PRE-CONSTRUCTION ACOUSTIC MONITORING FOR BATS
COPENHAGEN WIND FARM, LLC

LEWIS AND JEFFERSON COUNTIES, NY

Surveys Conducted from April 15th – October 15th, 2012
Report Last Revised
December 27, 2012

Report Prepared for:

Copenhagen Wind Farm, LLC
45 Main Street, Suite 538
Brooklyn, New York 11201
info@ownenergy.net
(636) 898-3690

Report Submitted by:

Sanders Environmental, Inc.
322 Borealis Way
Bellefonte, Pennsylvania 16823
Sanders@batgate.com
814-659-8257

Table of Contents

List of Figures

List of Tables

Appendices

1. Executive Summary

Acoustic monitoring for bat activity took place from April 15th through October 15th, 2012 on the proposed Copenhagen Wind Farm site in Lewis and Jefferson Counties, New York. Two Pettersson D500x full spectrum, direct recording bat detectors were used to monitor bat activity on the project area, one mounted at a height of 58 meters on the meteorological (MET) tower and the other mounted at the base, one meter off ground level.

Two-hundred and eighty-one recordings were identified as bat calls and classified into eleven (11) groups. The detector mounted at 58 meters (upper), recorded 182 identified bat calls which were classified into nine groups. The first five groups are comprised of an individual species; *Lasiurus cinereus* (Hoary bat, 94 calls, 51.6%), *Lasionycteris noctivagans* (Silver-haired bat, 59 calls, 32.4%), *Lasiurus borealis* (Red bat, 7 calls, 3.8%), *Eptesicus fuscus* (Big Brown bat, 2 calls, 1.1%) and *Corynorhinus rafinesquii* (Rafinesque's Big-eared bat, 1 calls, 0.5%). The final four groups are groups containing –calls that were unable to be classified to the single species level; *Lasionycteris noctivagans/Lasiurus cinereus* (12 calls, 6.6%), *Eptesicus fuscus/Lasionycteris noctivagans* (3 calls, 1.6%), *Eptesicus fuscus/Lasiurus cinereus* (2 calls, 1.1%), and *Lasionycteris noctivagans/Corynorhinus rafinesquii* (2 calls, 1.1%). The detector mounted one meter off ground level (lower), had 99 identified detections of bats. These recordings were classified into eight groups. *Lasionycteris noctivagans* (41 calls, 41.4%), *Eptesicus fuscus* (32 calls, 32.3%), *Lasiurus cinereus* (18 calls, 18.1%) and *Lasiurus borealis* (1 call, 1.0%) are four groups of individual species. The other four groups contain –calls, unable to be classified to the individual species level and are therefore grouped as, *Eptesicus fuscus/Lasionycteris noctivagans* (3 calls, 3.0%), *Lasionycteris noctivagans/Lasiurus cinereus* (2 calls, 2.0%), *Corynorhinus rafinesquii/Eptesicus fuscus* (1 call, 1.0%) and *Myotis lucifigus/Myotis sodalis* (1 call, 1.0).

Both acoustic detection heights showed significant positive correlations between hourly bat activity and temperature. This suggests that, as temperature increased, bat activity also increased. There was not a significant correlation between hourly bat activity and wind speed at either height.

Bats were most active during the 2nd and 3rd hours of recording (½ hour after sunset to 2 ½ hours after sunset) with 85 calls (46.7%) recorded by the upper detector and 40 calls (40.4%) recorded by the lower detector.

Overall, few calls were recorded and bat activity at the both heights was low. The majority of the calls (upper= 81.9%; lower= 85.9%), were recorded between July 1st and September 1st. After September 1st, only eight calls (4.4%) were recorded by the upper detector and six calls (6.1%) were recorded by the lower. Prior to July 1st, 25 calls (13.7%) were recorded by the upper detector and only eight calls (8.1%) were recorded by the lower detector. The species composition shows that the majority of species recorded were tree bats (upper= 171 calls, 94.0%; lower= 59 calls, 60.0%) and only one *Myotis lucifigus/ Myotis sodalis* call was recorded (on August 3, 2012).

2. Introduction

a. Description of Project Area

The project site is located near the village of Copenhagen in the town of Denmark. The proposed site encompasses parts of Lewis and Jefferson Counties, New York. It is located between Lowville and Watertown, NY in the North Country region of the state. The proposed wind farm will be in a leased project area and consist of fifty-eight turbines, a substation, and various roads, collection lines and transmission lines. The project area is mostly agricultural fields with some patches of forest and residential areas. Several roads transverse the project area.

i. Map of Site including Project Area, Turbines, & Acoustic Detector Locations

Site map is provided in Appendix A.

3. Methods

a. Sampling Protocol

Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects (2009) were adjusted specifically for the proposed Copenhagen Wind Farm and followed as outlined in the Copenhagen Wind Project Work Plan (Appendix B).

One Pettersson D500X detector was mounted on the MET tower at a height of 58 meters. Another Pettersson D500X detector was mounted at one meter from ground level, at a 30 degree upward angle. The detectors were maintained and monitored from April 15th through October 15th, 2012. Detectors were set to record very wide time ranges, significantly greater than ½ hour before dusk and after dawn to account for changing sunrise and sunset times. Only calls recorded within the required time frames have been included in the analysis and archived. Detectors were reprogrammed as needed to keep recording the required time frame.

b. Equipment

i. Type of Equipment Used

Two Pettersson D500x bat detectors were deployed on or near the MET tower for acoustic observations. Photos of the MET tower can be found in Appendix C. The D500X is a direct, ultrasound recording unit intended for long-term, unattended recording of bat calls.

Each detector was equipped with an external battery and was contained in a padded modified surplus ammunition box to keep the system dry. A pulley system, provided by OWNEnergy, Inc. (OWNEnergy), was used to raise and lower the detector from its recording position on the MET Tower. During each visit, a fresh battery and memory cards were installed, and a quick inspection for problems in the pulley system and detector operation was conducted. Visits were undertaken every one to three weeks throughout the monitoring period, generally about once a week. Exact visit dates were determined by weather and the presence or absence of technical problems on prior visits.

