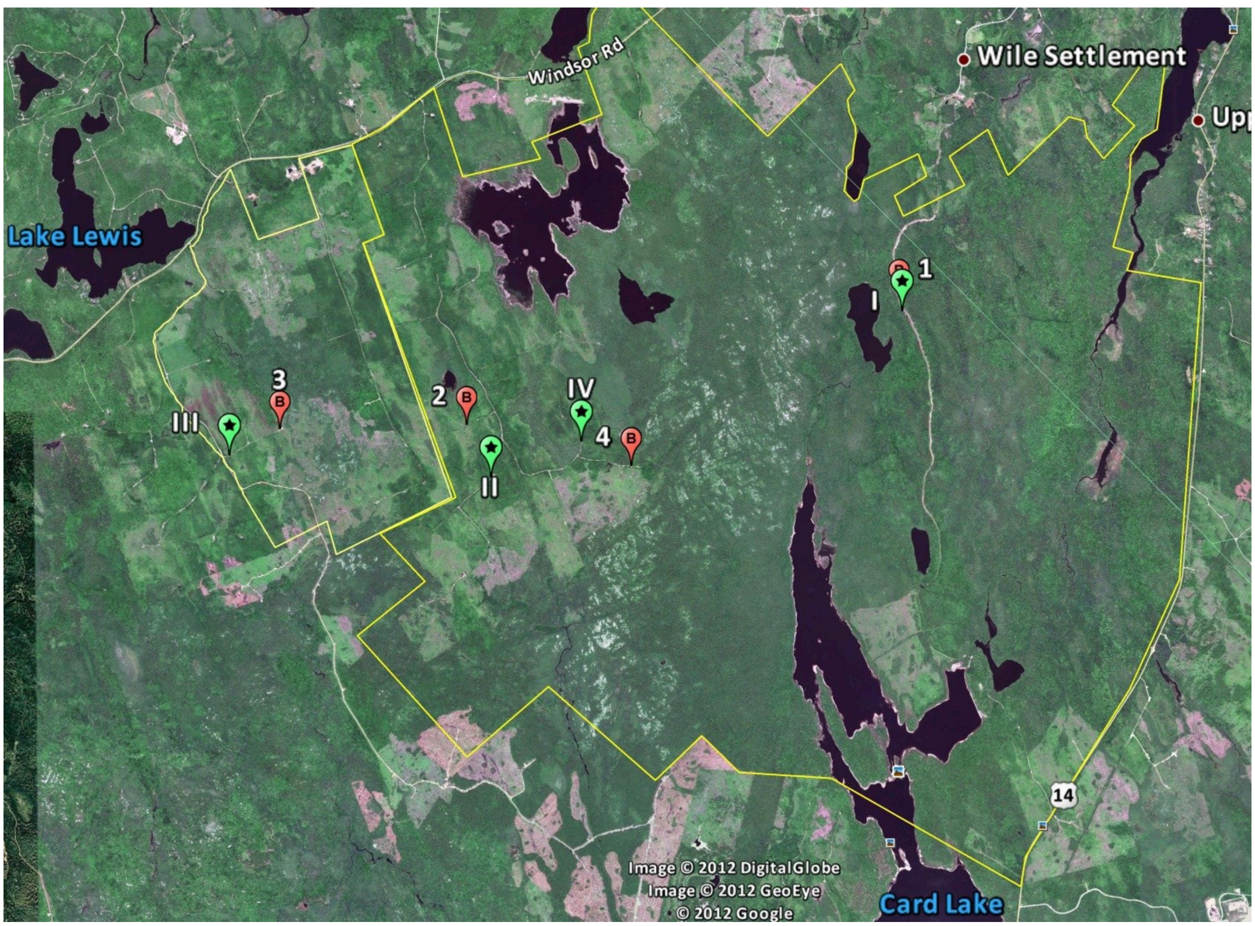

Figure 1. Map of AnaBat Locations

Anabat Location prior to move	The roman numerals and the # represent the same AnaBat detector, placed in another location.
Final Anabat location	

Data Interpretation

Specialized software (*Analook*, Titley Electronics, Ballina, NSW, Australia) was used to construct frequency/time graphs from the bat calls recorded by the AnaBat detectors. For each call, the slope, maximum frequency (*i.e.*, the highest frequency), minimum frequency (*i.e.*, the lowest frequency), and duration were determined, as those variables are believed to be species-specific (Gannon *et al.* 2004). Each variable was then compared with a library of reference calls collected from individual bats that had been identified to species. We defined a *bat call* (call) as a single, recognizable vocalization from one bat and a *bat pass* (pass) as one or more sequential calls, representing calls from a single bat, recorded in a one AnaBat digital file.