Weather data was provided by OWNEnergy. The data provided included two sets of temperature and wind speed, one near the height of each detector, with data recorded every ten minutes. The weather data was analyzed by creating tables and graphs depicting associations based on hourly averages. Correlations were run in Minitab to determine relationships between hourly weather averages and bat activity.

ii. Settings Used on Equipment

Detectors were set for long-term recording at settings recommended by the vendor. Input Gain was set to 80, Trigger Level to 160, Interval to 0, Sample Frequency to 500, Pretrigger off, Record Length of 5 sec, High Pass filter on, Auto-record on and a high Trigger Sensitivity. Detector firmware version was 2.1.3.

iii. Placement (heights of each detector) & Orientation

The MET tower is located in the eastern portion of the proposed project area, in an agricultural field. It was equipped with a pulley system installed by OWNEnergy. The pulley system was used to position the upper detector at a height of 58 meters aimed horizontally facing away from the tower. The lower detector was fastened to a barrel, one meter off the ground, with a 30 degree upward angle.

c. Data Analysis Protocol

i. Analysis Tools Used

Prior to processing, files were sorted using Snapshot Characterization and ANalysis Routine (SCAN'R) to eliminate files with obvious noise and/or no obvious bat calls. SCAN'R was set to eliminate files that did not meet the following requirements; minimum frequency: 15kHz, maximum frequency: 125kHz, trigger level: 8dB, have a minimum duration of 8milliseconds, and contain three or more chirps.

These files were then processed using the SonoBat 3.13 NY-PA-WV automatic call identification software. SonoBat was set to analyze the eight best call-pulses per call-sequence within a maximum of an 8.0 second segment. Classification to individual species level was made only if the analysis resulted with a classification that met or exceeded a discriminate probability threshold of 0.90 and an acceptable call quality threshold of 0.80. Classification to a group level was made if the discriminate probability threshold did not exceed 0.90. The autofilter setting was used with the default 5kHz filter. The acceptable quality for a tally pass per call was .20 and the preemphasis setting was medium.

ii. Groups Used

The recorded calls were broken down by Sonobat into 11 groups. The groups are as follows: *Eptesicus fuscus* (Big Brown bat), *Lasionycteris noctivagans* (Silver-haired bat), *Lasiurus borealis* (Red bat), *Lasiurus cinereus* (Hoary bat), *Myotis lucifigus/Myotis sodalis*(Little Brown Bat/Indiana bat, respectively), *Corynorhinus rafinesquii* (Rafinesque's Big-eared bat), *Eptesicus fuscus/Lasionycteris noctivagans, Eptesicus fuscus/Lasiurus cinereus*, *Lasionycteris noctivagans/Lasiurus cinereus, Lasionycteris noctivagans/Corynorhinus rafinesquii,* and *Eptesicus fuscus/Corynorhinus rafinesquii.*

4. Results

a. Sampling Effort

i. Dates Monitored

Monitoring was conducted from April 15, 2012 through October 15, 2012.

ii. Operational Percentages (success)

1. How many Nights the Detectors were Operational

The detectors were in place for 184 nights. Number of non-operational nights was very low for both detectors; the upper detector was non-functional for 15 (8.2%) entire nights and 1 (0.5%) partial night. The lower detector was non-functional for 4 (2.2%) entire nights and 1 (0.5%) partial night.

Each detector had the potential to be operational for 2,105 hours of sampling. Detector downtime was very low; the upper detector was non-operational for 179 (8.5%) hours. The lower detector was non-operational for 51 hours, or 2.4%, of this time.

2. If not Operational, Dates and Reasons why the Detector was NOT Operational - Upper

April 21st - 22nd – Cards were full and therefore unable to record files.

April 24th - May 7th – Card formatting error prevented recording.

3. If not Operational, Dates and Reasons why the Detector was NOT Operational - Lower

May 3rd - 7th – Card formatting error prevented recording.

iii. Data Collection

1. Overall Bat Activity

Few calls were recorded (upper= 182 calls, lower= 99 calls) and overall recorded bat activity was low.

The only *Myotis lucifigus/Myotis sodalis* call was recorded by the lower detector on August 3, 2012.

Eptesicus fuscus accounted for 1.1 %(2 calls) of the total recordings from the upper detector while it accounted for 32.3% (32 calls) of the recordings from the lower detector. There were three groups that contain *Eptesicus fuscus. Eptesicus fuscus/ Lasiurus cinereus,* only classified by the upper detector, accounted for 1.1% (2 calls) of its calls. *Eptesicus fuscus/ Lasionycteris noctivagans* was detected by both, upper and lower detectors, and recorded 3 calls each (1.6% and 3.0%, respectively). Group

Eptesicus fuscus/ Corynorhinus rafinesquii was only classified by the lower detector, consisting of 1 call (1.0%).

Lasionycteris noctivagans was recorded 59 times (32.4%) by the upper detector and 41.4% (41 calls) of the time by the lower detector. *Lasiurus cinereus / Lasionycteris noctivagans* consisted of 12 of the upper's 182 calls (6.6%) and accounted for 2 of the lower's 99 calls (2.0%). Two (1.1%) calls that could not be classified to the individual species level,*Lasionycteris noctivagans/Corynorhinus rafinesquii*,were recorded by the upper detector.

The upper detector also recorded a call (0.5%) that was classified as *Corynorhinus rafinesquii,* which is most likely a fictitious/false identification.

Seven (3.8%) *Lasiurus borealis* calls were detected by the upper detector while only one (1.0%) was detected by the lower detector.

Lasiurus cinereus accounted for 51.6% (94 calls) of the upper detectors calls and 18.1% (18 calls) of the calls from the lower detector.

Bat activity for the entire sampling period only averaged 0.09 and 0.05 calls per hour for the upper and lower detectors, respectively.

2. Bat Activity by Detector (species)

Activity levels recorded by the two detectors were low. The upper detector, deployed at 58 meters off the ground, recorded 182 recorded calls. The lower detector, deployed at one meter off the ground, recorded 99 calls. The majority of the calls (94 calls, 51.6%) recorded from the upper detector were *L. cinereus* while the majority of the calls (41 calls, 41.4%) recorded from the lower detector were *L. noctivagans.* Table 1 breaks down the recorded calls by species and detector.

Table 1: Bat Activity (Species) by Detector		
Group	Upper	Lower
Eptesicus fuscus	2	32
Eptesicus fuscus/ Corynorhinus rafinesquii	0	1
Eptesicus fuscus/ Lasionycteris noctivagans	3	3
Lasiurus borealis	7	1
Lasiurus cinereus	94	18
Lasionycteris noctivagans	59	41
Lasiurus cinereus/ Lasionycteris noctivagans	12	2
Myotis lucifigus/Myotis sodalis	0	1
Corynorhinus rafinesquii	1	0
Eptesicus fuscus/ Lasiurus cinereus	2	0
Lasionycteris noctivagans/Corynorhinus rafinesquii	2	0

3. Bat Activity Temporally

The highest number of bat calls was recorded during week 16 on both the upper and lower detector (23.6% and 25.3%, respectively). Number of bat calls ranged from 0 to 3 from week 2 through week 10. The majority of the calls were recorded from weeks 12 through 20 with 149 (82.9%) calls recorded on the upper and 85 (85.9%) calls recorded from the lower detector. Only 4.4% of the calls were recorded after week 20 on the upper detector. On the lower detector, only 6.1% of the calls were recorded after week 20. No calls were recorded during weeks 2 and 26. Table 2 breaks down bat activity by week. Figure 1 displays the data in a bar graph format.

Table 2: Number of Calls per Week per Detector			
Week #	Date Range	Upper	Lower
1	4/15 - 4/21	7 (*10)	2
2	4/22 - 4/28	0 (*70)	0
3	4/29 - 5/5	0 (*77)	1(*29)
4	5/6 - 5/12	1 (*22)	0(*22)
5	5/13 - 5/19	2	0
6	5/20 - 5/26	1	2
7	5/27 - 6/2	3	0
8	6/3 - 6/3	2	0
9	6/10 - 6/16	2	2
10	6/17 - 6/23	2	0
11	6/24 - 6/30	5	1
12	7/1 - 7/7	4	4
13	7/8 - 7/14	1	12
14	7/15 - 7/21	14	11
15	7/22 - 7/28	29	11
16	7/29 - 8/4	43	25
17	8/5 - 8/11	33	5
18	8/12 - 8/18	11	5
19	8/19 - 8/25	5	5
20	8/26 - 9/1	9	7
21	9/2 - 9/8	2	2
22	9/9 - 9/15	0	2
23	9/16 - 9/22	0	1
24	9/23 - 9/29	4	1
25	9/30 - 10/6	1	0
26	10/7 - 10/13	0	0
27	10/14 - 10/15	1	0
* non-operational hours			