We summarized bat activity based on the categories of bats (primarily *Myotis* spp.) and migratory bats (hoary, silver-haired, and red bats). Where echolocation calls could be identified to species, we classified them as

- *Myotis* spp. – primarily *Myotis lucifugus* (MYLU, little brown bat). Other *Myotis* species, including northern long-eared (*Myotis septentrionalis*) likely were also present but their calls cannot be reliably distinguished.
- LACI - *Lasiurus cinereus* (hoary bat);
- LANO - *Lasionycteris noctivagans* (silver-haired bat);
- EPFU - *Eptesicus fuscus* (big brown bat);
- LABO - *Lasionycteris borealis* (Eastern red bat); and,
- UNKN – Records recognized as bat calls, but for which frequencies could not be determined.

Data analysis was conducted by a Derrick Mitchell, a wildlife biologist who, in addition to having experience in analysing bat acoustic signals, received formal training in the identification of bat echolocation auditory signatures by attending courses provided by Hugh Broders, Ph.D. The analysis consisted of a tally of all bat 'passes', and assignment of the passes to bat species or species group based on characteristics of the echolocation recording. A bat 'pass' is attributed to a bat flying through the detection radius of the bat detector. Because an individual bat may be recorded making multiple passes, the data presented are a measure of bat activity in the vicinity of the bat detectors, not a direct measure of the numbers of bats within or passing through the Project Area.

RESULTS

Echolocation Survey

Echolocation surveys were conducted within the South Canoe study area from August 13th until September 29th, 2011; however, the number of survey nights was not consistent amongst the survey sites (Table 2, below). It should also be noted that data was only interpreted to the September 29th, 2011, even though AnaBat detectors were in the field until October 14th. The data confidence past September 29th was low and therefore not used. Echolocation surveys were conducted over a period of 121 nights across all four AnaBats. In total, there were 21,081 files recorded over four AnaBats, of this, only 4,211 files were determined to be bat generated ultrasound all remaining files were extraneous noise likely caused by wind.

The vast majority of echolocation calls recorded at AnaBats 1 through 4 were associated with Myotis species bats (i.e., little brown bat (*Myotis lucifugus)* and northern long-eared bat *M. septentrionalis*) both common species in Nova Scotia (Table 2). No attempt to identify each of the Myotis species calls to species level was completed because of the difficulty in achieving defensible identifications (Broders, 2011). Despite this, there were echolocation calls with characteristics consistent with both northern long-eared and little brown bat. A high percentage (28.8%) of the identified echolocation calls were categorized as unknown species. These calls were clearly bat generated ultrasound; however, the quality of the files was not sufficient to render a positive identification. Three calls recorded at AnaBat 1 were consistent with tricolored bat (*Perimyoptis subflavus*) echolocation calls, but due to insufficient file quality, defensible identification was not possible. Therefore, these files were categorized as non-Myotis species (Table 2). Echolocation files associated with two other species of bat were recorded at AnaBat 1 and AnaBat 3. One silver-haired bat (*Lasionycteris noctivagans*) call was recorded at AnaBat 1 and 11 hoary bats (*Lasiurus cinereus*) calls at AnaBat 3 (Table 2). All of the aforementioned species are known to occur in Nova Scotia.

Table 2. Number of echolocation calls by species recorded at four AnaBats within the South Canoe proposed wind farm between August 2011 and September 2011.

	AnaBat 1				AnaBat 2		AnaBat 3			AnaBat 4	
DATE	MYOT	NMYOT	LANO	UNK	MYOT	UNK	MYOT	LACI	UNK	MYOT	UNK
13/08/2011	141	0	0	66	100	64	86	0	64	0	0
14/08/2011	7	0	0	243	0	0	24	0	37	68	29
15/08/2011	28	0	0	24	4	27	22	0	23	30	6
16/08/2011	16	0	1	22	4	10	0	0	0	31	3
17/08/2011	40	0	0	24	4	2	0	0	0	57	22

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18/08/2011	35	0	0	37	18	9	0	0	0	68	11
19/08/2011	10	0	0	25	9	6	0	0	3	40	11
20/08/2011	0	0	0	0	0	4	0	0	2	56	3
21/08/2011	0	0	0	0	0	7	0	0	3	49	3
22/08/2011	0	0	0	0	1	17	1	0	5	32	3
23/08/2011	0	0	0	0	1	2	0	0	2	17	1
24/08/2011	0	0	0	0	2	1	0	0	2	48	2
25/08/2011	24	1	0	30	612	325	0	0	1	23	9
26/08/2011	42	1	0	34			2	0	5	51	1
27/08/2011	65	0	0	23			1	0	1	39	2
28/08/2011	5	0	0	4			0	0	0	3	0
29/08/2011	24	0	0	27			0	0	2	34	5
30/08/2011	30	0	0	22			1	0	0	21	9
31/08/2011	14	0	0	4			0	0	2	11	14
01/09/2011	29	0	0	17			4	11	4	20	6
02/09/2011	2	0	0	7			1	0	0	10	2
03/09/2011	72	0	0	27			75	0	29	23	6
04/09/2011	25	0	0	10			41	0	13	22	5
05/09/2011	17	0	0	21			0	0	3	15	2
06/09/2011	1	0	0	4			0	0	1	2	0
07/09/2011	3	1	0	4			4	0	2	12	0
08/09/2011	3	0	0	3			1	0	3	3	4
09/09/2011	4	0	0	8			0	0	0	13	9
10/09/2011	0	0	0	1			0	0	0	2	1
11/09/2011	0	0	0	0			0	0	2	6	0
12/09/2011	11	0	0	4			2	0	5	4	6
13/09/2011	13	0	0	3			0	0	1	7	1
14/09/2011	35	0	0	2			3	0	1	8	5
15/09/2011	0	0	0	0			2	0	1	6	1
16/09/2011							0	0	0	1	0
17/09/2011							1	0	1	1	1
18/09/2011							0	0	1	0	0
19/09/2011							0	0	0	3	0
20/09/2011							0	0	0	1	3
21/09/2011							0	0	1	0	3
22/09/2011							0	0	1	1	0
23/09/2011							1	0	2	5	1
24/09/2011							1	0	1	11	1
25/09/2011							0	0	1	6	2

26/09/2011							0	0	1	11	4
27/09/2011							0	0	1	6	0
28/09/2011							0	0	0	0	0
29/09/2011							0	0	0	1	0
Total	**696**	**3**	**1**	**696**	**755**	**474**	**273**	**11**	**227**	**878**	**197**
Total per ANABAT	**1396**				**1229**		**511**			**1075**	
Number nights	**27**				**12**		**37**			**45**	
# calls per night	**51.7**				**102.4**		**13.8**			**23.9**	

MYOT = Myotis spp., NMYOT = Non-Myotis spp., LANO = *Lariurus cinereus*, LACI = *Lasionycteris noctivagans,* UNK = Unknown.

Echolocation surveys were conducted over a period of 121 nights across all four AnaBats with an average of 34.8 calls per night. AnaBat 2 had the most passes/night activity with an average of 102.4 echolocation calls detected over 12 nights. Although AnaBat 2 had the highest average recorded activity, 937 echolocation calls out of a total of 1229 calls (76.2%) were recorded over the course of one night, August 25th, 2011, which incidentally was the last detector night for this location. A marked decrease in activity (i.e., echolocation calls) occurred on September 6th at AnaBats 1 and 4, while activity at AnaBat 3 decreased on September 5th. As previously stated, August 25th was the last day of detection at AnaBat 2.

A dramatic increase in activity at Site 2 on the night of August 25th may have been due to the presence of one Myotis bat continuously foraging in close proximity to the AnaBat detector over the course of the evening. It is not necessarily an indication of bat abundance but may indicate that there was an abundance of insects in the area surrounding the detector on that particular night. There is simply no way to determine whether bat abundance is high at this site without direct observation.

Average nightly bat activity at peaked between 19:00 and 20:00 due to a spike in activity at AnaBat 1 (Figure 2). If this outlier is discounted, activity tends to be highest between 22:00 and 5:00 the across all AnaBats when the data is combined. No apparent trend emerged with respect to temporal activity when the data was analyzed for each individual AnaBat. As to be expected, activity decreased significantly between 5:00 and 6:00 which coincides with sunrise.