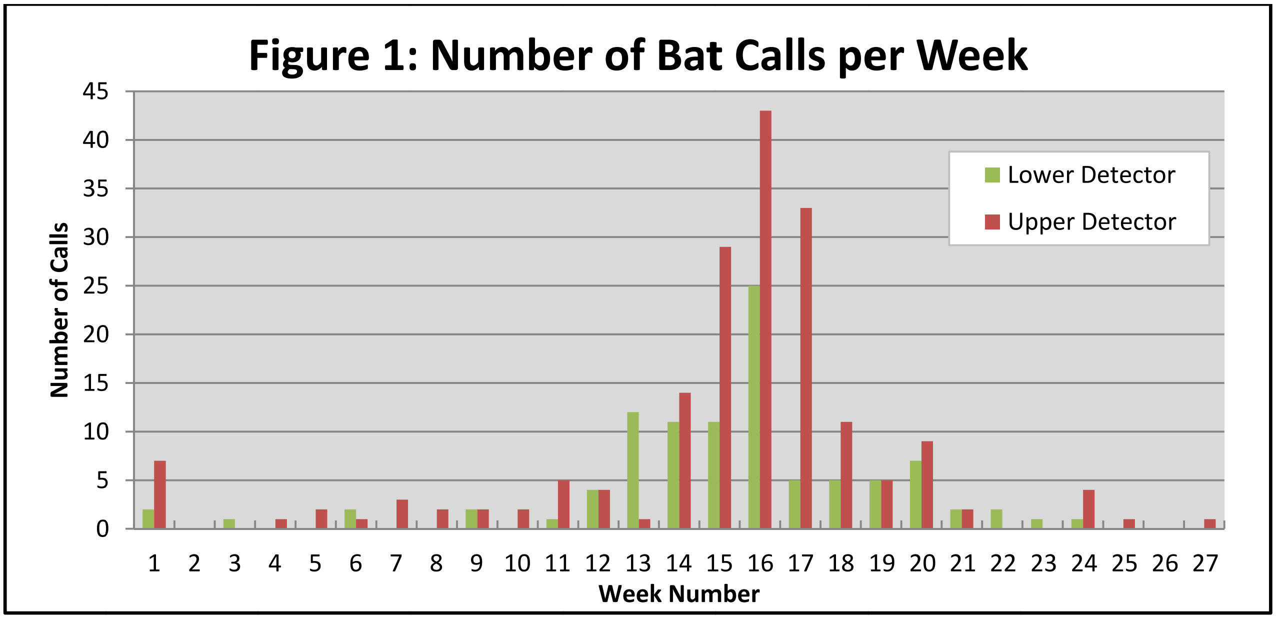
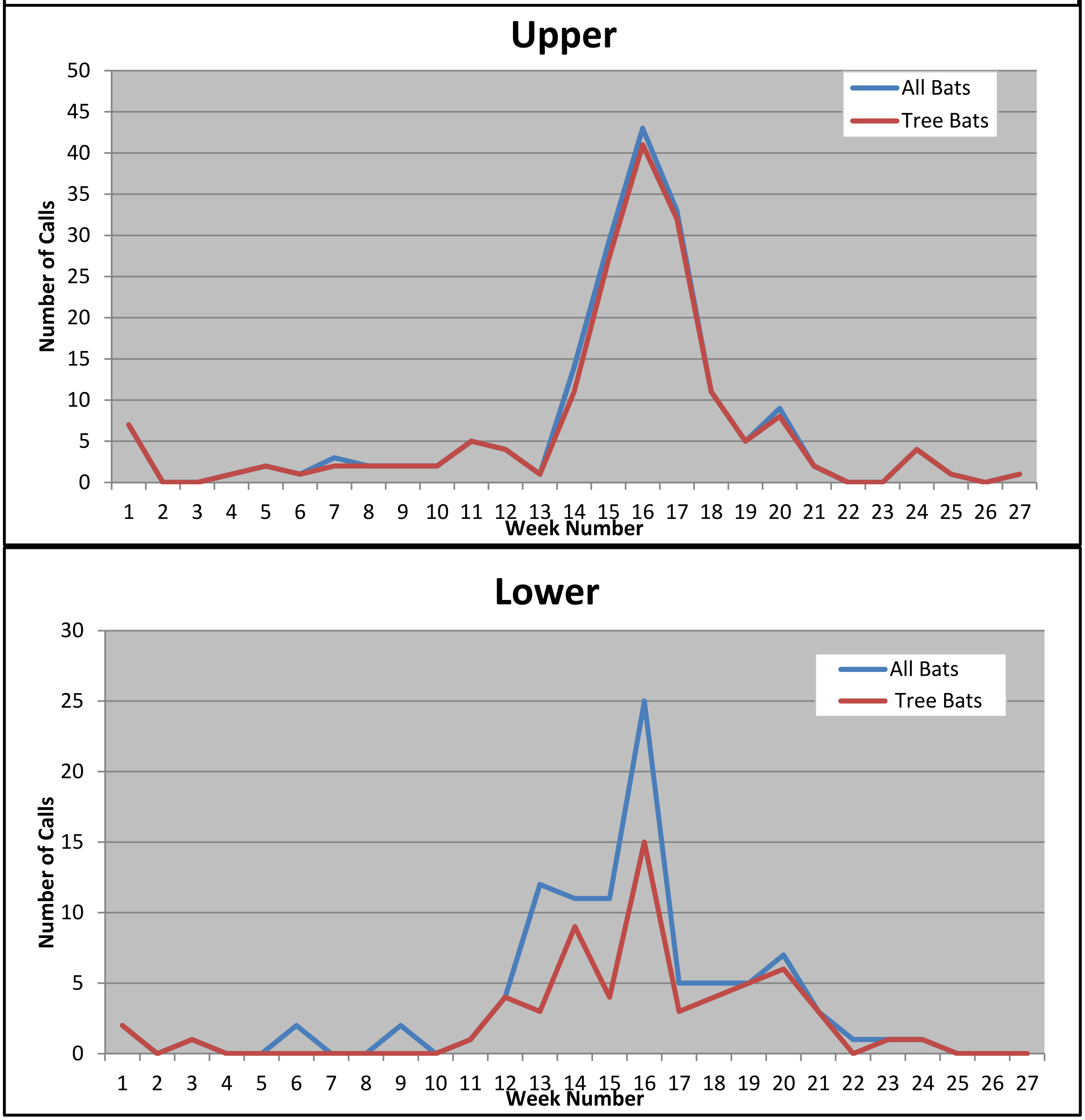


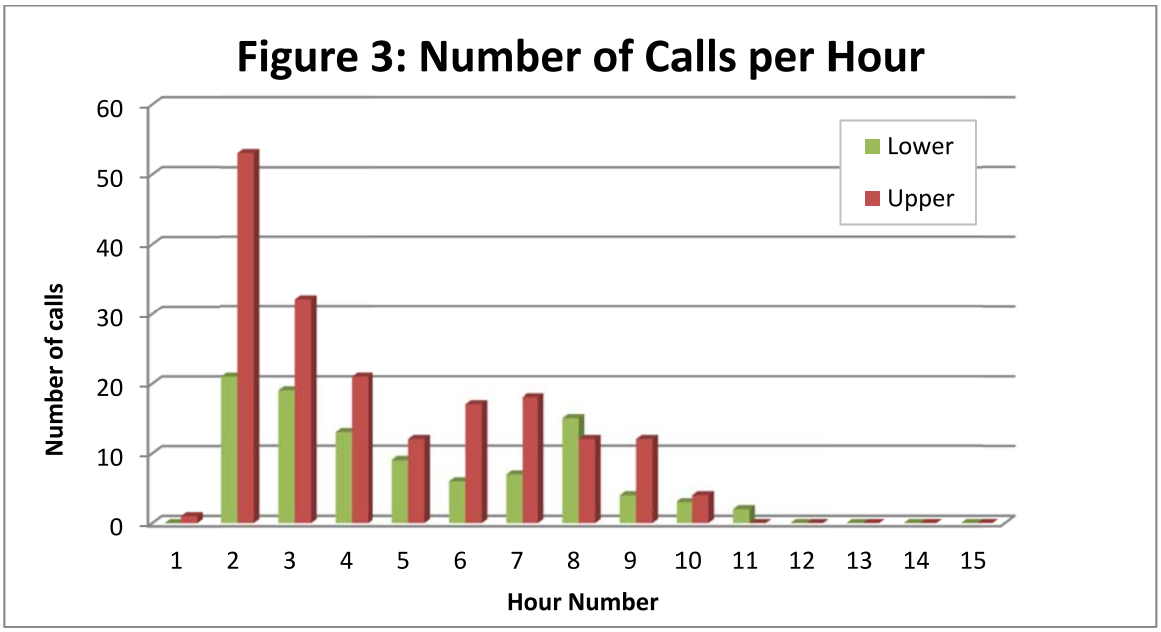
Figure 1: Number of Bat Calls per Week
Number of Calls
45
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Week Number
Lower Detector
Upper Detector

The majority of species recorded were tree (Red, Hoary and Silver-haired) bats (upper, 171 calls, 94.0%; lower, 59 calls, 60.0%) Figure 2 compares the number of tree bat calls to all bat calls by week. Both categories showed similar activity patterns.