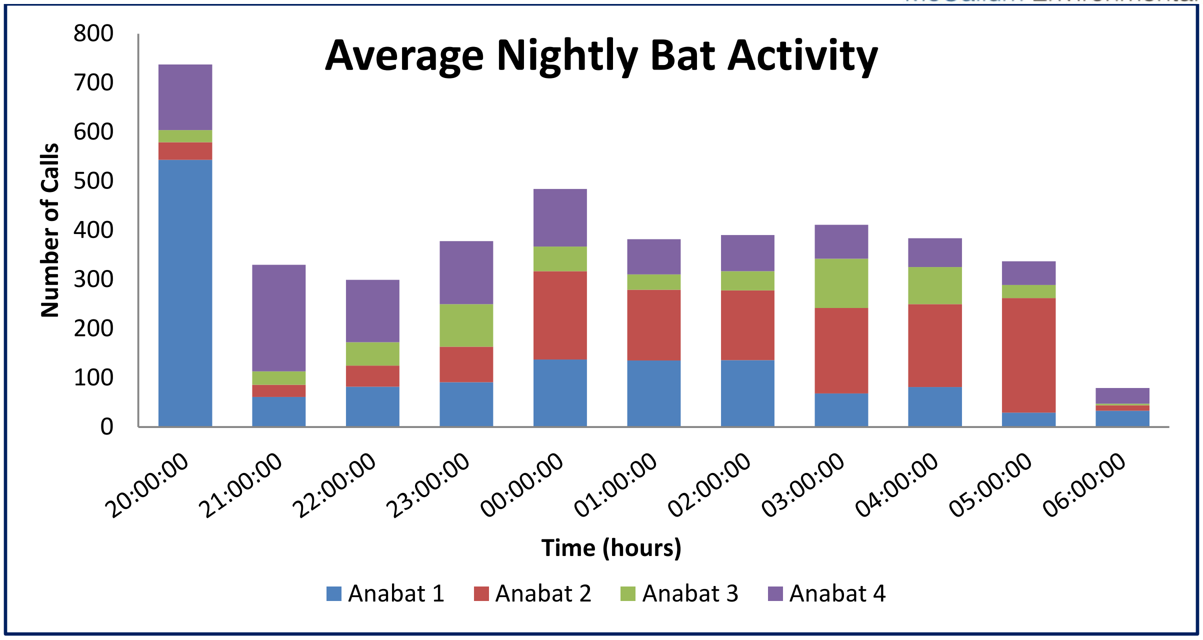

Figure 2. Average nightly activity for AnaBat 1 through 4 for the proposed South Canoe wind farm project, NS.

Hibernacula

The Proponent's Guide to Wind Power Projects: Guide for preparing an Environmental Assessment Registration Document (Nova Scotia Environment, 2009) states that wind farm sites within 25 km of a known bat hibernaculum have 'very high' site sensitivity. In 2007, Max Mosely, in cooperation with the Nova Scotia Museum of Natural History collated all known records of Bat hibernacula up to 2005 (Mosley, 2007). That report indicates that the two closest known hibernacula to the Project area (Frenchman's Cave and Frenchman's II) are located approximately 22 km (at 44 degrees) from the Project.

A search of government GIS datasets of known mine sites in proximity to the Project identified 2 records of abandoned mine openings within 10 km of the proposed Project. However, both of these mines (LAK-1-001; FOS-1-001) are shaft mines with an original depth less than 10 metres (4.5 metres and 7.5 metres respectively). Mine FOS-1-001 is recorded as being flooded with an original depth of only 7.5 metres. As such both are not likely to provide suitable hibernacula.

Approximately 17 km due south of the Project, there are an additional 88 mine sites listed in government datasets. These 88 mines are clustered due west of the Chester Basin, located between 400 metres and 1800 metres west of Highway 103. Of those, only 20 have a shaft length of greater than 20 metres. And of those 20, the dataset indicates only one has been inspected by government personnel (GRI-6-057), and at the time of inspection was plugged with garbage. Only 7 have shaft lengths greater than or equal to 50 metres.

DISCUSSION

None of the bats identified during this assessment are listed federally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or are listed under the *Species at Risk Act* (SARA) (COSEWIC 2012). However, both the Little Brown Bat and Northern Long Eared bat are listed as Yellow under the Nova Scotia General Status of Wild Species.

Bat activity was detected throughout the Project Area in all habitat types sampled. The greatest activity was recorded at AnaBat 1, located on the eastern boundary of the Project area; however the highest average number of bat passes/night occurred at AnaBat 2. Activity levels at AnaBat 1 accounted for approximately 33% of the bat activity detected within the Project Area. AnaBat 1 was positioned near the eastern boundary of the Project Area adjacent to a road edge and located 226 metres east of Big Otter Lake within an older mixed wood forest system.

Activity levels were the lowest at AnaBat 3 accounting for approximately 12% of the bat activity detected within the Project Area. AnaBat 3 was positioned near the western boundary of the Project Area in a younger regrowth mixed wood forest system, dominated by deciduous overstory.

Results indicate that multiple bat species passed through, and / or utilized the Project Area during the fall migration period of 2011. Two species of bats were positively identified during the study, including silver-haired bat and hoary bat. The Silver-haired bat (*Lariurus cinereus*) was detected a single time, at AnaBat 1 on August 16, 2011. Hoary bat was detected 11 times on a single night on September 11, 2011. Both Myotis and Unknown species accounted for the greatest number of calls at all AnaBats and were generally found throughout the sampling period.

Other echo location signatures were recorded during the study that could not be classified into species, but were categorized as "high frequency" bat calls (which may include various species of *Myotis*) and "low frequency" bat calls (which may include hoary bat, silver-haired bat, and / or big brown bat). The most common species, or species complex, detected during the 2011 monitoring period was *Myotis* species followed by "low frequency" bats.

The intensity of fall bat migration activity levels varied throughout the monitoring period. Night-to-night variation in bat activity levels may be caused by variations in weather conditions, migration timing or foraging intensity. Both migratory and foraging behaviour may also be a function of environmental conditions (e.g., wind speed) (Baerwald et al. 2009).

Echolocation surveys were conducted over a period of 121 nights across all four AnaBats with an average of 34.8 calls per night. In previous studies of Bat activity at three other wind power projects in Nova Scotia (all studies completed by Dr. Hugh Broders), the average number of sequences per night at the various projects were as follows:

1. Glen Dhu wind development area in 2007 was 6 per night during the sampling period;
2. Hampton Mountain wind development area in 2009 was recorded on the ground-based detector from 19 July until 25 August 2010 was 75 per night;
3. Glen Dhu South wind development area in 2011 was 28.4 for ground based detectors.

In another recent Environmental Assessment for the Pugwash Wind Farm, the average number of sequences per night was 30 during the sample period (CBCL, 2012).

For context, in 129 nights of monitoring along 5 forested edges from June-August 1999 in the Greater Fundy National Park Ecosystem the average number of sequences per night was 27 (SD = 44) (Broders, unpublished data).

The level of activity found at the Minas Project was higher than the average nightly activity level found during the summer in southern New Brunswick (Broders, unpublished data), but consistent with the averages for the Hampton, Glen Dhu South, and Pugwash projects.

Bats exhibit dynamic movements across the landscape where they typically forage in several different locations each night (Kunz et al. 2007). Nightly activity as measured by bat passes can vary significantly at any one location so that a single night of data will not statistically represent the overall trend of bat activity at that location (Kunz et al. 2007). This conclusion is supported by the data presented in Figure 2 (above) which demonstrates the highest level of activity beginning around 8:00 p.m., decreasing slightly, and then increasing at all sample points around midnight.

At present, a fundamental data gap exists between preconstruction activity numbers of bats and post-construction fatalities. Given this, rigorous assessments of number of fatalities reported during the post-construction periods are needed. Without a clear understanding of correlation between the two numbers, reliable interpretation of risks and actual effects of wind turbine facilities to bat populations will remain speculative.

CERTIFICATION

The undersigned has personally inspected the subject property and considered relevant factors and influences pertinent within the scope of the assessment. The undersigned has no past, present, or contemplated interest in the assessed property or Project outcome.

I have reviewed the information as submitted and completed this report in conformity with the Code of Ethics and the Duties of Professional Biologists.

Respectfully submitted,

Robert McCallum, P.Biol
President
McCallum Environmental Ltd.