Figure 2: Number of Tree Bat Calls vs. All Bat Calls By Week



Bat activity was highest (upper: 46.7%, 85 calls; lower: 40.4%, 40 calls) during hours 2 and 3 of recording (½ hour after sunset to 2 ½ hours after sunset). There was a slight increase in the recordings from the upper detector in hours 6 and 7 (35 calls, 19.2%). In the lower detector, a slight increase was seen in hour 8 with 15 calls recorded (15.1%). No calls were recorded in hours 12, 13, 14 and 15. Figure 3 displays the number of bat calls recorded per hour. Note that as monitoring progressed, the recording period (½ hour before sunset to ½ hour after sunrise) changed in length with the seasonal changes in sunrise and sunset. Night shortened from 12 hours in April to 10 hours in June then lengthened to 15 hours in October.



iv. Bat Activity & Weather Data

Hourly trends were examined by running a correlation between weather data and bat activity. Table 3 shows the correlation coefficient and associated p-value for each relationship. The p-value is based on an alpha of 0.05, meaning that when the p-value is less than 0.05 the null hypothesis is rejected and the correlation is determined to be statistically significant. Table 3 displays the correlation coefficients and associated p-values for hourly weather variables and bat activity.

Table 3: Correlation: Hourly Weather to Bat Activity			
Upper		**Lower**	
	Bat Activity		Bat Activity
Temperature	**0.124 (p=0.000)**	Temperature	**0.113 (p=0.000)**
Wind Speed	**-0.036 (p=0.118)**	Wind Speed	**0.037 (p=0.098)**

A significant, positive relationship was found between temperature and bat activity at both upper (p=0.000) and lower (p=0.000) detectors. This suggests that as temperature increased so did bat activity. Correlation between wind speed and number of calls at the upper and lower detectors was strong but was not statistically significant (p=0.098, p= 0.118, respectively).

Figure 4 shows a comparison between the upper and lower weather data. At some points there were substantial differences in wind speeds as shown in the figure. Overall, there was an average wind speed of 5.325 m/s for the upper detector while the average at the lower detector was only 3.650 m/s. The difference in the average temperature between the detectors was only 0.21°C.

Figure 4: A Comparison of Upper vs. Lower Weather

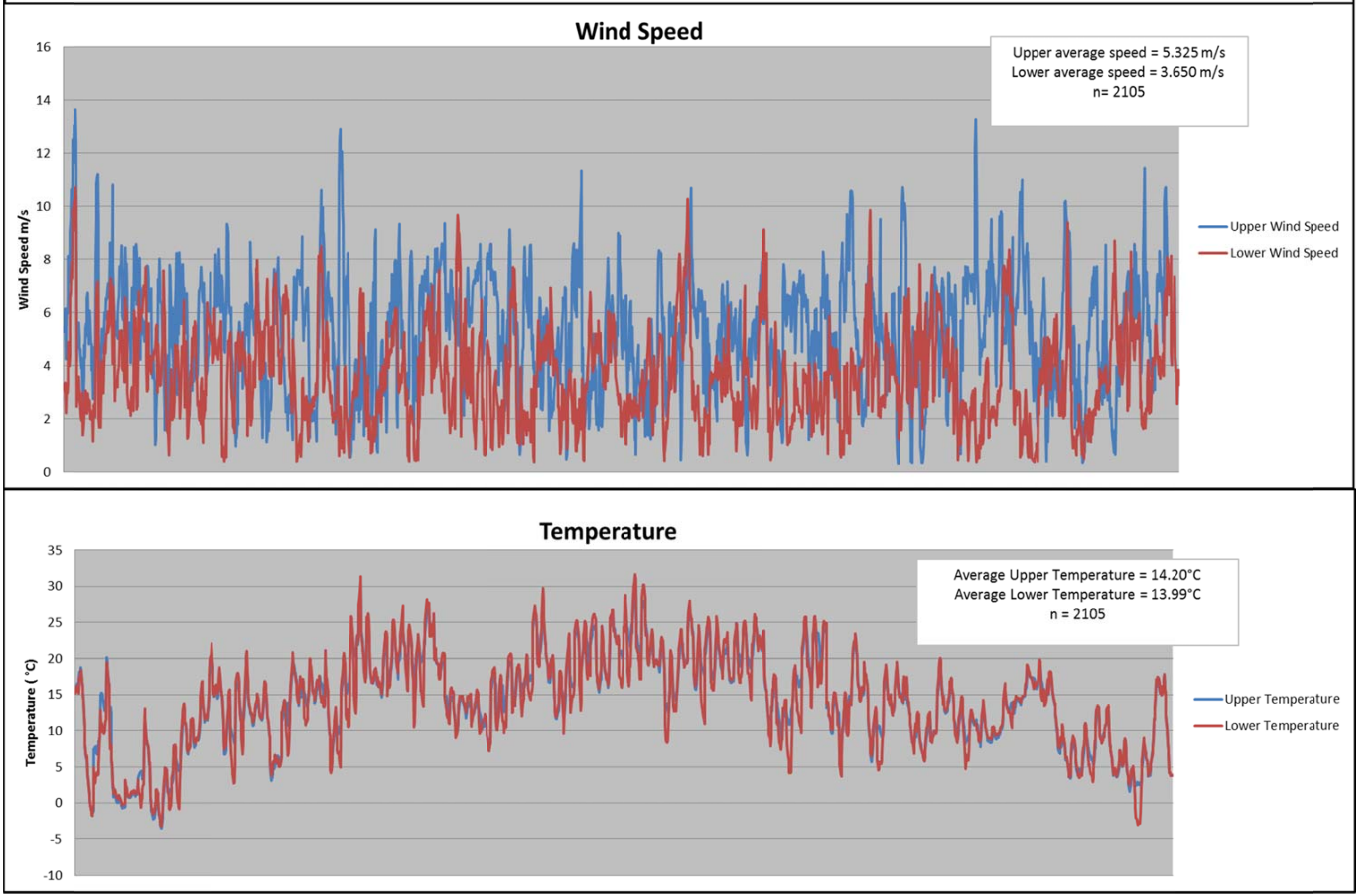


Figure 5 displays the percentage of total bat calls versus the percentage of hourly wind speed averages that fall within 1 m/s wind speed increments. The two detectors show different trends. The upper detector shows that a greater percent of overall bats flew during a lesser percent of the overall wind speeds (0-6.1m/s = 73.08% bats, 63.21% wind speeds). Meaning bat activity favored less windy hours than the average. The lower detector shows that a lesser percent of overall bats flew in the greatest percent of the overall wind speeds (0-6.1 m/s = 85.86% bats, 89.79% wind speeds). Meaning bat activity was not much affected by average hourly wind speed. The wind speeds were greater at the upper height. Hours during which the detector was not running or no weather data was available were not included in this analysis.