REFERENCES

Altringham, J. D. 1996. *Bats: Biology and Behaviour*. Oxford University Press, Oxford. 262 pp.

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O-Connell, M.D. Piorkowski, and R. D. Tankersley, Jr. 2008. *Patterns of bat fatalities at wind energy facilities in North America*. Journal of Wildlife Management 72:61-7

Baerwald, E. F., D'Amours, G. H., Klug, B. J. and Barclay, R. M. R. (2008). *Barotrauma is a significant cause of bat fatalities at wind turbines*. Current Biology 18, R695-R696.

Baerwald, E. F., Barclay, R. M. R. (2009). *Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities.* Journal of Mammology, 90(6): 1341-1349

Broders, H.G., (2011) *Analysis of ultrasonic AnaBat recordings with inferences on bat species composition and activity at the site of the proposed wind turbine farm at Glen Dhu, Nova Scotia.* Submitted as a component of the Glen Dhu South Wind Power Project Environmental Assessment.

CBCL. 2012. Environmental Assessment. Proposed Pugwash Wind Farm. Section 4.3.3.1 Results of Research and Field Work; Bats, p. 51. http://www.gov.ns.ca/nse/ea/pugwash.wind.farm.asp.

Fenton, M. B. 1985. *Communication in the Chiroptera*. Indiana University Press, Bloomington. 161 pp.

Kunz , Thomas H., Edward B. Arnett, Brian M Cooper, Wallace P. Erickson, Ronald P. Larkin, Todd Mabee, Michael L. Morrison, M. Dale Strickland, Joseph M. Szewczak. 2007. *Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document.* Journal of Wildlife Management 71(8):2449–2486.

Mosely, M. 2007. *Records of Bats (CHIROPTERA) at Caves and Mines in Nova Scotia.* Curatorial Report Number 99, Nova Scotia Museum, Halifax: 21p.

Thomas, D. W., and S. D. West. 1989. *Sampling methods for bats*. IN A. B. Carey, and L. F. Ruggiero (tech. eds.). Wildlife-Habitat Relationships: Sampling Procedures for Pacific Northwest Vertebrates. U.S. Department of Agriculture, Forest Service, Portland, OR. General Technical Report PNW-GTR-243.

Vonhof , Maarten. 2006. *Handbook of Inventory Methods and Standard Protocols for Surveying Bats in Alberta*. Alberta Fish and Wildlife Division Edmonton, Alberta. 71 pp.

LIMITATIONS

- Absolute abundance of bats cannot be determined in most cases, and thus it is difficult to estimate the number of Study Areas or Study Sites that should be established within a Project area, or the length of time that should be spent sampling each one. Therefore, statements regarding adequate sample sizes are difficult to make.
- Limitations of current sampling methods, and the spatial and temporal heterogeneity exhibited by bats, may give an inaccurate representation of species present at a site during any given night. Furthermore, the failure to find evidence for the presence of a species should be viewed with caution as it may reflect the rarity of a species or a sampling artifact, rather than the true absence of that species.
- Another potential sampling problem is that some techniques (those using ultrasonic detection) cannot allow for precise discrimination among species, only between ‘species groups’ that contain several species which share similar characteristics.
- Bat species normally present in an area during the summer may be absent in early May or late August because they have not yet moved in to the area, or have already moved on to other areas. Similarly, bats present in an area during May and August may not normally reside in that area during the rest of the summer. Hibernating bat species may move 10s or 100s of kilometers to and from hibernacula, and migratory species make much longer movements. Surveys conducted at these times may not provide accurate representations of presence or relative abundance data.
- There is considerable intraspecific variation in echolocation call structure. While it is true that consistent differences in echolocation call structures may exist between species, at least in their search phase calls in open habitats, it is impossible to know which of the above factors may be influencing the calls being used by the bats being detected at a given time. The high degree of potential intraspecific variation likely masks interspecific variation in many situations.
- Recorded features of calls depend heavily on factors such as the distance between the bat and the microphone and the direction the bat’s head is facing relative to the microphone. The further a bat is from the microphone or the greater the angle between the head and the microphone, the greater the potential for missing the higher frequency portions of the calls. Furthermore, different bat species produce calls at different intensities, which will influence the distance at which they may be detected, and therefore the amount of information in the calls that is captured by the ultrasonic detector.