Figure 5: Percentage of Bat Calls and Wind Speed by m/s Increments

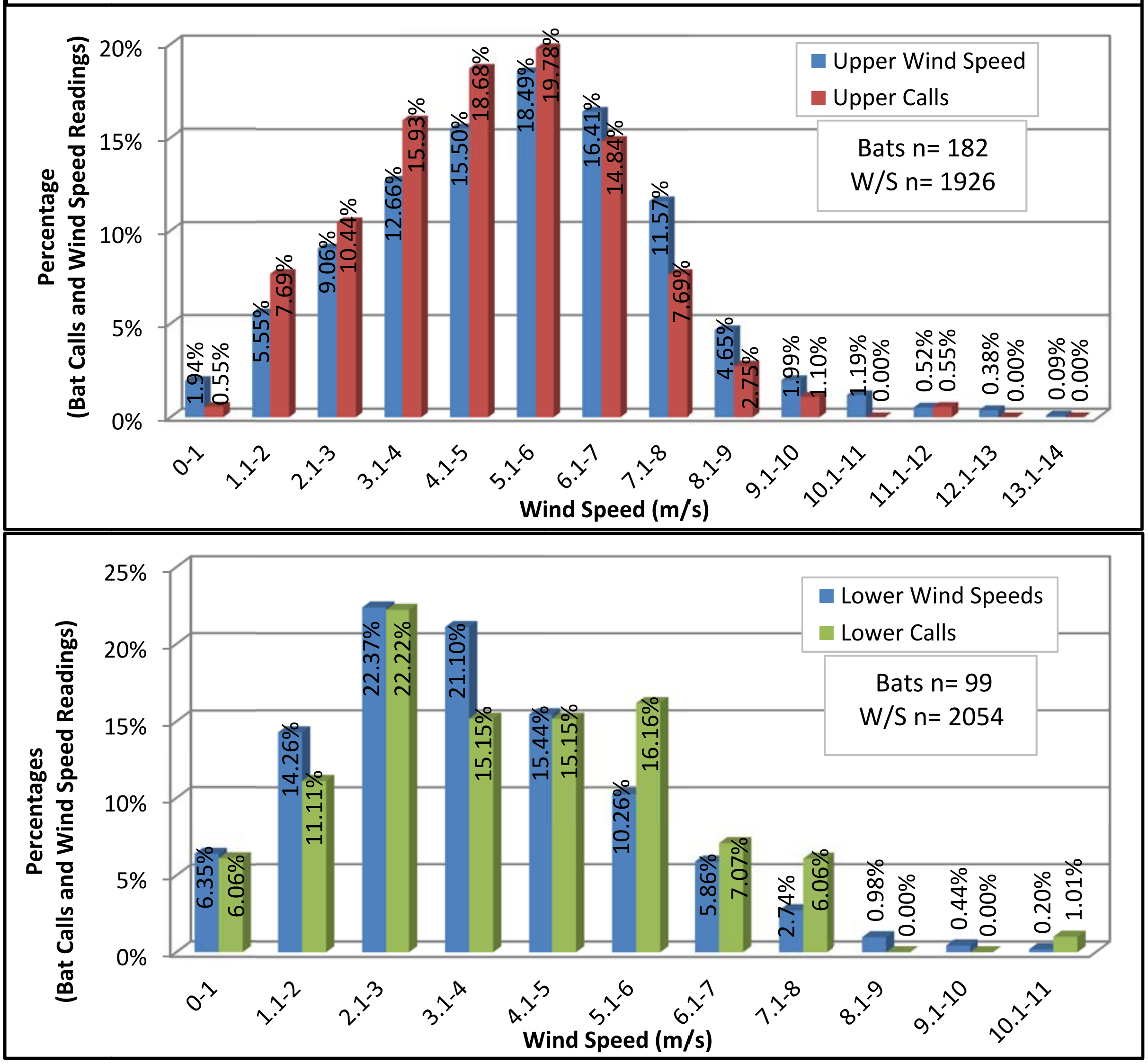


Figure 6 displays the percent difference between bat calls and wind speed readings by 1 m/s increments. When the lines are at zero it means the wind speed readings are directly proportional to bat activity. When the lines are above zero percent difference, it implies greater bat activity in relation to wind speed readings. When the lines are below zero percent difference it implies lessor bat activity in relation to wind speed readings.

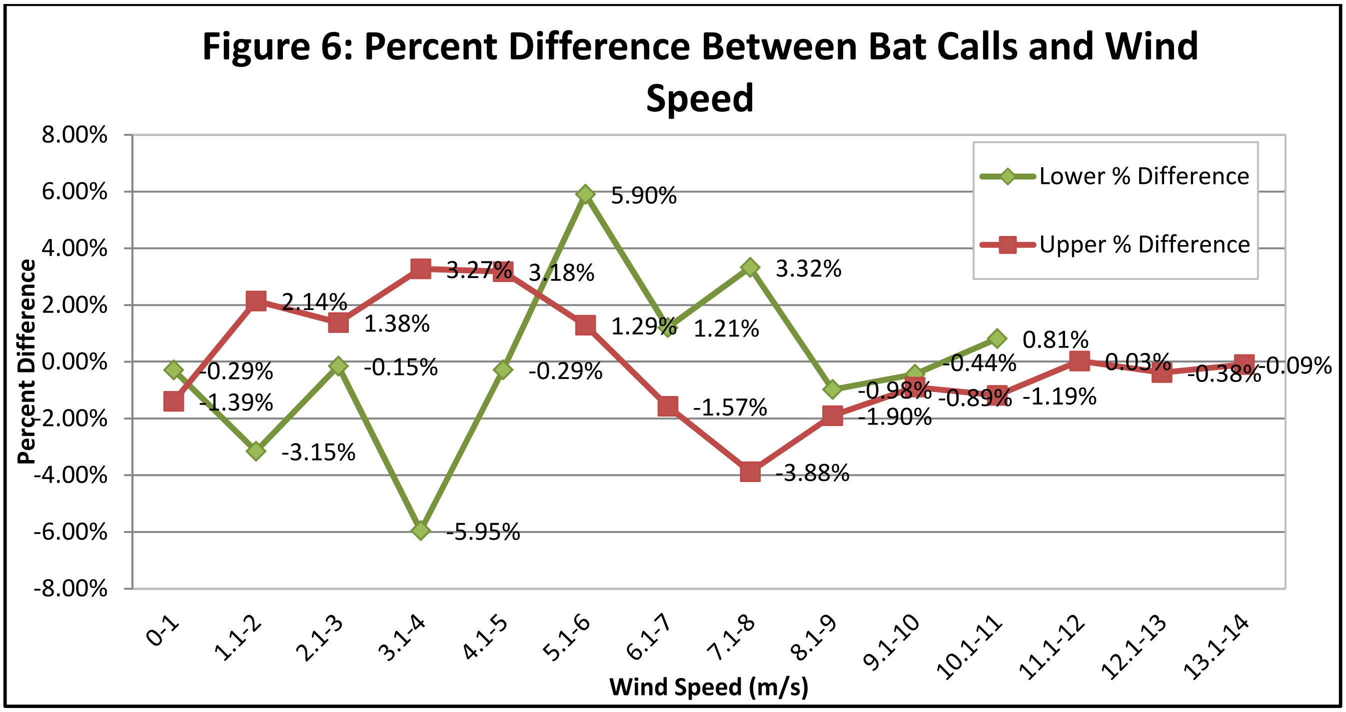


Figure 6: Percent Difference Between Bat Calls and Wind Speed

5. Discussion

a. Bat Activity & Species Composition

182 calls were recorded by the upper detector during the 168 day operational period. An average of 1.08 bat calls per night (0.094 per detector hour) was recorded. The lower detector recorded 99 calls during the 179 operational days. An average of 0.55 bat calls per night (0.048 per detector hour) was recorded. Collectively, a total of five individual species and six groups (consisting of two individual species) were identified during the data collection.

L*. noctivagans* (100 calls, 35.6% overall) and *L. cinereus* (112 calls, 39.9% overall) were the two most frequently recorded species.

The *Corynorhinus rafinesquii* calls are most likely false identifications, caused by faint call recordings. Bats exhibit considerable plasticity in their vocalizations, and in many cases considerable overlap in call parameters among species. This, coupled with complications from noise and weak signals (from bats at a greater distance from the detector), result in misclassification. It is critical to understand that the classification decisions generated by SonoBat are to be considered "suggested classifications." Although some species have distinctive call types that facilitate confident identification, other species exhibit call characteristics similar to that of other species that reduce the reliability of using bat echolocation calls as a sole indicator of presence. In some instances irrefutable species confirmation may require a "bat in hand." Even among the known species of the library reference data, the rate of correct classification of Sonobat ranges from about 70% to 99%.

Migratory tree bat species (*L. noctivagans, L. cinereus,* and/or *L. borealis)* make up 94.5% of the upper detectors recorded calls while only 62.6% were recorded on the lower detector. 32.3% of the lower detectors calls were classified as E. fuscus, indicating that although E. fuscus were common, few fly at elevations where they would be picked up by the upper detector.

b. Bat Activity Temporally

Bat activity was consistently low from week 2 through week 10. A peak occurred from weeks 12 through 20 with 149 (82.9%) calls recorded on the upper and 85 (85.9%) calls recorded from the lower detector. Only eight calls were recorded after week 20 on the upper detector. On the lower detector, only six calls were recorded after week 20.

Bat activity was greater during the hours after dusk than during the hours preceding dawn. Bats were most active during the second hour (upper: 29%; lower: 21.2%) of recording (½ hours after sunset to 1 ½ hours after sunset).

c. Bat Activity & Weather Data

Data recorded at both detector stations showed bat activity was significantly positively correlated to temperature data, suggesting that as temperature increased so did bat activity. There was not significant correlation between wind speed and bat call at either elevation. However, some trends were seen while looking at percentages of wind speed and bat calls broken down by m/s increments. The upper detector showed that 73.08% of the bat activity occurred less than 6.1 m/s. The lower detector showed that 85.86% occurred less than 6.1 m/s.

d. Implications

The majority of the calls, 82.9% (upper) and 85.9% (lower), were recorded between July 1st and September 1st. If bat mortality events coincide with acoustic activity dates, little mortality should occur outside of those dates. The majority (77.6%) of calls were recorded in hours where average wind speed was below 6.1m/s, meaning that the majority of mortality is likely to occur at under this wind speed.

6. References

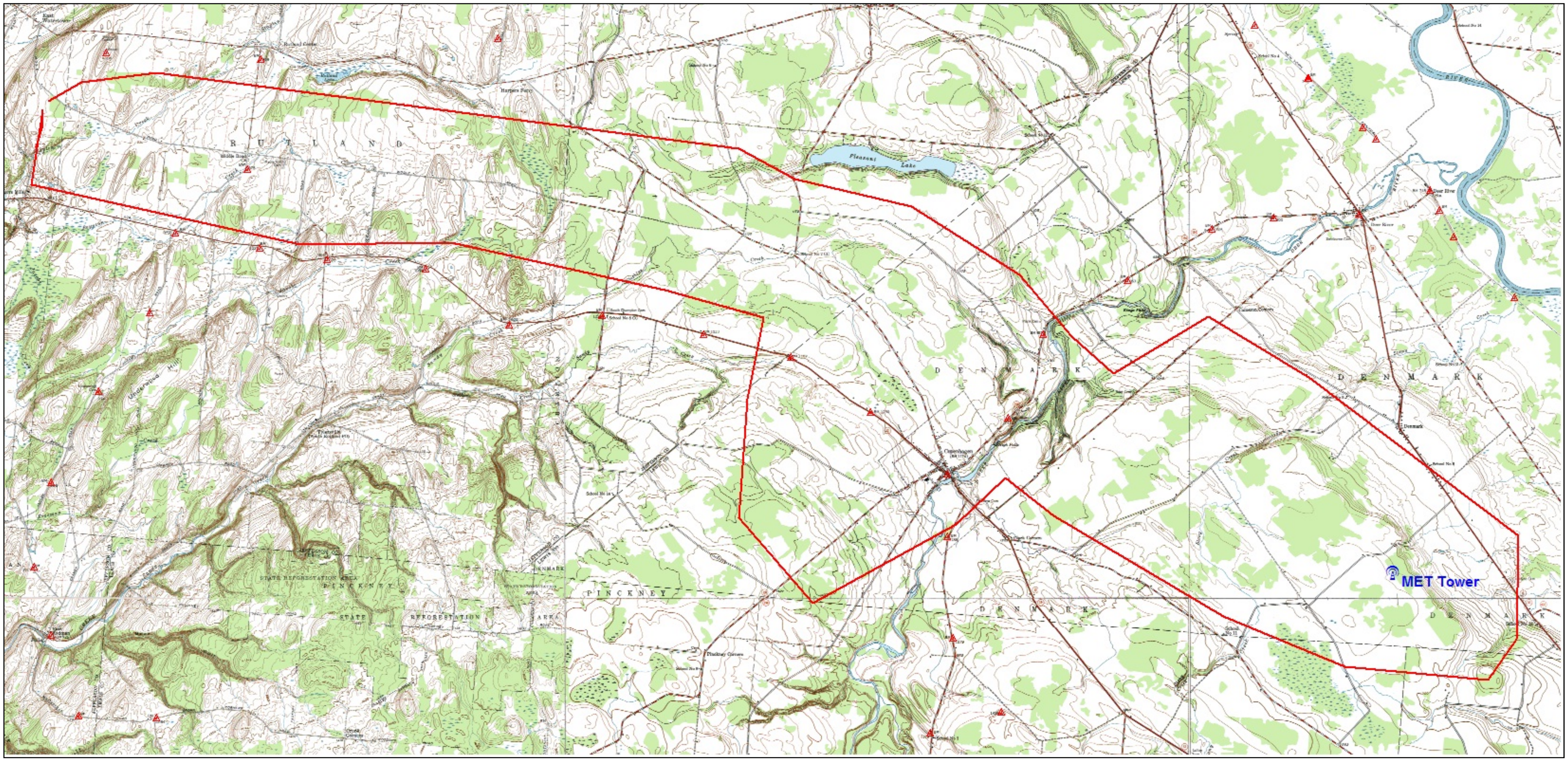
New York Department of Environmental Conservation (Division of Fish, Wildlife and Marine Resources). August 2009. Guidelines for Conducting Bird and Bat Studies at Commercials Wind Energy Projects. 9pp.

7. Data sheets

a. Electronic Acoustic Spreadsheet

Appendix A – Map of Copenhagen Wind Farm Project Area

Copenhagen Wind Farm Project Area



Appendix B – Copenhagen Wind Project Work Plan

Copenhagen Wind Project Work Plan
Pre-Construction Acoustic Sampling for Bats
Last Revised: 3/8/2012

1.0 Introduction

The proposed location for the Copenhagen Wind Project is near the town of Copenhagen in Lewis and Jefferson Counties, New York. The purpose of this work plan is to clarify and describe pre-construction monitoring methods as described in the New York Department of Environmental Conservation (DEC) Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects (Guidelines) specifically adapted for the proposed Copenhagen Wind Project. The clarifications in this document will hold precedence over the original monitoring guidelines, as some methods may have been adjusted exclusively for the Copenhagen site.

2.0 Survey Methods

Movements of bats feeding in or passing through the site will be characterized using acoustical detectors. Two Pettersson D500X detectors will be mounted on or near the existing meteorological (MET) tower. One detector will be as high on the met tower as possible and will sample in a horizontal plane (please see attached photos in Appendix A). The other will be positioned a meter from ground level and will sample at approximately 30 degrees upward. The MET tower location can be found on the attached map (Appendix B). Each detector will be equipped with a large external battery and will be contained in a modified ammunition box which keeps the system dry. A pulley system provided by OwnEnergy will be used to raise and lower the high detector from its 50M+ high recording position on the MET Tower.

The sampling season will run from April 15th – October 15th. The detectors will record daily, covering 30 minutes prior to sunset to 30 minutes following sunrise. Detectors will be set for long term recording at settings recommended by the vendor. Detector firmware version is 2.1.3. Input Gain is set to 80, Trigger Level to 160, Interval to 0, Sample Frequency to 500, Pretrigger off, Record Length of 5 sec, High Pass filter on, and Autorecord on.

Data will be retrieved from the detectors at least biweekly and more frequently if needed based on recording capacity and call volume. During each visit, a fresh battery and memory cards will be placed in the detectors as well as a quick inspection or problems in the pulley system and detector operation.

Weather data will be provided by the on site MET tower. The data provided will include wind speed, wind direction, humidity and temperature. The weather data will be analyzed by creating tables and graphs depicting associations based on determined hourly averages. Statistics and correlations will be run in Excel and Minitab to look for significant patterns. Analysis of calls will be done by SonoBat 3.05NE in native full spectrum and converted to zero crossing for analysis by the the Britzke 2012 filter if it is released at the time of analysis.

3.0 Reporting

The data collected from the acoustic detectors will be presented in a written report and excel spreadsheet. Data collected will be sent to the NYDEC by the end of February 2013.

Appendix C – Detector Station Photos

Detector Station Photos